Sign Language

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# Sign Language

An International Handbook

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# Preface

Five long years ago, we met to plan what looked like an impossibly ambitious project – this Handbook. Since then, we have met in Berlin, London, Amsterdam, and Frankfurt; we have exchanged hundreds of e-mails; we have read and commented on dozens of chapters – and we have found the time to write our own. The work on this Handbook has been challenging at times but it has also been inspiring and rewarding. We have learned a lot.

Obviously, a project of this size would have been impossible without the help and encouragement of others. We are therefore grateful to the people and organizations that supported our work on this Handbook. First of all, we wish to express our gratitude to the section editors, who assisted us in providing feedback to authors and in getting the chapters into shape: Onno Crasborn (section I), Josep Quer (section III), Ronnie Wilbur (section IV), Trude Schermer (section VII), Adam Schembri (section VIII), and Myriam Vermeerbergen (section IX).

As for the content and final shape of the chapters, we are indebted to all the publishers who granted us permission to reproduce figures, to Nancy Campbell, our meticulous, reliable, and highly efficient editorial assistant, and to Sina Schade and Anna-Christina Boell, who assisted us in the final check of consistency and formatting issues as well as in putting together the index – a truly cumbersome task.

It was a true pleasure to cooperate with the professional and supportive people at Mouton de Gruyter. We are indebted to Anke Beck for sharing our enthusiasm for the project and for supporting us in getting the ball rolling. We are very grateful to Barbara Karlson for guiding and encouraging us throughout the process. Her optimism helped us to keep up our spirits whenever we felt that things were not going as smoothly as we hoped. After talking to her, things always looked much brighter. Finally, we thank Wolfgang Konwitschny for his assistance during the production phase.

Bencie Woll's work on the handbook has been supported by the Economic and Social Research Council of Great Britain (Grants RES-620-28-6001 and 6002), Deafness, Cognition and Language Research Centre (DCAL). Roland Pfau's editorial work was facilitated thanks to a fellowship financed by the German Science Foundation (DFG) in the framework of the *Lichtenberg-Kolleg* at the Georg-August-University, Göttingen.

Last but definitely not least, we thank all the authors who contributed to the handbook for joining us in this adventure.

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## Indexes

# Notational conventions

As is common convention in the sign language literature, signs are glossed in small caps (SIGN) in the examples as well as in the text. Glosses are usually in English, irrespective of the sign language, except for examples quoted from other sources where these are not in English (see chapter 43 for a detailed discussion of the challenges of sign language transcription). The acronym for the respective sign language is always given at the end of the gloss line (see next section for a list of the acronyms used in this handbook). For illustration, consider the following examples from Sign Language of the Netherlands (NGT) and German Sign Language (DGS).

(1) y/n
INDEX$_2$ h-a-n-s INDEX$_{3a}$ BOOK++ $_2$GIVE:CL$_{3a}$ [NGT]
'Will you give Hans the books?'

(2) TWO-DAYS-AGO MONK^BOSS SCHOOL INDEX$_{3a}$ VISIT$_{3a}$ [DGS]
'Two days ago, the abbot visited the school.'

With respect to manual signs, the following notation conventions are used.

INDEX$_3$/IX$_3$ pointing sign used in pronominalization (e.g. INDEX$_2$ in (1)) and for localizing non-present referents and locations in the signing space (e.g. INDEX$_{3a}$ in (1) and (2)). The subscript numbers refer to points in the signing space and are not necessarily meant to reflect person distinctions: 1 = towards signer's chest; 2 = towards addressee; 3a/3b = towards ipsi- or contralateral side of the signing space.

$_1$SIGN$_{3a}$ verb sign moving in space from one location to another; in (1), for example, the verb sign GIVE moves from the locus of the addressee to the locus introduced for the non-present referent 'h-a-n-s'.

s-i-g-n represents a fingerspelled sign.

SIGN^SIGN indicates either the combination of two signs in a compound, e.g. MONK^BOSS 'abbot' in (2), or a sign plus affix/clitic combination (e.g. KNOW^NOT); in both types of combinations, characteristic assimilation and/or reduction processes may apply.

SIGN-SIGN indicates that two or more words are needed to gloss a single sign (e.g. TWO-DAYS-AGO in (2)).

SIGN++ indicates reduplication of a sign to express grammatical features such as plurality (e.g. BOOK++ in (1)) or aspect (e.g. iterative or durative aspect).

CL indicates the use of a classifier handshape that may combine with verbs of movement and location (e.g. GIVE in (1)); throughout the handbook, different conventions are used for classifiers: the CL may be further specified by a letter of the manual alphabet (e.g. CL:C) or by a subscript specifying either a shape characteristic or the entity that is classified (e.g. CL$_{round}$ or CL$_{car}$).

Lines above the glosses (as in (1)) indicate the scope, that is, the onset and offset of a particular non-manual marker, be it a lexical, a morphological, a syntactic, or a pro-

sodic marker. Below we provide a list of the most common markers. Note that some of the abbreviations used refer to the function of the non-manual marker (e.g. 'top' and 'neg') while others refer to its form (e.g. 're' and 'hs'). When necessary, additional markers will be introduced in the respective chapters.

| | |
|---|---|
| /xxx/ | lexical marker: a mouthing (silent articulation of (part of) a spoken word) associated with a sign; |
| xxx | lexical or morphological marker: a mouth gesture associated with a sign; |
| top | syntactic topic marker; |
| wh | syntactic wh-question marker; |
| y/n | syntactic yes/no-question marker (as in (1)); |
| rel | syntactic relative clause marker; |
| neg | syntactic negation marker; |
| hs | headshake; |
| hn | headnod; |
| re | raised eyebrows. |

As for handshapes, whenever possible, the Tang handshape font is used (http://www.cuhk.edu.hk/cslds), instead of labels relating to manual alphabet or counting systems, because the latter may differ from sign language to sign language (e.g. T-hand is different in ASL, NGT, and DGS); that is, we use '  -hand' instead of 'C-hand', etc.

The usual convention concerning the use of upper case D in *Deaf* vs. *deaf* is respected. Deaf with an upper-case *D* refers to (members of) linguistic communities characterized by the use of sign languages. Lower case *deaf* refers to an individual's audiological status.

# Sign language acronyms

Below we provide a list of sign language acronyms that are used throughout the handbook. Within every chapter, acronyms will also be introduced when a particular sign language is mentioned for the first time. For some sign languages, alternative acronyms exist in the sign language literature (for instance, *ISL* is commonly used for both Israeli Sign Language and Irish Sign Language, and *Libras* for Brazilian Sign Language). Note that some of the acronyms listed below are based on the name of the sign language in the respective country; these names are given in brackets in italics.

| | |
|---|---|
| ABSL | Al-Sayyid Bedouin Sign Language (Israel) |
| AdaSL | Adamorobe Sign Language (Ghana) |
| ASL | American Sign Language |
| Auslan | Australian Sign Language |
| BSL | British Sign Language |
| CisSL | Cistercian Sign Language |
| CSL | Chinese Sign Language |
| DGS | German Sign Language (*Deutsche Gebärdensprache*) |
| DSL | Danish Sign Language |
| FinSL | Finnish Sign Language |
| GSL | Greek Sign Language |
| HKSL | Hong Kong Sign Language |
| HZJ | Croatian Sign Language (*Hrvatski Znakovni Jezik*) |
| IPSL | Indopakistani Sign Language |
| IS | International Sign |
| Irish SL | Irish Sign Language |
| Israeli SL | Israeli Sign Language |
| ISN | Nicaraguan Sign Language (*Idioma de Señas Nicaragüense*) |
| KK | Sign Language of Desa Kolok, Bali (*Kata Kolok*) |
| KSL | Korean Sign Language |
| LIL | Lebanese Sign Language (*Lughat il-Ishaarah il-Lubnaniah*) |
| LIS | Italian Sign Language (*Lingua Italiana dei Segni*) |
| LIU | Jordanian Sign Language (*Lughat il-Ishaara il-Urdunia*) |
| LSA | Argentine Sign Language (*Lengua de Señas Argentina*) |
| LSB | Brazilian Sign Language (*Língua de Sinais Brasileira*) |
| LSC | Catalan Sign Language (*Llengua de Signes Catalana*) |
| LSE | Spanish Sign Language (*Lengua de Señas Espanõla*) |
| LSF | French Sign Language (*Langue des Signes Française*) |
| LSQ | Quebec Sign Language (*Langue des Signes Québécoise*) |
| MSL | Mauritian Sign Language |
| NCDSL | North Central Desert Sign Language (Australia) |
| NGT | Sign Language of the Netherlands (*Nederlandse Gebarentaal*) |
| NS | Japanese Sign Language (*Nihon Syuwa*) |
| NSL | Norwegian Sign Language |
| NZSL | New Zealand Sign Language |
| ÖGS | Austrian Sign Language (*Österreichische Gebärdensprache*) |

| | |
|---|---|
| PISL | Plains Indian Sign Language (North America) |
| | Providence Island Sign Language |
| RSL | Russian Sign Language |
| SASL | South African Sign Language |
| SGSL | Swiss-German Sign Language |
| SKSL | South Korean Sign Language |
| SSL | Swedish Sign Language |
| TİD | Turkish Sign Language (*Türk Işaret Dili*) |
| TSL | Taiwan Sign Language |
| VGT | Flemish Sign Language (*Vlaamse Gebarentaal*) |
| WSL | Warlpiri Sign Language (Australia) |
| YSL | Yolngu Sign Language (Australia) |

# 1. Introduction



## 1. The impact of sign language research on linguistics

Before the beginning of sign language linguistics, sign languages were regarded as exemplifying a primitive universal way of communicating through gestures. Early sign linguistic research from the 1960s onward emphasized the equivalences between sign languages and spoken languages and the recognition of sign languages as full, complex, independent human languages. Contemporary sign linguistics now explores the similarities and differences between different sign languages, and between sign languages and spoken languages. This move has offered a new window on human language but has also posed challenges to linguistics. While it is uncommon to find an introductory text on linguistics which does not include some mention of sign language, and sign language linguistics is increasingly offered as a subject within linguistics departments, instead of being restricted to departments of speech and language pathology, there is still great scope for linguists to recognize that sign language linguistics provides a unique means of exploring the most fundamental questions about human language: the role of modality in shaping language, the nature of linguistic universals approached cross-modally, the functions of iconicity and arbitrariness in language, and the relationship of language and gesture. The answers to these questions are not only of importance within the field of linguistics but also to neuroscience, psychology, the social sciences, and to the broadest understanding of human communication. It is in this spirit that this Handbook has been created.

## 2. Why a handbook on sign language linguistics is timely and important

The sign language linguistics scene has been very active in recent years. First of all, sign language linguists have contributed (and continue to contribute) to various handbooks, addressing topic from a sign language perspective and thus familiarizing a broader audience with aspects of sign language research and structure; e.g. linguistics in general (Sandler/Lillo-Martin 2001), cognitive linguistics (Wilcox 2007), linguistic analysis (Wilcox/Wilcox 2010), phonology (Brentari 2011), grammaticalization (Pfau/Steinbach 2011), and information structure (Kimmelman/Pfau forthcoming). A recent handbook that focuses entirely on sign languages is Brentari (2010); this handbook covers three broad areas: transmission, structure, and variation and change. There have also been several comprehensive introductory textbooks on single sign languages – e.g.

British Sign Language (Sutton-Spence/Woll 1999), Australian Sign Language (Johnston/Schembri 2007), and Israeli Sign Language (Meir/Sandler 2008) – which discuss some of the issues also addressed in the present handbook. The focus of these books, however, is clearly on structural, and to a lesser extent, historical and sociolinguistic, aspects of the respective sign language. A textbook that focuses on structural and theoretical aspects of sign language grammar, discussing examples from different sign languages (mostly American Sign Language and Israeli Sign Language), is Sandler and Lillo-Martin (2006). The central aim of that book is to scrutinize the existence of alleged linguistic universals in the light of languages in the visual-gestural modality.

The time is thus ripe for a handbook on sign language linguistics that addresses a wider range of topics from cross-linguistic, cross-modal, and theoretical perspectives. It is these features which distinguish the present handbook from previous publications, making it a unique source of information: First, it covers all areas of contemporary linguistic research. Second, given that sign language typology is a fascinating and promising young research field, authors have been encouraged to address the topic of their chapter from a broad typological perspective, including – wherever possible – data from different sign languages, thus also illustrating the range of variation attested among sign languages. Third, where appropriate, the contributions also sketch theoretical analyses for the phenomena under discussion, providing a neutral survey of existing, sometimes conflicting, approaches. Therefore, this handbook is of relevance to general linguistics, that is, it is designed not only for linguists researching sign language but also for linguists researching spoken language. Examples are provided from a large number of sign languages covering all regions of the world, illustrating the similarities and differences among sign languages and between sign languages and spoken languages. The book is also of interest to those working in related fields such as psycholinguistics and sociolinguistics and to those in applied fields, such as language learning and neuropsychology.

## 3. Structure of the handbook

The handbook consists of 44 chapters organized in nine sections, each of which has been supervised by a responsible section editor. Although each chapter deals with a specific topic, several topics make an appearance in more than one chapter. The first four sections of the handbook (sections I–IV) are dedicated to the core modules of grammar (phonetics, phonology, morphology, syntax, semantics, and pragmatics). The fifth section deals with issues of sign language evolution and typology, including a discussion of the similarities and differences between signing and gesturing. Psycho- and neurolinguistic aspects of sign languages are discussed in section VI. Section VII addresses sociolinguistic variation and language change. Section VIII discusses a number of applied issues in sign language linguistics such as education, interpreting, and sign language poetry. Finally, section IX deals with questions of sign language documentation, transcription, and computer modelling.

Despite the broad coverage, a few topics do not receive a detailed discussion in the handbook; among these are topics such as Deaf culture, literacy, educational practices, mental health, sign language assessment, ethical issues, and cochlear implants. We refer

the reader to Marschark and Spencer (2003, 2010), two comprehensive handbooks that address these and many other issues of an applied nature. We hope – whatever one's background – the reader will be drawn along new paths of interest and discovery.

## 4. Literature


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# I. Phonetics, phonology, and prosody

# 2. Phonetics



## Abstract

*Sign and spoken languages differ primarily in their perceptual channel, vision vs. audition. This 'modality difference' has an effect on the structure of sign languages throughout the grammar, as is discussed in other chapters in this volume. Phonetic studies of sign languages typically focus on the articulation of signs. The arms, hands, and fingers form very complex articulators that allow for many different articulations for any given phonological specification for hand configuration, movement, and location. Indeed phonetic variation in sign language articulation is abundant, and in this respect, too, sign languages resemble spoken languages.*

## 1. Introduction

Sign languages are produced by body movements that are perceived visually, while spoken languages are produced by vocal articulation and perceived by the ear. This most striking difference between sign and spoken languages is termed the 'modality difference'. It refers to a difference in communication channel that is often considered to be the ultimate cause for structural differences between spoken and sign languages. Since auditory perception is better targeted at processing small temporal detail than visual perception, and since the manual articulators in signing move slower than the oral articulators in speech, one would for example predict the richness of simultaneous information in sign languages (Vermeerbergen/Leeson/Crasborn 2006).

In all, this chapter aims to characterise the area of sign language phonetics rather than to provide an exhaustive overview of the studies that have been done. The focus will be on the manual component in terms of articulation and phonetic variation. Despite the large importance that is often (intuitively) attributed to the phonetic difference between sign and speech, relatively little research within the field of sign language studies has focused on the area of sign language phonetics, especially in comparison to the phonological analysis of sign languages. This is illustrated by the fact that none of the textbooks on sign language that have appeared in recent years includes 'phonetics'

as a keyword (e.g., Boyes Braem 1995; Sutton-Spence/Woll 1999; Emmorey 2002; Sandler/Lillo-Martin 2006; Johnston/Schembri 2007; Meir/Sandler 2008).

In section 2, the modality difference is discussed in further detail. Section 3 will then discuss the relation between phonetics and phonology in sign languages, as it may not be self-evident how a phonetic and a phonological level of analysis can be distinguished in a visual language. Section 4 discusses articulation, and section 5 takes a look at phonetic variation. (Note that perception studies are also discussed in section F of the handbook, see especially chapter 29 on processing. The phonetic transcription and notation of sign languages are covered in chapter 43.)

## 2. The modality difference

It is attractive to see modality as a black-and-white distinction in channel between spoken language and sign language. One is auditory, the other visual. The deep embedding of writing systems and written culture in many civilisations has perhaps contributed to our view of spoken language as a string of sounds, downplaying the presence of non-verbal communication and visual communication more generally among hearing people (Olson 1994). Yet there is growing evidence for the multimodality of spoken language communication among hearing people. It is clear that visual aspects of communication among hearing people can be complementary to auditory signals. For example, emotional state is often visible in the facial expression while someone speaks (Ekman 1993), and many interactional cues are expressed by a wide variety of head movements (McClave 2000). Manual gestures are known to serve many functions that complement the content of the spoken utterances (McNeill 1992; Kendon 2004).

Moreover, there is also evidence that speech itself is not only perceived auditorily but also visually. McGurk and MacDonald (1976) showed that the visible state of the face can influence the auditory perception of consonants. More recently, Swerts and Krahmer (2008) demonstrated that the perception of manual beat gestures are interpreted as increased prominence of the simultaneously uttered spoken word. However, while hearing people are very skilled at perceiving speech without looking at the speaker (as when communicating by telephone), they are very bad at speech-reading without any acoustic input (Woodward/Barber 1960). Only a small subset of the articulatory features of speech sounds can actually be seen (mainly lip rounding and opening, labiodental contact, and jaw height), while others such as the state of the glottis, velum lowering, and tongue dorsum height are invisible. Thus, for the segmental or syllabic level in speech, it remains fair to say that speech primarily makes use of the acoustic-auditory modality, while there is some visual input as well.

So as a starting point, it should be emphasised that the 'modality difference' appears not to be a black-and-white contrast in phonetic channel. While sign languages are exclusively perceived visually by their core users, deaf people, spoken languages are perceived both auditorily and visually. Ongoing research on spoken language communication is exploring the role of visual communication among hearing people more and more, including the role of gestures and facial expressions that are exclusively expressed visually. Hearing users of sign languages can in principle also hear some of the sounds that are made, for instance by the lips or the hands contacting each other, yet

| ACTION | | SIGNAL | | PERCEPTION |
|---|---|---|---|---|
| **Hearing communication** | | | | |
| bodily actions | → | sound | → | auditory perception |
| | | light | → | visual perception |
| **Deaf communication** | | | | |
| bodily actions | → | light | → | visual perception |

Fig. 2.1: The modelling difference

this is unlikely to have a substantial phonetic impact on the linguistic structure of sign languages given the fact that the core users of sign languages only have little residual hearing, if any. The modality difference is summarised in Figure 2.1.

Where researchers have made significant progress in the acoustic analysis of the speech signal and in the study of auditory perception, we have very little knowledge of the signal and perception components of the communication chain of sign languages. Yet these are important to study, as general human perceptual abilities form the framework within which linguistic perception takes place. The phonetic research that has been done has focused almost exclusively on the articulation of sign languages (but see Bosworth 2003 for a notable exception). Therefore this chapter will also be primarily devoted to sign language articulation. The reason for this may be that visual perception is extremely complex. While there are only a few parameters of a small section of the electromagnetic spectrum that the human visual system can exploit (luminance and wavelength), these parameters constitute the input to a large array of light-sensitive tissue (the retina) of the two eyes, which themselves move with our head and body movements and which can also move independently (together constituting 'eye gaze'). The human brain processes this very complex input in highly intricate ways to give us the conscious impression that we see three-dimensional coloured objects moving through space over time (Zeki 1993; Palmer 1999).

At a high level of processing, there are abstract forms that the brain can recognise. There have been very few if any sign language studies that have aimed to describe the phonetic form of signs in such abstract visual categories (see Crasborn 2001, 2003 for attempts in that direction). It is clearly an underexplored area in the study of sign languages. This may be due to the lack of a specialised field of 'body movement perception' in perceptual psychology that linguists can readily borrow a descriptive toolkit from, whereas anatomical and physiological terminology is gratefully borrowed from the biological and medical sciences when talking about the articulation of finger movements, for example.

Two generalisations about visual perception have made their way into the sign language literature in attempts to directly link properties of visual perception to the structure of sign languages. First, Siple (1978) noted that the visual field can be divided into a 'centre' and a 'periphery'. The centre is a small area in which fine spatial detail is best processed, while in the relatively large periphery it is motion rather than fine details that are best perceived. Siple argued that native signers perceiving ASL focus their eye gaze around the chin, and do not move their gaze around to follow the movements of the hands, for example. Thus, someone looking at signing would see more details of handshape, orientation, and location for signs near the face than for signs made lower on the body or in front of the trunk. This distinction might then

provide an explanatory basis for finer phonological location distinctions near the face area as compared to the upper body area. Irrespective of the data on phonological location distinctions, this hypothesis is hard to evaluate since the face area also includes many visual landmarks that might also help perceivers distinguish small phonetic differences in place of articulation and categorise these as phonologically distinct locations. Since 1978, very few if any eye tracking studies have specifically evaluated to what extent eye gaze is actually relatively immobile and focused on the chin in sign language perception. Also, we do not know whether this differs for different sign languages, nor whether there are differences in the perceptual behaviour of early versus late sign language learners. A related hypothesis that has not yet been tested is that there are more and finer handshape distinctions in the lexicon of any sign language for locations at the face than for lower locations.

The second generalisation concerns the temporal processing of sound versus light. Auditory perception is much better suited to distinguishing fine temporal patterns than visual perception. This general difference is sometimes correlated to the sequential structure found in spoken language phonology, where a sequence of segments together can constitute one syllable, and in turn sequences of syllables can be the form of single morphemes. In sign language, morphemes typically do not show such temporal complexity (van der Kooij/Crasborn 2008). The phonological structure of signs is discussed in the next chapter in this section. While the perceptual functional explanation for the difference in phonological structure may well be valid, there is an equally plausible explanation in terms of articulatory differences: the large difference in size between the arms, hands, and fingers that are mostly involved in the realisation of lexical items and the oral articulators involved in the production of speech sounds leads to a difference in the speed of movement given, assuming a constant energy expense. The mouth, lips, and tongue are faster than the fingers and hands, and we thus correctly predict more fine-grained temporal articulations in speech than in sign. As for the first generalisation about the influence of language modality on structure, very few if any concrete studies have been done in this area, for example allowing us to disentangle articulatory and perceptual influences.

## 3. Phonetics vs. phonology

The phonetic study of sign languages includes the low-level production and perception of manual and non-manual signals. It is much less evident how such phonetic analysis of language relates to the phonological structure. As chapter 3 on phonology makes clear, we have a good understanding of the phonological characteristics of several sign languages and of sign languages in general. However, one cannot directly observe the categorical properties and structures in sign language phonology: they have to be inferred from the gradient phonetic form. Perhaps the impression that we can *see* the articulators in sign languages has made it self-evident what the phonological form looks like, and in that way reduced the need for an accurate phonetic description.

The first description of the manual form of signs that was introduced by Stokoe (1960) in his groundbreaking work was clearly targeted at the lexical phonological level. It used explicit articulatory terms in the description of the orientation of the

hand, even though it aimed to characterise the distinctions within this 'minor' parameter at a phonological level. Orientation was characterised in terms of 'prone' and 'supine', referring to the rotation of the forearm around its length axis. There has never been a phonetic variant of Stokoe's system that has been commonly used as a phonetic notation system. Phonetic notation systems such as HamNoSys (http://www.sign-lang.uni-hamburg.de/projects/hamnosys.html) are sometimes used in lexicography. HamNoSys itself is based on the linguistic analyses initiated by Stokoe, describing the handshape, location, and movement for a manual sign, but it allows for the transcription of finer phonetic detail than a phonological characterisation would require, and like the International Phonetic Alphabet (IPA) for spoken languages it is not designed for one specific language (see chapter 43 for details). Another ongoing effort to describe phonetic events insign languages aims to describe American Sign Language (ASL) at a fine articulatory level of detail, yet still incorporates categories (similar to 'movements' and 'holds') that cannot be directly observed in a video recording of sign but that derive from a specific phonological analysis (Johnson/Liddell, 2010, 2011a,b, to appear).

What we consider to be 'phonetic' and 'phonological' descriptions and how these two interact depends on our model of these different components of language form. Different types of spoken language models have been applied to sign languages, from rule-based formalisms of the SPE (Chomsky/Halle 1957) type to modern constraint-based models (e.g., Sandler 1989; Corina/Sandler 1993; van der Hulst 1993; Brentari 1998). Irrespective of the specific model that is used, such models can help us to get a better grip on what we talk about when we describe a phonetic form in sign language. As an example, Figure 2.2 presents an overview of the Functional Phonology model developed by Boersma (1998, 2007) for spoken languages that was adopted by Crasborn (2001) for the description of a sign language.

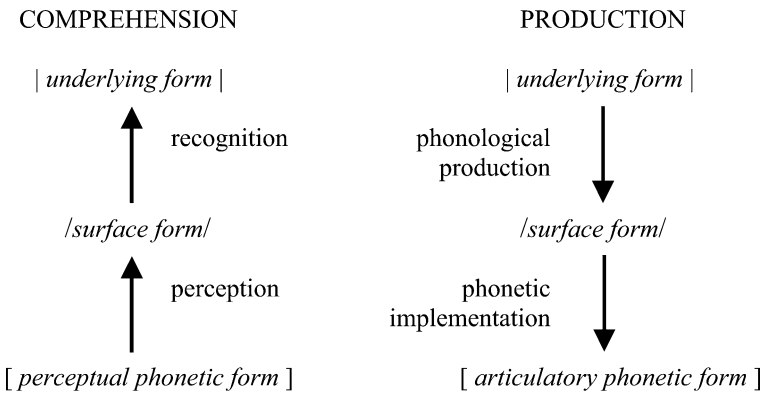



Fig. 2.2: The Functional Phonology model

For example, take the sign PROOF from Sign Language of the Netherlands (NGT) as illustrated in Figure 2.3. The underlying form of this sign specifies that the dominant hand touches the non-dominant hand repeatedly, and that the shape of the two hands is flat with all fingers selected. By default, signs that are specified for a location on the

non-dominant hand are realised with both hands in the centre of neutral space. This predictable aspect of the phonological form is added to form the phonological surface representation in the phonetic implementation, and it may be impacted by the phonetic context, showing coarticulation effects (Ormel/Crasborn/van der Kooij 2012). Likewise, the phonological characterisation of the form of signs does not contain any details of how the movement is executed: whether it is the elbow, wrist, or even the fingers that extend to realise the contact with the other hand, or both, is left to the phonetic implementation. It is not fully predictable by phonological rules alone as the phonetic form of a word or sign is also determined by all kinds of sociolinguistic and practical factors (see Crasborn 2001 for extensive discussion). In the instance of the sign PROOF in Figure 2.3, all three joint types appear to participate in the downward movement. This specific type of phonetic variation will be further discussed in section 5.5.

Fig. 2.3: PROOF (NGT)

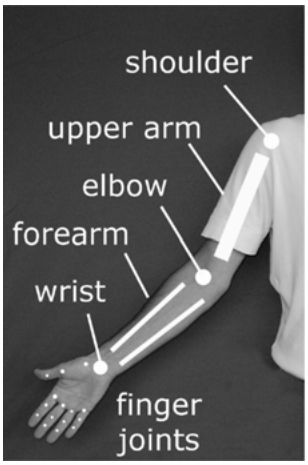
In the Functional Phonology model, the form of signs that is stored in the lexicon is a perceptual target, whereas the concrete phonetic realisation at a given point in time needs to be characterised at both an articulatory and a perceptual level in order to be properly understood. Most phonological models of sign languages aim for the characterisation of the underlying form of signs, yet this can be viewed as clearly distinct from the phonetic form that is generated by the phonetic implementation in the model above. Section 5 of this chapter will discuss studies on phonetic variation, and we will see how these different articulations (phonetic forms) relate to a single underlying representation. First, section 4 will discuss in some detail how the articulation of signs can be described.

## 4. Articulation

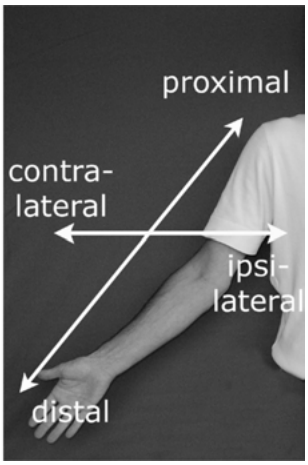
### 4.1. Levels of description

The articulation of manual signs can be characterised in different ways. Figure 2.4a presents an overview of the parts of the upper limb. We can describe the location and

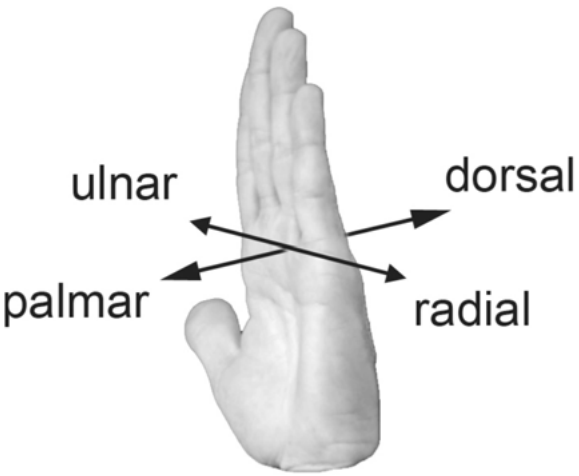
orientation of the various *body parts* (fingers, whole hand, forearm, upper arm) in space or relative to the upper body or head, for example. In the sign language literature, we mostly find descriptions of the whole hand or of one or more of the fingers with respect to a body location or in the 'neutral space' in front of the body. Such descriptions rarely describe in detail the location and rotation of the upper arm, for example. It is the 'distal end' of the articulator that realises the phonologically specified values for location and movement in almost all lexical items in sign languages studied to date. The anatomical terms 'distal' and 'proximal' refer to the relative location with respect to the torso, following the line of the arm and hand (see Figure 2.4b). An additional pair of terms displayed in Figure 2.4b is 'ipsilateral − contralateral'. These are similar to 'left − right', yet take the side of the active articulator as a basis: ipsilat-



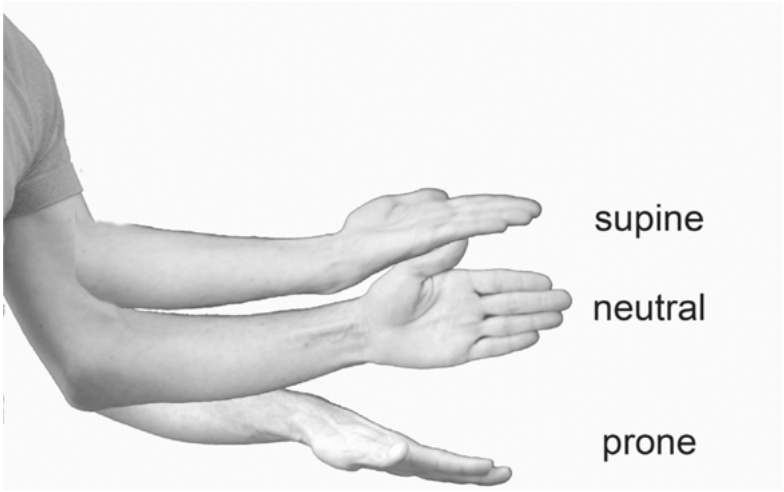

a. Body parts and joints




b. Location terms




c. Sides of the hand




d. Rotation states of the forearm

Fig. 2.4: Terminology used for the description of manual signs

eral refers to the side of the articulator in question, whereas contralateral refers to the opposite side. As such, these terms are better suited to describe the bilaterally symmetric human body than the terms 'left − right' are.

Alternatively, one can also look at manual articulations by focusing on the state of the different *joints*, from the shoulder to the most distal finger joints. For joints like the elbow that have only one degree of freedom, this is very straightforward, while other joints are more complex. The wrist has two degrees of freedom in its movement (flexion-extension and lateral flexion-extension), while the shoulder not only allows movement of the upper arm at the upper body (three degrees of freedom: flexion in two dimensions plus rotation about the upper arm axis), but also shows restricted movement of the shoulder blade and clavicle with respect to the torso, affecting the whole arm plus the hand.

In addition to describing articulation in terms of body part states or joint states, one can look at the *muscles* involved in movements of the arms and hands. There are a large number of muscles involved in the articulation of each sign, and as they are not directly visible, knowledge about the anatomy and physiology of the hand is needed to create such descriptions. Several sign language studies have focused at this level of description in an attempt to phonetically distinguish easy from hard articulations; these will be discussed in section 4.2.

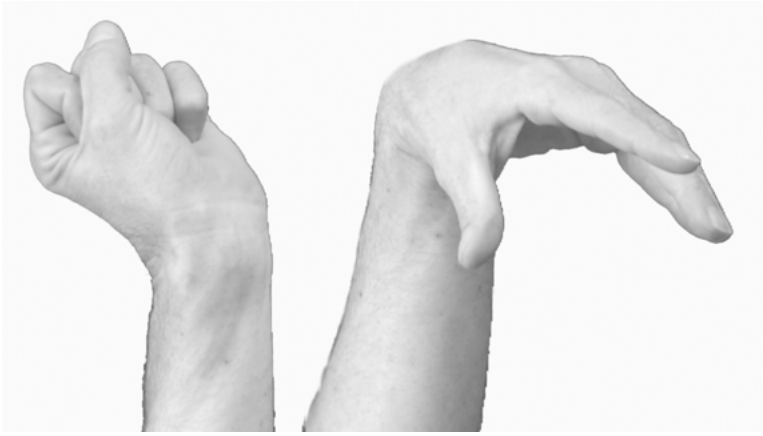
The phonological description of signs typically centres on the hand: its shape, rotation in space, location, and movement are represented in the lexicon. Such a specification does not contain a concrete articulatory specification, irrespective of the level of description. In terms of the model outlined in Figure 2.2, a phonetic implementation is needed to generate a phonetic form from a phonological surface form. Take for example the NGT sign INDIA. Its phonological specification includes the location *forehead*, the *extended thumb* as the selected finger, and a *rotation* movement of the thumb at the forehead. As the state of more proximal joints will influence the location of the

end of the extremity, the state of the upper body will also influence the location of the fingertips. Thus, bringing the tip of the thumb to the forehead (in other words, articulating the phonological location) does not only involve a specific state of the shoulder, elbow, wrist, and thumb joints, but needs to take into account the current state of the upper body and head. When the head is turned rightwards, the hand will also need to be moved rightwards, for example by rotating the upper arm outwards. Thus, while the phonological specification of a sign contains global phonetic information on the realisation of that sign, it is quite different from its actual articulation in a given instance.

Although this section aimed to characterise the articulation of manual parts of signs, a short note on non-manual articulations is in place. The articulations of the jaw, head, and upper body can be described in ways similar to those of the arms and hands. Facial articulations are different in that other than the lower jaw there are no bones underlying the skin of the face that can move. Rather, what we see when we describe facial expressions are the impact that the muscles have on the skin of the face. Psychologist Paul Ekman and colleagues have developed a notation system to analyse these articulations. The system emphasises that there is no one-to-one mapping between muscle actions and visible changes in the skin. In other words, we cannot directly see the muscles, but only their effect on the facial skin. The FACS coding system uses the term 'action unit' for each type of articulation; each action unit can be the result of the action of one or more muscles (Ekman/Friesen/Hagen 2002).

## 4.2. Ease of articulation

In an effort to explain the relative frequency of some forms over others in the lexicon of sign languages, among other things, several studies have looked at the anatomy and physiology of the upper extremity. In particular, the muscles that are used in the articulation of aspects of signs have been discussed in a number of studies. Mandel (1979) looked at the extensor muscles of the fingers, showing that these are not long enough to fully flex the fingers at all joints when the wrist is also maximally flexed. This physiological fact has an impact on the possible movements of the wrist and fingers. One can easily test this by holding the forearm horizontal and pronated, and relaxing both wrist and finger muscles. When one then quickly forms a fist, the wrist automatically extends. Similarly, when the wrist quickly flexes from a neutral or extended state, the fingers automatically extend to accommodate the new position of the wrist. The slower these movements are performed, the better they can be controlled, although in the end the anatomy restricts the possible range of movement and the resulting states of the different joints in combination. At normal signing speed, we do expect to find a certain influence of this 'knuckle-wrist connection', as Mandel called it: closing movements of all fingers are likely to be combined with wrist extension, which in turn leads to a dorsal movement of the hand. Mandel argues that these dorsal movements are typically enhanced as path movements of the whole hand through space in ASL; conversely, opening movements of the fingers tend to be combined with path movements in the direction of the palmar surface of the hand. Thus, while phonologically, path movement direction and handshape change are independent, there is a phonetic effect that relates the two. This is illustrated by the two configura-



(a) Fingers flexed, wrist hyperextended (b) Fingers extended, wrist flexed

Fig. 2.5: The relation between finger extension and hand position in two articulatory configurations

tions in Figure 2.5: when all fingers are closed (2.5a), the wrist is hyperextended; by consequence, the hand appears more 'backwards' than when all fingers are open and the wrist can flex (2.5b).

The literature on ASL contains several studies on handshape that make reference to the articulation of the fingers, arguing that some handshapes are easier to articulate than others (Mandel 1981; Woodward 1982, 1985, 1987; Ann 1993). Patterns of frequency of occurrence − both within the ASL lexicon and in comparison to the lexicon of other sign languages − were attributed as evidence for the 'unmarked' status of handshapes with only the index, thumb, or little finger extended, or with all fingers extended. Supporting evidence came from the order of acquisition of such handshapes. Such distributional (phonological) patterns were related to articulatory (phonetic) properties. Ann (1993, 2008) was the first to perform a detailed physiological study of the articulation of all handshapes. She argued that many of the patterns that were found could be explained by reference to the anatomy and physiology of the hand. For instance, both the index finger and the little finger have a separate extensor muscle and tendon allowing them to extend independently (viz. the *extensor indicis proprius* and the *extensor digiti minimi*). The middle and ring fingers do not: they can only be extended on their own by employing a shared extensor muscle for all four fingers (the *extensor digitorum communis*) while other muscles simultaneously flex the other fingers.

A different articulatory constraint appears to play a role in the formation of some morphological forms. Mathur and Rathmann (2001) argued that the range of motion of the arm joints restricts the inflection of some verbs in sign languages. Inflections for first person plural objects (as in 'send us') do not occur if their articulation requires extreme flexion or rotation at multiple joints. These articulations are required in combining an arc movement (part of the first person plural morpheme) with the lexical orientation and location specifications of verbs such as INVITE in ASL and German Sign Language (DGS) or PAY in Australian Sign Language (Auslan).

# 5. Phonetic variation

## 5.1. Introduction

Studies on the articulation of signs as described above form an important contribution to our phonetic understanding of signs. In most of the studies that were done until now, this articulatory knowledge was related directly to patterns observed in the lexicon. As the model of the relation between phonetics and phonology in Figure 2.2 makes clear, this is a rather large step to make. As the lexicon contains abstract phonological representations that are more likely to be perceptual than articulatory, it is not always self-evident how a sign (or even the handshape of a sign) can be articulated and whether there is a prototypical articulation of a sign that can be taken as a reference point for studies on markedness.

## 5.2. Handedness

The phonetic realisation of signs, just as for words in spoken language, is in fact highly variable. In other words, there are many different phonetic forms corresponding to a single phonological underlying form. One obvious aspect that leads to variation is handedness: whether a signer is left-dominant or right-dominant for non-sign tasks is the primary factor in determining whether one-handed signs are typically realised with the left or right hand (Bonvillian/Orlansky/Garland 1982; Sáfár/Crasborn/Ormel 2010). There is anecdotal evidence that L2 learners may find left-handed signers more difficult to perceive.

## 5.3. Hand height

The height of the hand in signs that are lexically specified for a neutral space location has been shown to vary. Coulter (1993) found that in the realisation of lists of number signs ONE to FIVE in ASL, the location is realised higher for stressed items and lower for the initial and final items. In an experimental study of ASL, Mauk, Lindblom, and Meier (2008) found that the height of the hand in the realisation of neutral space locations in ASL is raised under the influence of a high location of the hand in the preceding and following sign. The same has been shown for NGT (Ormel/Crasborn/van der Kooij 2012). For signs located on the body, Tyrone and Mauk (2008) found the reverse effect as well: under the influence of a lower location in the preceding or following sign, a target sign assumes a lower location. These raising and lowering effects in the last two studies are argued to be an instance of coarticulation in sign languages. Similar to coarticulation in spoken language, the strength of the effect is gradual and sensitive to the rate of speaking or signing. It is thus not categorical phonological assimilation that leads to the visible difference in phonetic location, but a case of phonetic variation. This analysis is supported by the fact that the degree of experimentally elicited differences in hand height varies across signers (Tyrone/Mauk 2008).

## 5.4. Handshape

Similar coarticulation effects for the realisation of handshapes have been described by Jerde, Soechting, and Flanders (2003) for the articulation of fingerspelling (see also Wilcox 1992). They found both progressive and anticipatory influences of fingerspelled letters on each other in ASL; both dissimilation and assimilation were found. Cheek (2001) found that similar assimilation processes also occur in the articulation of handshapes in regular lexical items in ASL. For example, the extension of the little finger needed for the articulation of the 🖐-handshape following a 👌-handshape was demonstrated to start before the end of the preceding sign. Again, their gradient nature and dependence on signing rate argues for the interpretation of these findings as instances of phonetic coarticulation rather than phonological assimilation.

## 5.5. Movement

In addition to these effects of the sequential linguistic context on the appearance of signs, different articulations are found depending on the distance between the signers. Larger and smaller forms of a sign can be compared to shouting and whispering in speech. Crasborn (2001) elicited such forms by changing the distance between pairs of NGT signers, and found that different articulations of the same sign can invoke movement at different joints. For example, phonologically specified changes in location that in their neutral form are articulated by extension of both the elbow and wrist joint were found to be enhanced by a large movement of the elbow joint alone, and reduced by movement at the wrist and metacarpophalangeal joints (which link the fingers to the rest of the hand). In Figure 2.6 below, this is illustrated for the NGT signs WARM and SAY.

a. Small and large articulations of WARM (NGT)

b. Small and large articulations of SAY (NGT)

Fig. 2.6: Smaller and larger realisations of path movements can involve articulation by different joints in the NGT signs WARM and SAY.

The contribution of various joints to a change in location was also illustrated in Figure 2.3 for the NGT sign PROOF. Rather than the whole hand moving downward as a unit, the movement to contact was articulated by simultaneous extension at finger, wrist, and elbow joints in the instance in the image.

## 5.6. The nature of the phonological abstraction of phonetically variable forms

On the basis of these movement variation data, it can be argued that even though phonological specifications by definition show a large step of abstraction away from the concrete articulatory detail, one hidden articulatory category that may be too concrete for accurate phonological specifications is the hand itself: phonological specifications typically specify the selected fingers and their state, but in many cases this is done in such a way that there is no distinction anymore between 'finger state' and 'handshape' (Crasborn 2003). Finger configurations such as 'extended' or 'straight' imply not only that the two interphalangeal joints of a finger are extended, but also the metacarpophalangeal joint. Thus, most phonological 'handshape' specifications are just that: a specification of the form of the whole hand, albeit at a certain level of abstraction, not aiming to include the exact angles of all joints in the lexicon. For example, in the characterisation of different types of movement, Brentari (1998) distinguishes path movements from local movements by referring directly to possible articulators: by default, the former are realised by the shoulder or elbow joints, the latter are realised by the wrist or finger joints (Brentari 1998, 130−131). Thus, movement of the hand

through space is distinguished from movement that changes the form or orientation of the hand. While it may be the case that the underlying form of some signs does indeed include the activity of the whole hand, it may be more accurate for yet other signs to consider a fingertip or a finger to be the articulator (Crasborn 2003). Such a representation would better account for some of the variations in the data that are found in several sign languages, because it abstracts away further from the concrete articulation and aims for a more perceptual representation. However, Emmorey, Bosworth and Kraljic (2009) found that signers only use visual feedback of their own signing to a limited extent, suggesting that visual representations may not play an important role in language production. This is clearly an area in need of further research.

### 5.7. Summary

In conclusion, the few studies that have explicitly targeted phonetic variation have looked at articulatory variability in the realisation of categorical phonological distinctions. These studies open up a whole field of investigation for linguists and movement scientists. The few studies that there are show that similar processes are at work as in speech variation. Although for convenience's sake these studies have targeted an articulatory level rather than the level of the visual signal, basic factors like the aim to reduce articulatory effort whenever perceptual demands of the addressee do not prohibit it are not different from the spoken modality.

## 6. Conclusion

The phonetic variation studies discussed above make clear that indeed there is a phonetic level of description in sign languages that is different from the phonological level, even though it has received relatively little attention in the sign language literature. At the same time, these studies make clear that there is a whole field of study to be further explored: the articulation and perception of sign languages is likely to be just as complex as the phonetics of the vocal-auditory modality. While we primarily expect to find differences between sign and speech due to the unique importance of the gestural-visual modality used in Deaf communication, there are also likely to be similarities between the two modalities at some phonetic level. Both sign and speech are instances of human perception and performance; both take place over time and cost energy to perform. These similarities and their impact on the phonology of human language form an important area for future investigations, just as a deeper understanding of the differences merits much further research.

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# 3. Phonology



## Abstract

*This chapter is concerned with the sub-lexical structure of sign language phonology: features and their organization into phonological units, such as the segment, syllable and word. It is organized around three themes* – structure, modality, *and* iconicity – *because these themes have been well-studied since the inception of the field and they touch on the reasons why the consideration of sign languages is essential if one wishes to understand the full range of possibilities of the phonology of natural languages. The cumulative work described here makes two main arguments. First, modality affects the phonological representation in sign and spoken languages; that is, the phonological structure represents the strengths of the phonetic and physiological systems employed. Without a comparison between sign and spoken languages, it is easy to lose sight of this point. Second, iconicity works with phonology, not against it. It is one of the pressures – like ease of perception and ease of production – that shape a phonological system. This interaction is more readily seen in sign languages because of the availability of visual iconicity and the ease with which it is assumed by phonological structures.*

## 1. Introduction

Why should phonologists, who above all else are fascinated with the way things *sound,* care about systems without sound? The short answer is that the organization of phonological material is as interesting as the phonological material itself − whether it is of spoken or sign languages. Moreover, certain aspects of work on spoken languages can be seen in a surprising new light, because sign languages offer a new range of possibilities both articulatorily and perceptually.

In this chapter the body of work on the single sign will be described under the umbrella terms *structure, modality,* and *iconicity.* Under the term *structure* is included all the work that showed that sign languages were natural languages with demonstrable structure at all levels of the grammar including, of course, phonology. Much progress has been achieved toward the aim of delineating the structures, distribution, and operations in sign language phonology, even though this work is by no means over and debates about the segment, feature hierarchies, contrast, and phonological operations continue. For now, it will suffice to say that it is well-established crosslinguistically that sign languages have hierarchical organization of structures analogous to those of spo-

ken languages. Phonologists are in a privileged place to see differences between sign and spoken languages, because, unlike semantics or syntax, the language medium affects the organization of the phonological system. This chapter deals with the word-sized unit (the sign) and phonological elements relevant to it; phonetic structure and prosodic structure above the level of the word are dealt with in chapter 2 and chapter 4 of the handbook, respectively.

Taken together, the five sign language parameters of Handshape, Place of Articulation (where the sign is made), Movement (how the articulators move), Orientation (the hands' relation towards the Place of Articulation), and Non-manual behaviors (what the body and face are doing) function similarly to the cavities, articulators and features of spoken languages. Despite their different content, these parameters (i.e., phonemic groups of features) in sign languages are subject to operations that are similar to their counterparts in spoken languages. These broad-based similarities must be seen, however, in light of important differences due to modality and iconicity effects on the system. *Modality* addresses the effect of peripheral systems (i.e., visual/gestural vs. auditory/vocal) on the very nature of the phonological system that is generated (see also chapter 25). *Iconicity* refers to the non-arbitrary relationships between form and meaning, either visual/spatial iconicity in the case of sign languages (Brennan 1990, 2005), or sound symbolism in the case of spoken languages (Hinton/Nicholls/Ohala 1995; Bodomo 2006; see also chapter 18).

This chapter will be structured around the three themes of structure, modality, and iconicity because these issues have been studied in sign language phonology (indeed, in sign language linguistics) from the very beginning. Section 2 will outline the phonological structures of sign languages, focusing on important differences from and similarities to their spoken language counterparts. Section 3 will discuss modality effects by using a key example of word-level phonotactics. I will argue that modality effects allow sign languages to occupy a specific typological niche based on signal processing and experimental evidence. Section 4 will focus on iconicity. Here I will argue that this concept is not in opposition to arbitrariness; instead iconicity co-exists along with other factors – such as ease of perception and ease of production – that contribute to sign language phonological form.

## 2. Structure

### 2.1. The word and sublexical structure

The structure in Figure 3.1 shows the three basic manual parameters – Handshape (HS), Place of Articulation (POA), and Movement (MOV) – in a hierarchical structure from the Prosodic Model (Brentari 1998), which will be used throughout the chapter to make generalizations across sets of data. This structure presents a fundamental difference between sign and spoken languages. Besides the different featural content, the most striking difference between sign and spoken languages is the hierarchical structure itself – i.e., the root node at the top of the structure is an entire lexeme, a stem, not a consonant- or vowel-like unit. This is a fact that is – if not explicitly

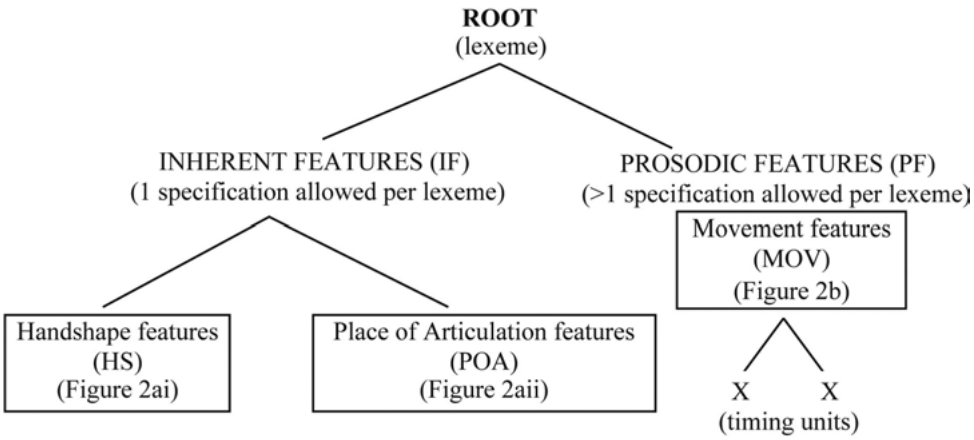



Fig. 3.1: The hierarchical organization of a sign's Handshape, Place of Articulation, and Movement in the Prosodic Model (Brentari 1998).

stated – inferred in many models of sign language phonology (Sandler 1989; Brentari 1990a, 1998; Channon 2002; van der Hulst 1993, 1995, 2000; Sandler/Lillo-Martin 2006).

Both sign and spoken languages have simultaneous structure, but the representation in Figure 3.1 encodes the fact that a high number of features are specified only once per lexeme in sign languages. This idea will be described in detail below. Since the beginning of the field there has been debate about how much to allow the simultaneous aspects of sublexical sign structure to dominate the representation: whether sign languages have the same structures and structural relationships as spoken languages, but with lots of exceptional behavior, or a different structure entirely. A proposal such as the one in Figure 3.1 is proposing a different structure, a bold move not to be taken lightly. Based on a wide range of available evidence, it appears that the simultaneous structure of words is indeed more prevalent in sign than in spoken languages. The point here is that the root node refers to a lexical unit, rather than a C- or V-unit or a syllabic unit.

The general concept of 'root-as-lexeme' in sign language phonology accurately reflects the fact that sign languages typically specify many distinctive features just once per lexeme, not once per segment or once per syllable, but once per word. Tone in tonal languages, and features that harmonize across a lexeme (e.g., vowel features and nasality) behave this way in spoken languages, but fewer features seem to have this type of domain in spoken than in sign languages. And when features do operate this way in spoken languages, it is not universal for all spoken languages. In sign languages a larger number of features operate this way and they do so universally across most known sign languages that have been well studied to date.

## 2.2. The Prosodic Model

In the space provided, I can provide neither a complete discussion of all of the phonological models nor of the internal debates about particular elements of structure. Please

see Brentari (1998) and Sandler and Lillo-Martin (2006) for a more comprehensive treatment of these matters. When possible, I will be as theory-neutral as possible, but given that many points made in the chapter refer to the Prosodic Model, I will provide a brief overview here of the major structures of a sign in the Prosodic Model for Handshape, Place of Articulation, Movement, and Orientation. Non-manual properties of signs will be touched on only as necessary, since their sublexical structure is not well worked out in any phonological model of sign language, and, in fact, it plays a larger role in prosodic structure above the level of the word (sign); see chapter 4. The structure follows Dependency Theory (Anderson/Ewen 1987; van der Hulst 1993) in that each node is maximally binary branching, and each branching structure has a head, which is more elaborate, and a dependent, which is less elaborate. The specific features will be introduced only as they become relevant; the discussion below will focus on the class nodes of the feature hierarchy.

The *inherent feature structure* (Figure 3.2a) includes both *Handshape* and *Place of Articulation*. The *Handshape (HS) structure* (Figure 3.2ai) specifies the active articulator. Moving down the tree in (2ai), the head and body (non-manual articulators) can be active articulators in some signs, but in most cases the arm and hands are the active articulators. The manual node branches into the dominant (*H1*) and non-dominant (*H2*) hands. If the sign is two-handed as in SIT and HAPPEN (Figures 3.3aiii and 3.3aiv) it will have both H1 and H2 features. There are a number of issues about two-handed signs that are extremely interesting, since nothing like this exists in spoken languages (i.e., two articulators potentially active at the same time). Unfortunately these issues will not be covered in this chapter in the interest of space (Battison 1978; Crasborn 1995, submitted; Brentari 1998). If the sign is one-handed, as in WE, SORRY, and THROW (Figures 3.3ai, 3.3aii, and 3.3av), it will have only H1 features. The H1 features enable each contrastive handshape in a sign language to be distinguished from every other. These features indicate, for instance, which fingers are 'active' (*selected*), and of these selected fingers, exactly how many of them there are (*quantity*) and whether they are straight bent, flat, or curved (*joints*). The *Place of Articulation (POA) structure* (Figure 3.2aii) specifies the passive articulator, divided into the three dimensional planes – horizontal (*y-plane*), vertical (*x-plane*), and midsagittal (*z-plane*). If the sign occurs in the vertical plane, then it might also require further specifications for the major place on the body where the sign is articulated (*head, torso, arm, H2*) and also even a particular *location* within that major body area; each major body area has eight possibilities. The POA specifications allow all of the contrastive places of articulation to be distinguished from one another in a given sign language. The inherent features have only one specification per lexeme; that is, no changes in values.

Returning to our point of root-as-lexeme, we can see this concept at work in the signs illustrated in Figure 3.3a. There is just one Handshape in the first three signs: WE (3.3ai), SORRY (3.3aii), and SIT (3.3aiii). The Handshape does not change at all throughout articulation of the sign. In each case, the letters '1', 'S', and 'V' stand for entire feature sets that specify the given handshape. In the last sign, THROW (3.3av), the two fingers change from closed [−open] to open [+open], but the *selected fingers* used in the handshape do not change. The opening is itself a type of movement, which is described below in more detail. Regarding Place of Articulation, even though it looks like the hand starts and stops in a different places in each sign, the major region where the sign is articulated is the same – the *torso* in WE and SORRY, the *horizontal plane*

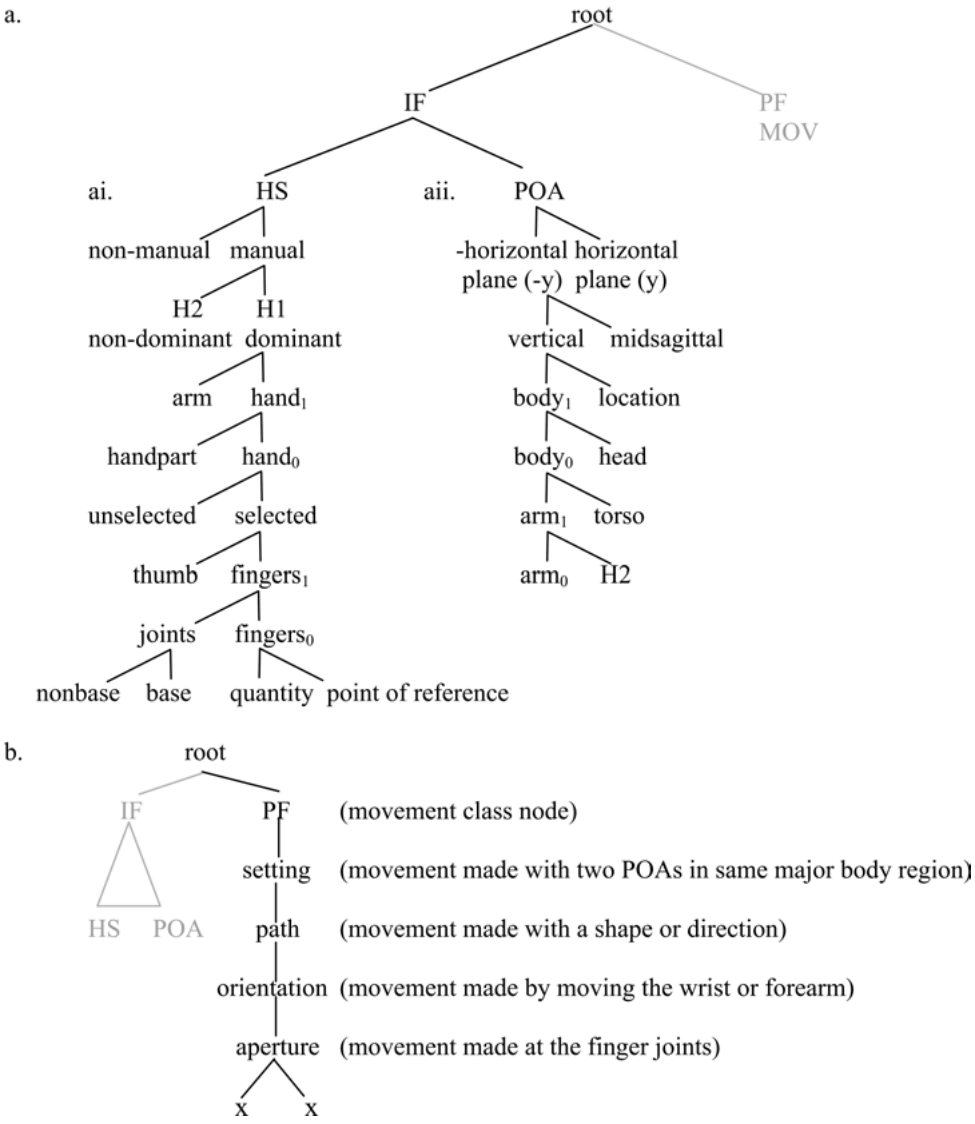



Fig. 3.2: The feature geometry for Handshape, Place of Articulation, and Movement in the Prosodic Model.

(y-plane) in front of the signer in SIT and HAPPEN, and the *vertical plane* (x-plane) in front of the signer in THROW. These are examples of contrastive places of articulation within the system, and the labels given in Figure 3.3b stand for the entire Place of Articulation structure.

The *prosodic feature structure* in Figure 3.1 (shown in detail in Figure 3.2b) specifies movements within the sign, such as the aperture change just mentioned for the sign THROW (3.3av). These features allow for changes in their values within a single root

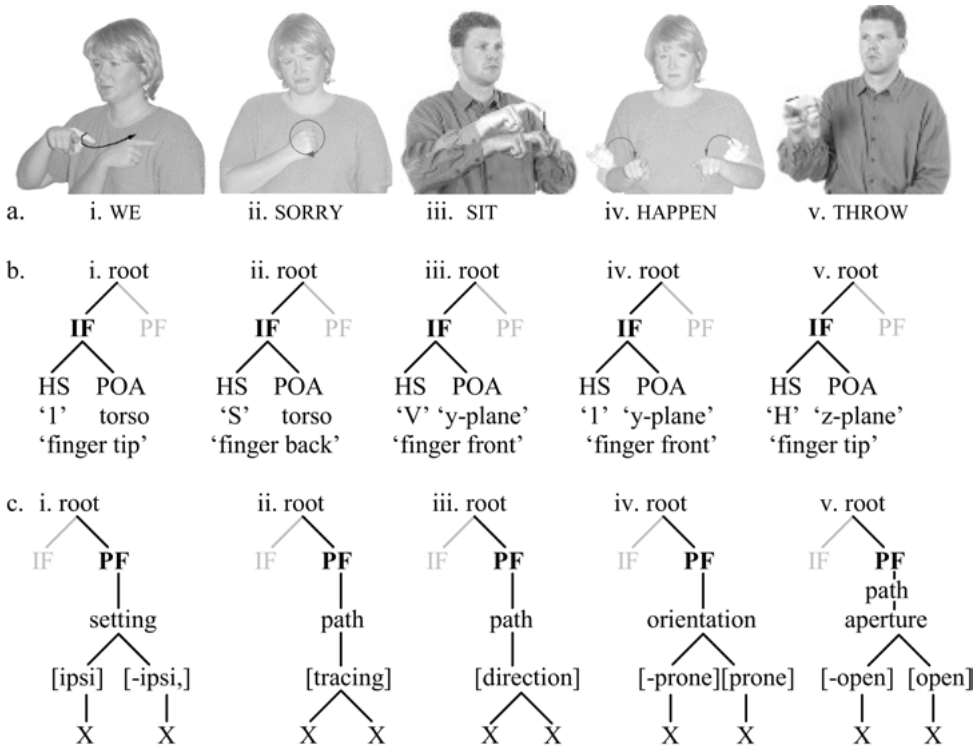



Fig. 3.3: Examples of ASL signs that demonstrate how the phonological representation organizes sublexical information in the Prosodic Model (3a). Inherent features (HS and POA) are specified once per lexeme in (3b), and prosodic features (PF) may have different values within a lexeme; PF features also generate the timing units (x-slots) (3c).

node (lexeme) while the inherent features do not, and this phonological behavior is part of the justification for isolating the movement features on a separate autosegmental tier. Note that Figures 3.3ai, 3.3iv, and 3.3av (WE, HAPPEN, and THROW) all have changes in their movement feature values; i.e., only one contrastive feature, but changes in values. Each specification indicates which anatomical structures are responsible for articulating the movement. Going from top to bottom, the more *proximal* joints of the shoulder and arm are at the top and the more *distal* joints of the wrist and hand are at the bottom. In other words, the shoulder articulating the *setting* movement in WE is located closer to the center of the body than the elbow that articulates a *path* movement in SORRY and SIT. A sign having an *orientation change* (e.g., HAPPEN) is articulated by the forearm or wrist, a joint that is even further away from the body's center, and an *aperture change* (e.g., THROW), is articulated by joints of the hand, furthest away from the center of the body. Notice that it is possible to have two simultaneous types of movement articulated together; the sign THROW has a path movement and an aperture change. Despite their blatantly articulatory labels, these may have an articulatory or a perceptual basis (see Crasborn 2001). The trees in Figure 3.3c demonstrate different types of movement features for the signs in Figure 3.3a. Note that

Figures 3.3ai, 3.3aiv, and 3.3av (WE, HAPPEN, and THROW) all have changes in their movement feature values; one contrastive feature but changes in their values.

*Orientation* was proposed as a major manual parameter like Handshape, Place of Articulation and Movement by Battison (1978), but there are only a few minimal pairs based on Orientation alone. In the Prosodic Model, Orientation is derivable from a relation between the *handpart* specified in the Handshape structure and the Place of Articulation, following a convincing proposal by Crasborn and van der Kooij (1997). The mini-representations of the signs in Figure 3.3 show their orientation as well. The position of the fingertip of the 1-handshape towards the POA determines the hand's orientation of WE and THROW; the position of the back of the fingers towards the torso determines the hand's orientation in SORRY, and the front of the fingers towards the POA determines the hand's orientation in SIT and HAPPEN.

The timing slots (segments) are projected from the prosodic structure, shown as x-slots in Figure 3.2b. Path features generate two timing slots; all other features generate one timing slot. The inherent features do not generate timing slots at all, only movement features can do this in the Prosodic Model. When two movement components are articulated simultaneously as in THROW, they align with one another and only two timing slots are projected onto the timing tier. The movement features play an important role in the sign language syllable, discussed in the next section.

## 2.3. The syllable

The syllable is as fundamental a unit in sign as it is in spoken languages. One point of nearly complete consensus across models of sign language phonology is that the movements are the nuclei of the syllable. This idea has its origin in the correlation between the function of movements and the function of vowels in spoken languages (Liddell 1984; Brentari 2002), which is that both vowels and movements are the 'medium' by which signs are visible from considerable distance, just as vowels are the 'medium' in spoken languages making words audible from considerable distance. This physical fact was determined to have theoretical consequences and was developed into a theory of syllable structure by Brentari (1990a) and Perlmutter (1992). The arguments for the syllable are based on its importance to the system (see also Jantunen/Takkinen 2010). They are as follows:

### 2.3.1. The babbling argument

Petitto and Marentette (1991) have observed that a sequential dynamic unit formed around a phonological movement appears in young Deaf children at the same time as hearing children start to produce syllabic babbling. Because the distributional and phonological properties of such units are analogous to the properties usually associated with syllabic babbling, this activity has been referred to as manual babbling. Like syllabic babbling, manual babbling includes a lot of repetition of the same movement, and also like syllabic babbling, manual babbling makes use of only a part of the phonemic units available in a given sign language. The period of manual babbling develops without interruption into the first signs (just as syllabic babbling continues without

interruption into the first words in spoken languages). Moreover, manual babbling can be distinguished from excitatory motor hand activity and other communicative gestures by its rhythmic timing, velocity, and spectral frequencies (Petitto 2000).

### 2.3.2. The minimal word argument

This argument is based on the generalization that all well-formed (prosodic) words must contain at least one syllable. In spoken languages, a vowel is inserted to insure well-formedness, and in the case of sign languages a movement is inserted for the same reason. Brentari (1990b) observed that American Sign Language (ASL) signs without a movement in their input, such as the numeral signs 'one' to 'nine' add a small, epenthetic path movement when used as independent words, signed one at a time. Jantunen (2007) observed that the same is true in Finnish Sign Language (FinSL), and Geraci (2009) has observed a similar phenomenon in Italian Sign Language (LIS).

### 2.3.3. Evidence of a sonority hierarchy

Many researchers have proposed sonority hierarchies based 'movement visibility' (Corina 1990; Perlmutter 1992; Sandler 1993; Brentari 1993). Such a sonority hierarchy is built into the prosodic features' structure in Figure 3.2b since movements represented by the more proximal joints higher in the structure are more visible than are those articulated by the distal joints represented lower in the structure. For example, movements executed by the elbow are typically more easily seen from further away than those articulated by opening and closing of the hand. See Crasborn (2001) for experimental evidence demonstrating this point. Because of this finding some researchers have observed that movements articulated by more proximal joints are a manifestation of visual 'loudness' (Crasborn 2001; Sander/Lillo-Martin 2006). In both spoken and sign languages more sonorous elements of the phonology are louder than less sonorous ones (/a/ is louder than /i/; /l/ is louder than /b/, etc.). The evidence from the nativization of fingerspelled words, below, demonstrates that sonority has also infiltrated the word-level phonotactics of sign languages.

In a study of fingerspelled words used in a series of published ASL lectures on linguistics (Valli/Lucas 1992), Brentari (1994) found that fingerspelled forms containing

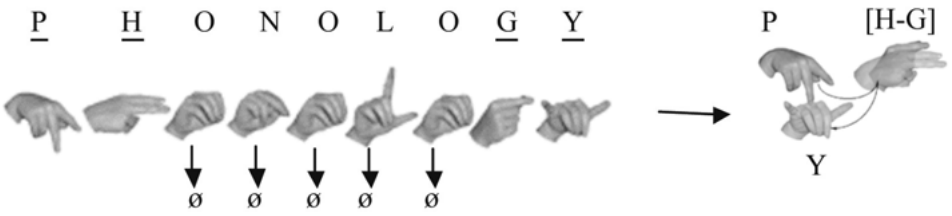



Fig. 3.4: An example of nativization of the fingerspelled word P-H-O-N-O-L-O-G-Y, demonstrating evidence of the sonority hierarchy by organizing the reduced form around the two more sonorous wrist movements.

strings of eight or more handshapes representing the English letters were reduced in a systematic way to forms that contain fewer handshapes. The remaining handshapes are organized around just two movements. This is a type of nativization process; native signs conform to a word-level phonotactic of having no more than two syllables. By native signs I am referring to those that appear in the core vocabulary, including monomorphemic forms and lexicalized compounds (Brentari/Padden 2001). Crucially, the movements retained were the most visible ones, argued to be most sonorous ones, e.g., movements made by the wrist were retained while aperture changes produced by the hand were deleted. Figure 3.4 contains an example of this process: the carefully fingerspelled form P-H-O-N-O-L-O-G-Y is reduced to the letters underlined, which are the letters responsible for the two wrist movements.

### 2.3.4. Evidence for light vs. heavy syllables

Further evidence for the syllable comes from a division between those movements that contain just one movement element (features on only one tier of Figure 3.2b are specified), which behave as *light* syllables (e.g., WE, SORRY, and SIT in Figure 3.3 are light), vs. those that contain more than one simultaneous movement element, which behave as heavy syllables (e.g., THROW in Figure 3.3). It has been observed in ASL that a process of nominalization by movement reduplication can occur only to forms that consist of a light syllable (Brentari 1998). In other words, holding other semantic factors constant, there are signs, such as SIT, that have two possible forms: a verbal form with the whole sequential movement articulated once and a nominal form with the whole movement articulated twice in a restrained manner (Supalla/Newport 1978). The curious fact is that the verb SIT has such a corresponding reduplicated nominal form (CHAIR), while THROW does not. Reduplication is not the only type of nominalization process in sign languages, so when reduplication is not possible, other possible forms of nominalization are possible (see Shay 2002). These facts can be explained by the following generalization: *ceteris paribus*, the set of forms that allow reduplication have just one simultaneous movement component, and are *light* syllables, while those that disallow reduplication, such as THROW, have two or more simultaneous movement elements and are therefore *heavy*. A process in FinSL requiring the distinction between heavy and light syllables has also been observed by Jantunen (2007) and Jantunen and Takkinen (2010). Both analyses call syllables with one movement component light, and those with more than one heavy.

## 2.4. The segment and feature organization

This is an area of sign language phonology where there is still lively debate. Abstracting away from the lowest level of representation, the features themselves (e.g., [one], [all], [flexed], etc.), I will try to summarize one trend − namely, features and their relation to segmental (timing) structure. Figure 3.5 shows schematic structures capturing the changes in perspective on how timing units, or segments, are organized with respect to the feature material throughout the 50 years of work in this area. All models in Figure 3.5 are compatible with the idea of 'root-as-lexeme' described in section 2.1; the

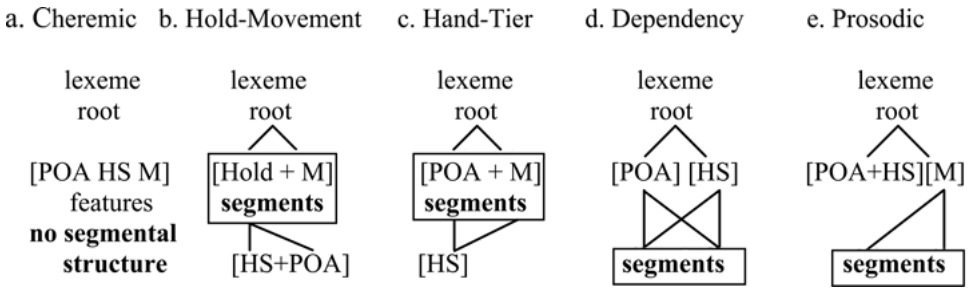



Fig. 3.5: Schematic structures showing the relationship of segments to features in different models of sign language phonology (left to right): the Cheremic Model (Stokoe 1960; Stokoe et al. 1965), the Hold-Movement Model (Liddell/Johnson 1989), the Hand-Tier Model (Sandler 1989), the Dependency Model (van der Hulst 1995), and the Prosodic Model (Brentari 1998).

root node at the top of the structure represents the lexeme. Figure 3.5a represents Stokoe's *Cheremic Model* described in *Sign Language Structures* (1960). The sub-lexical parameters of Handshape, Place of Articulation, and Movement had no hierarchical organization, and like the spoken models of the 1950s (e.g., Bloomfield 1933), were based entirely on phonemic structure (i.e., minimal pairs). It was the first linguistic work on sign language linguistics of any type, and the debt owed to Stokoe is enormous for bringing the sub-lexical parameters of signs to light.

Thirty years later, Liddell and Johnson (1989) looked primarily to sequential structure (timing units) to organize phonological material (see Figure 3.5b). Their Hold-Movement Model was also a product of spoken language models of the period, which were largely segmental (Chomsky/Halle 1968), but were moving in the direction of non-linear phonology, starting with autosegmental phonology (Goldsmith 1976). Segmental models depended heavily on slicing up the signal into units of *time* as a way of organizing the phonological material. In such a model, consonant and vowel units take center stage in spoken language, which can be identified sequentially. Liddell and Johnson called the static Holds 'consonants', and Movements the 'vowels' of sign languages. While this type of division is certainly possible phonetically, several problems related to phonological distribution of Holds make this model implausible. First of all, the presence and duration of most instances of holds are predictable (Perlmutter 1992; Brentari 1998). Secondly, length is not contrastive in movements or holds; a few morphologically related forms are realized by lengthening − e.g., [intensive] forms have a geminated first segment, such as GOOD vs. GOOD [intensive] 'very good', LATE vs. LATE [intensive] 'very late', etc. − but no lexical contrast is achieved by segment length. Thirdly, the feature matrix of all of the holds in a given lexeme contains a great deal of redundant material (Sandler 1989; Brentari 1990a, 1998).

As spoken language theories became increasingly non-linear (Clements 1985; Sagey 1986) sign language phonology re-discovered and re-acknowledged the non-linear simultaneous structure of these languages. The Hand-Tier Model (Sandler 1989 and Figure 3.5c) and all future models use feature geometry to organize the properties of the sign language parameters according to phonological behavior and articulatory properties. The Hand-Tier Model might be considered balanced in terms of sequential

and simultaneous structure. Linear segmental timing units still hold a prominent place in the representation, but Handshape was identified as having non-linear (autosegmental) properties. The Moraic Model (Perlmutter 1992) is similar to the Hand-Tier Model in hierarchical organization, but this approach uses morae, a different type of timing unit (Hyman 1985; Hayes 1989).

Two more recent models have placed the simultaneous structure back in central position, and they have made further use of feature geometry. In these models, timing units play a role, but this role is not as important as that which they play in spoken languages. The Dependency Model (van der Hulst 1993, 1995, see Figure 3.5d) derives timing slots from the dependent features of Handshape and Place of Articulation. In fact, this model calls the root node a segment/lexeme and refers to the timing units as timing (X)-slots, shown at the bottom of this representation. The Movement parameter is demoted in this model, and van der Hulst argues that most of movement can be derived from Handshape and Place of Articulation features, despite its role in the syllable (discussed in section 2.3) and in morphology (see sections 4.3 and 4.4). The proposals by Uyechi (1995) and Channon (2002) are similar in this regard. This differs from the Hand-Tier and Prosodic Models, which award movement a much more central role in the structure.

Like the Dependency Model, the Prosodic Model (already discussed in section 2.2, Brentari 1990a, 1998) derives segmental structure. It recognizes that Handshape, Place of Articulation, and Movement all have autosegmental properties. The role of the sign language syllable is acknowledged by incorporating it into the representation (see Figure 3.5e). Because of their role in the syllable and in generating segments prosodic (Movement) features are set apart from Handshape and Place of Articulation on their own autosegmental tier, and the skeletal structure is derived from them, as in the Dependency Model described above. In Figure 3.5e timing slots are at the bottom of the representation.

To summarize these sections on sign language structure, it is clear that sign languages have all of the elements one might expect to see in a spoken language phonological system, yet their organization and content is somewhat different: features are organized around the lexeme and segmental structure assumes a more minor role. What motivates this difference? One might hypothesize that this is in part due to the visual/gestural nature of sign languages, and this topic of modality effects will be taken up in section 3.

## 3. Modality effects

The modality effects described here refer to the influence that the phonetics (or communication mode) used in a signed or spoken medium have on the very nature of the phonological system that is generated. How is communication modality expressed in the phonological representation? Brentari (2002) describes several ways in which signal processing differs in sign and spoken languages (see also chapters 2 and 25). 'Simultaneous processing' is a cover term for our ability to process various input types presented roughly at the same time (e.g., pattern recognition, paradigmatic processing in phonological terms) for which the visual system is better equipped relative to audition.

'Sequential processing' is our ability to process temporally discrete inputs into temporally discrete events (e.g., ordering and sequencing of objects in time, syntagmatic processing in phonological terms), for which the auditory system is better equipped relative to vision. I am claiming that these differences have consequences for the organization of units in the phonology at the most fundamental level. Word shape will be used as an example of how modality effects ultimately become reflected in phonological and morphological representations.

## 3.1. Word shape

In this section, first outlined in Brentari (1995), the differences in the shape of the canonical word in sign and spoken languages will be described, first in terms of typological characteristics alone, and then in terms of factors due to communication modality. Canonical word shape refers to the preferred phonological shape of words in a given language. For an example of such canonical word properties, many languages, including the Bantu language Shona (Myers 1987) and the Austronesian language Yidin (Dixon 1977), require that all words be composed of binary branching feet. With regard to statistical tendencies at the word level, there is also a preferred canonical word shape exhibited by the relationship between the number of syllables and morphemes in a word, and it is here that sign languages differ from spoken languages. Signed words tend to be monosyllabic (Coulter 1982) and, unlike spoken languages, sign languages have an abundance of monosyllabic, polymorphemic words because most affixes in sign languages are feature-sized and are layered simultaneously onto the stem rather than concatenated (see also Aronoff/Meir/Sandler (2005) for a discussion of this point).

This relationship between syllables and morphemes is a hybrid measurement, which is both phonological and morphological in nature, due in part to the shape of stems and in part to the type of affixal morphology in a given language. A spoken language such as Hmong contains words that tend to be monosyllabic and monomorphemic with just two syllable positions (CV), but a rather large segmental inventory of 39 consonants and 13 vowels. The distinctive inventory of consonants includes voiced and voiceless nasals, as well as several types of secondary articulations (e.g., pre- and post-nasalized obstruents, lateralized obstruents). The inventory of vowels includes monophthongs, diphthongs, and seven contrastive tones, both simple and contour tones (Golston/Yang 2001; Andruski/Ratliff 2000). Affixal morphology is linear, but there isn't a great deal of it. In contrast, a language such as West Greenlandic contains stems of a variety of shapes and a rich system of affixal morphology that lengthens words considerably (Fortescue 1984). In English, stems tend to be polysyllabic, and there is relatively little affixal morphology. In sign languages, words tend to be monosyllabic, even when they are polymorphemic. An example of such a form – re-presented from Brentari (1995, 633) – is given in Figure 3.6; this form means 'two bent-over upright-beings advance-forward carefully side-by-side' and contains at least six morphemes in a single syllable. All of the classifier constructions in Figure 3.10 (discussed later in section 4) are monosyllabic, as are the agreement forms in Figure 3.11. There is also a large amount of affixal morphology, but most of these affixes are smaller than a segment in size; hence, both polymorphemic and monomorphemic words are typically just

Fig. 3.6: An example of a monosyllabic, polymorphemic form in ASL: 'two bent-over upright-beings advance-forward carefully side-by-side'.

one syllable in length. In Table 3.1, a chart schematizes the canonical word shape in terms of the number of morphemes and syllables per word.

(1) Canonical word shape according to the number of syllables and morphemes per word

Tab. 3.1: Canonical word shape according to the number of syllable and morphemes per word

| | monosyllabic | polysyllabic |
|---|---|---|
| monomorphemic | Hmong | English, German, Hawaiian |
| polymorphemic | **sign languages** | West Greenlandic, Turkish, Navajo |

This typological fact about sign languages has been attributed to communication modality, as a consequence of their visual/gestural nature. Without a doubt, spoken languages have simultaneous phenomena in phonology and morphophonology such tone, vowel harmony, nasal harmony, and ablaut marking (e.g., the past preterite in English ('sing' [pres.]/'sang' [preterit]; 'ring' [pres.]/'rang' [preterit]), and even person marking in Hua indicated by the [±back] feature on the vowel (Haiman 1979)). There is also nonconcatenative morphology found in Semitic languages, which is another type of simultaneous phenomenon, where lexical roots and grammatical vocalisms alternate with one another in time. Even collectively, however, this doesn't approach the degree of simultaneity in sign languages, because many features are specified once per stem to begin with: one Handshape, one Place of Articulation, one Movement. In addition, the morphology is feature-sized and layered onto the same monosyllabic stem, adding additional features but no more linear complexity, and the result is that sign languages have two sources of simultaneity − one phonological and another morphological. I would argue that it is this combination of these two types of simultaneity that causes sign languages to occupy this typological niche (see also Aronoff et al. (2004) for a similar argument). Many researchers since the 1960s have observed a preference for simultaneity of structure in sign languages, but for this particular typological comparison it was important to have understood the nature of the syllable in sign languages and its relationship to the Movement component (Brentari 1998).

Consider this typological fact about canonical word shape just described from the perspective of the peripheral systems involved and their particular strengths in signal processing, described in detail in chapters 2 and 25. What I have argued here is that signal processing differences in the visual and auditory system have typological consequences for the shape of words, which is a notion that goes to the heart of what a language looks like. In the next section we explore this claim experimentally using word segmentation task.

## 3.2. Word segmentation is grounded in communication modality

If this typological difference between words in sign and spoken language is deeply grounded in communication modality it should be evident in populations with different types of language experience. From a psycholinguistic perspective, this phenomenon of word shape can be fruitfully explored using word segmentation tasks, because it can address how language users with different experience handle the same types of items. We discuss such studies in this section. In other words, if the typological niche in (1) is due to the visual nature of sign languages, rather than historical similarity or language-particular constraints, then signers of different sign languages and non-signers should segment nonsense strings of signed material into word-sized units in the same way.

The cues that people use to make word segmentation decisions are typically put into conflict with each other in experiments to determine their relative salience to perceivers. Word segmentation judgments in spoken languages are based on (i) the rhythmic properties of metrical feet (syllabic or moraic in nature), (ii) segmental cues, such as the distribution of allophones, and (iii) domain cues, such as the spreading of tone or nasality. Within the word, the first two of these are 'linear' or 'sequential' in nature, while domain cues are simultaneous in nature − they are co-extensive with the whole word. These cues have been put into conflict in word segmentation experiments in a number of spoken languages, and it has been determined crosslinguistically that rhythmic cues are more salient when put into conflict with domain cues or segmental cues (Vroomen/Tuomainen/Gelder 1998; Jusczyk/Cutler/Redanz 1993; Jusczyk/Hohne/Bauman 1999; Houston et al. 2000). By way of background, while both segmental and rhythmic cues in spoken languages are realized sequentially, segmental alternations, such as knowing the allophonic form that appears in coda vs. onset position, requires language-particular knowledge at a rather sophisticated level. Several potential allophonic variants can be associated with different positions in the syllable or word, though infants master it sometime between 9 and 12 months of age (Jusczyk/Hohne/Bauman 1999). Rhythm cues unfold more slowly than segmental alternations and require less specialized knowledge about the grammar. For instance, there are fewer degrees of freedom (e.g., strong vs. weak syllables in '**chil.**dren', '**break.**fast') and there are only a few logically possible alternatives in a given word. If we assume that there is at least one prominent syllable in every word (two-syllable words have three possibilities; three-syllable words have seven possibilities). Incorporating modality into the phonological architecture of spoken languages would help explain why certain structures, such as the trochaic foot, may be so powerful a cue to word learning in infants (Jusczyk/Hohne/Bauman 1999).

Word-level phonotactic cues are available for sign languages as well, and these have also been used in word segmentation experiments. Rhythmic cues are not used at the word level in ASL, they begin to be in evidence at the phrasal level (see Miller 1996; see also chapter 4, Visual Prosody). The word-level phonotactics described in (1) hold above all for lexical stems; they are violated in ASL compounds to different degrees.

(1) Word-level phonotactics
   a. Handshape: within a word selected finger features do not change in their value; aperture features may change. (Mandel 1981)
   b. Place of Articulation: within a word major Place of Articulation features may not change in their value; setting features (minor place features) within the same major body region may change. (Brentari 1998)
   c. Movement: within a word repetition of movement is possible, or 'circle + straight' sequences (*'straight + circle' sequences). (Uyechi 1996)

Within a word, which properties play more of a role in sign language word segmentation: those that span the whole word (the domain cues) or those that change within

ai. One sign, based on ASL

aii. Two signs, based on ASL

bi. One sign, based on ASL

bii. Two signs, based on ASL

Fig. 3.7: Examples of one- and two-movement nonsense forms in the word segmentation experiments. The forms in (a) with one movement were judged to be one sign by our participants; the forms in (b) with two movements were judged to be two signs by our participants. Based on ASL phonotactics, however, the forms (ai) and (bi) should have been judged to be one sign and those of (aii) and (bii) should have been judged to be two signs.

the word (i.e. the linear ones)? These cues were put into conflict with one another in a set of balanced nonsense stimuli that were presented to signers and non-signers. The use of a linear cue might be, for example, noticing that the open and closed aperture variants of handshapes are related, and thereby judging a form containing such a change to be one sign. The use of a domain strategy might be, for example, to ignore sequential alternations entirely, and to judge every handshape or movement as a new word. The nonsense forms in Figure 3.7 demonstrate this. If an ASL participant relied on a linear strategy, Figure 3.7ai would be judged as one sign because it has an open and closed variant of the same handshape, and Figure 3.7aii would be judged as two signs because it contains two distinctively contrastive handshapes (two different selected finger groups). Figure 3.7bi should be judged as one sign because it has a repetition of the movement and only one handshape and 3.7bii as two signs because it has two contrastive handshapes and two contrastive movements.

In these studies there were six groups of subjects included in two experiments. In one study groups of native users of ASL and English participated (Brentari 2006), and in a second study four more groups were added, totaling six: native users of ASL, Croatian Sign Language (HZJ), and Austrian Sign Language (ÖGS), spoken English, spoken Austrian German and spoken Croatian (Brentari et al. 2011). The method was the same in both studies. All were administered the same word segmentation task using signed stimuli only. Participants were asked to judge whether controlled strings of nonsense stimuli based on ASL words were one sign or two signs. It was hypothesized that (1) signers and non-signers would differ in their strategies for segmentation, and (2) signers would use their language-particular knowledge to segment sign strings. Overall, the results were mixed. A "1 value = 1 word" strategy was employed overall, primarily based on how many *movement*s were in the string, despite language-particular grammatical knowledge. As stated earlier, for ASL participants Figures 3.7ai and 3.7bi should be judged one sign, because in 3.7ai the two handshapes are allowable in one sign, as are the two movements in 3.7bi. Those in Figures 3.7aii and 3.7bii should be judged as two signs. This did not happen in general; however, if each *parameter* is analyzed separately, the way that the Handshape parameter was employed was significantly different both between signing and non-signing groups, and among sign language groups.

The conclusion drawn from the word segmentation experiments is that modality (the visual nature of the signal) plays a powerful role in word segmentation; this drives the strong similarity in performance between groups using the Movement parameter. It suggests that, when faced with a new type of linguistic string, the modality will play a role in segmenting it. Incorporating this factor into the logic of phonological architecture might help to explain why certain structures, such as the trochaic foot, may be so powerful a cue to word learning in infants (Jusczyk/Cutler/Redanz 1993) and why prosodic cues are so resilient crosslinguistically in spoken languages.

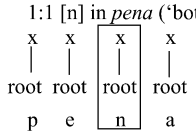
## 3.3. The reversal of segment to melody

A final modality effect is the organization of melody features to skeletal segments in the hierarchical structure in Figure 3.1, and this will be described here in detail. The reason that timing units are located at the top of the hierarchical structure of spoken

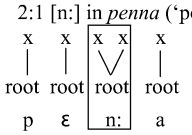
languages is because they can be contrastive. In spoken languages, affricates, geminates, long vowels, and diphthongs demonstrate that the number of timing slots must be represented independently from the melody, even if the default case is one timing slot per root node. Examples of affricate and geminates in Italian are given in (2).

(2) Spoken language phonology − root:segment ratios [Italian]

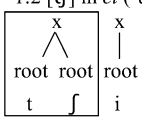
a. 1:1 [n] in *pena* ('bother')




b. 2:1 [n:] in *penna* ('pen')




c. 1:2 [ʧ] in *ci* ('us')

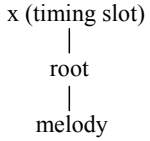



The Dependency and Prosodic Models of sign language phonology build into them the fact that length is not contrastive in any known sign language, and the number of timing slots is predictable from the content of the features. As a consequence, the melody (i.e., the feature material) has a higher position in the structure and timing slots a lower position; in other words, the reverse of what occurs in spoken languages where timing units are the highest node in the structure (see also van der Hulst (2000) for this same point). As shown in Figure 3.2b and 3.3c, the composition of the prosodic features can generate the number of timing slots. In the Prosodic Model path features generate two timing slots, all other features generate one timing slot.

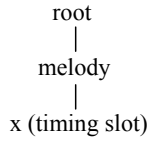
What would motivate this structural difference between the two types of languages? One reason has already been mentioned: audition has the advantage over vision in making temporal judgments, so it makes sense that the temporal elements of speech have a powerful and independent role in phonological structure with respect to the melody. One logical consequence of this is that the timing tier, containing either segments or moras, is more heavily exploited to produce contrast within the system and must assume a more prominent role in spoken than in sign languages. A schema for the relationship between timing slots, root node, and melody in sign and spoken languages is given in (3).

(3) Organization of phonological material in sign vs. spoken languages

a. Spoken languages




b. Sign languages




To conclude this section on modality, we see that it affects other levels of representation. An effect of modality on the phonetic representation can be seen in the similar use of movement in signers and non-signers in making word segmentation judgments. An effect on the phonological representation can be seen when the single movement (now assuming the role of syllable in a sign language phonological system) is used to express a particular phonological rule or constraint, such as the phonotactic constraint on handshape change: that is, one handshape change per syllable. An effect of modality

on the morphophonological representation can be seen in the typological niche that sign languages occupy, whereby words are monosyllabic and polymorphemic.

Modality effects are readily observable when considering sign languages because of their contrast with structures in spoken languages, and they also encourage an additional look at spoken language systems for similar effects of modality on speech that might be typically taken for granted.

## 4. Iconicity effects

The topic of iconicity in sign languages is vast, covering all linguistic areas – e.g., pragmatics, lexical organization, phonetics, morphology, the evolution of language – but in this chapter only aspects of iconicity that are specifically relevant for the phonological and morphophonemic representation will be discussed in depth (see also chapter 18 on iconicity and metaphor). The idea of analyzing iconicity and phonology together is fascinating and relatively recent. See, for instance, van der Kooij (2002), who examined the phonology-iconicity connection in native signs and has proposed a level of phonetic implementation rules where iconicity exerts a role. Even more recently, Eccarius (2008) provides a way to rank the effects of iconicity throughout the whole lexicon of a sign language. Until recently research on phonology and research concerning iconicity have been taken up by sub-fields completely independent from one other, one side sometimes even going so far as to deny the importance of the other side. Iconicity has been a serious topic of study in cognitive, semiotic, and functionalist linguistic perspectives, most particularly dealing with productive, metaphoric, and metonymic phenomena (Brennan 1990; Cuxac 2000; Taub 2001; Brennan 2005, Wilcox 2001; Russo 2005; Cuxac/Sallandre 2007). In contrast, with the notable exceptions just mentioned, phonology has been studied within a generative approach, using tools that make as little reference to meaning or iconicity as possible. For example, the five models in Figure 3.5 (the Cheremic, Hold-Movement, Hand-Tier, Dependency, and Prosodic Models) make reference to iconicity in neither the inventory nor the system of rules.

'Iconicity' refers to mapping of a source domain and the linguistic form (Taub 2001); it is one of three Peircean notions of iconicity, indexicality, and symbolicity (Peirce, 1932 [1902]); see chapter 18 for a general introduction to iconicity in sign languages. From the very beginning, iconicity has been a major topic of study in sign language research. It is always the '800-lb. gorilla in the room', despite the fact that the phonology can be constructed without it. Stokoe (1960), Battison (1978), Friedman (1976), Klima and Bellugi (1979), Boyes Braem (1981), Sandler (1989), Brentari (1998), and hosts of references cited therein have all established that ASL has a phonological level of representation using exclusively linguistic evidence based on the distribution of forms – examples come from slips of the hand, minimal pairs, phonological operations, and processes of word-formation (see Hohenberger/Happ/Leuninger 2002 and chapter 30). In native signers, iconicity has been shown experimentally to play little role in first-language acquisition (Bonvillian/Orlansky/Folven 1990; Conlin et al. 2000 and also chapter 28) or in language processing; Poizner, Bellugi, and Tweney (1981) demonstrated that iconicity has no reliable effect on short-term recall of signs; Emmorey et al. (2004) showed specifically that motor-iconicity of sign languages (involving movement) does not alter the neural systems

underlying tool and action naming. Thompson, Emmorey, and Gollan (2005) have used 'tip of the finger' phenomena (i.e., almost – but not quite – being able to recall a sign) to show that the meaning and form of signs are accessed independently, just as they are in spoken languages (see also chapter 29 for further discussion). Yet iconicity is present throughout the lexicon, and every one of these authors mentioned above also acknowledges that iconicity is pervasive.

There is, however, no means to quantitatively and absolutely measure just how much iconicity there is in a sign language lexicon. The question, 'Iconic to whom, and under what conditions?' is always relevant, so we need to acknowledge that iconicity is age-specific (signs for TELEPHONE have changed over time, yet both are iconic, cf. Supalla 1982, 2004) and language-specific (signs for TREE are different in Danish, Hong Kong, and American Sign Languages, yet all are iconic). Except for a restricted set of cases where entire gestures from the surrounding (hearing) community are incorporated in their entirety into a specific sign language, the iconicity resides in the sublexical units, either in classes of features that reside at a class node or in individual features themselves. Iconicity is thought to be one of the factors that makes sign languages look so similar (Guerra 1999; Guerra/Meier/Walters 2002; Wilcox/Rossini/Pizzuto 2010; Wilbur 2010), and sensitivity to and productive use of iconicity may be one of the reasons why signers from different language families can communicate with each other so readily after such little time, despite crosslinguistic differences in lexicon, and, in many instances, also in the grammar (Russo 2005). Learning how to use iconicity productively within the grammar is undoubtedly a part of acquiring a sign language.

I will argue that iconicity and phonology are not incompatible, and this view is gaining more support within the field (van der Kooij 2002; Meir 2002; Brentari 2007; Eccarius 2008; Brentari/Eccarius 2010; Wilbur 2010). Now, after all of the work over recent decades showing indisputably that sign languages have phonology and duality of patterning, one can only conclude it is the *distribution* that must be arbitrary and systematic in order for phonology to exist. In other words, even if a property is iconic, it can also be phonological because of its distribution. Iconicity should not be thought of as either a hindrance or opposition to a phonological grammar, but rather another mechanism, on a par with ease of production or ease of perception, that contributes to inventories. Saussure wasn't wrong, but since he based his generalizations on spoken languages, his conclusions are based on tendencies in a communication modality that can only use iconicity on a more limited basis than sign languages can. Iconicity does exist in spoken languages in reduplication (e.g., Haiman 1980) as well as expressives/ideophones. See, for example, Bodomo (2006) for a discussion of these in Dagaare, a Gur language of West Africa. See also Okrent (2002), Shintel, Nussbaum, and Okrent (2006), and Shintel and Nussbaum (2007) for the use of vocal quality, such as length and pitch, in an iconic manner.

Iconicity contributes to the phonological shape of forms more in sign than in spoken languages, so much so that we cannot afford to ignore it. I will show that iconicity is a strong factor in building signed words, but it is also restricted and can ultimately give rise to arbitrary distribution in the morphology and phonology. What problems can be confronted or insights gained from considering iconicity? In the next sections we will see some examples of iconicity and arbitrariness working in parallel to build words and expressions in sign languages, using the feature classes of handshape and orientation and movement. See also chapter 20 for a discussion of the Event Visibility Hypothesis (Wilbur 2008, 2010), which also pertains to iconicity and movement. The mor-

phophonology of word formation exploits and restricts iconicity at the same time; it is used to build signed words, yet outputs are still very much restricted by the phonological grammar. Section 4.1 can be seen as contributing to the historical development of a particular aspect of sign language phonology; the other sections concern synchronic phenomena.

## 4.1. The historical emergence of phonology

Historically speaking, Frishberg (1975) and Klima and Bellugi (1979) have established that sign languages become 'less iconic' over time, but iconicity never reduces to zero and continues to be productive in contemporary sign languages. Let us consider the two contexts in which sign languages arise. In most Deaf communities, sign languages are passed down from generation to generation not through families, but through communities – i.e., schools, athletic associations, social clubs, etc. But initially, before there is a community per se, signs begin to be used through interactions among individuals – either among deaf and hearing individuals ('homesign systems'), or in stable communities in which there is a high incidence of deafness. In inventing a homesign system, isolated individuals live within a hearing family or community and devise a method for communicating through gestures that become systematic (Goldin-Meadow 2001). Something similar happens on a larger scale in systems that develop in communities with a high incidence of deafness due to genetic factors, such as the island of Martha's Vineyard in the seventeenth century (Groce 1985) and Al-Sayyid Bedouin Sign Language (ABSL; Sandler et al. 2005; Meir et al. 2007; Padden et al. 2010). In both cases, these systems develop at first within a context where being transparent through the use of iconicity is important in making oneself understood.

Mapping this path from homesign to sign language has become an important research topic since it allows linguists the opportunity to follow the diachronic path of a sign language *al vivo* in a way that is no longer possible for spoken languages. In the case of a pidgin, a group of isolated deaf individuals are brought together to a school for the deaf. Each individual brings to the school a homesign system that, along with other homesign systems, undergoes pidginization and ultimately creolization. This has happened in the development of Nicaraguan Sign Language (NSL; Kegl/Senghas/Coppola 1999; Senghas/Coppola 2001). This work to date has largely focused on morphology and syntax, but *when and how does phonology arise in these systems*? Aronoff et al. (2008) and Sandler et al. (2011) have claimed that ABSL, while highly iconic, still has no duality of patterning even though it is ~75 years old. It is well known, however, that in first-language acquisition of spoken languages, infants are statistical learners and phonology is one of the first components to appear (Locke 1995; Aslin/Saffran/Newport 1998; Creel/Newport/Aslin 2004; Jusczyk et al. 1993, 1999).

Phonology emerges in a sign language when properties – even those with iconic origins – take on conventionalized distributions, which are not predictable from their iconic forms. Over the last several years, a project has been studying how these subtypes of features adhere to similar patterns of distribution in sign languages, gesture, and homesign (Brentari et al. 2012). It is an example of the intertwined nature of iconicity and phonology that addresses *how* a phonological distribution might emerge in sign languages over time.

Productive handshapes were studied in adult native signers, hearing gesturers (without using their voices), and homesigners in handshapes – particularly the selected finger features of handshape. The results show that the distribution of selected finger properties is re-organized over time. Handshapes were divided into three levels of selected finger complexity. *Low complexity* handshapes have the simplest phonological representation (Brentari 1998), are the most frequent handshapes crosslinguistically (Hara 2003; Eccarius/Brentari 2007), and are the earliest handshapes acquired by native signers (Boyes Braem 1981). *Medium complexity* and *High complexity* handshapes are defined in structural terms – i.e., the simpler the structure the less complexity it contains. *Medium complexity* handshapes have one additional elaboration of the representation of a [one]-finger handshape, either by adding a branching structure or an extra association line. *High complexity* handshapes are all other handshapes. Examples of low and medium complexity handshapes are shown in Figure 3.8.

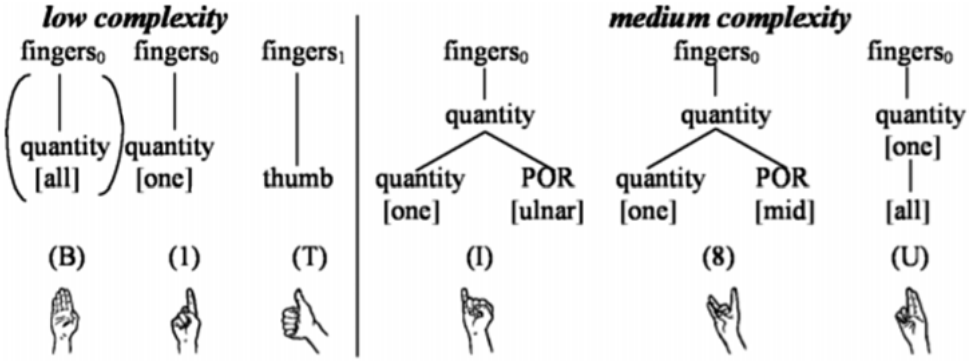



Fig. 3.8: The three handshapes with low finger complexity and examples of handshapes with medium finger complexity. The parentheses around the B-handshape indicate that it is the default handshape in the system.

The selected finger complexity of two types of productive handshapes was analyzed: those representing *objects* and those representing the *handling* of objects (corresponding to whole entity and handling classifier handshapes in a sign language, respectively see section 4.2 and chapter 8). The pattern that appeared in signers and homesigners showed no significant differences along the dimension analyzed: relatively higher finger complexity in object handshapes and lower for handling handshapes (Figure 3.9). The opposite pattern appeared in gesturers, which differed significantly from the other two groups: higher finger complexity in handling handshapes and lower in object handshapes. These results indicate that as handshape moves from gesture to homesign and ultimately to a sign language, object handshapes *gain* finger complexity and handling handshapes *lose* it relative to their distribution in gesture. In other words, even though all of these handshapes are iconic in all three groups, the features involved in selected fingers are heavily re-organized in sign languages, and the homesigners already display signs of this re-organization.

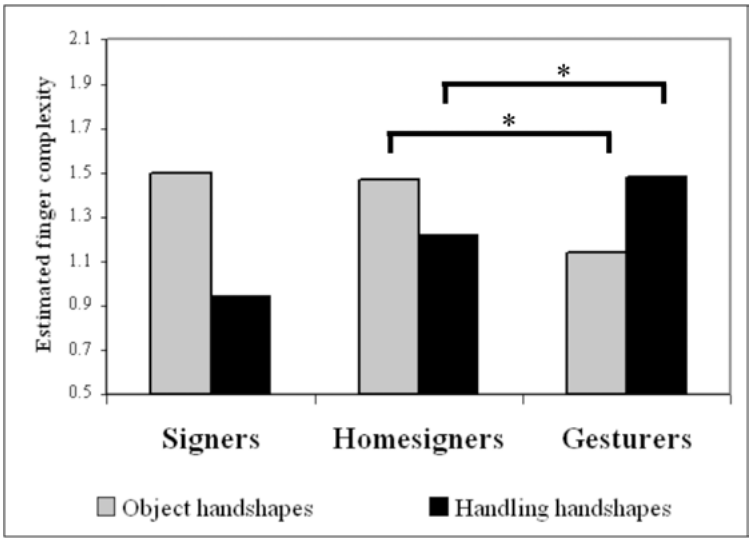



Fig. 3.9: Mean finger complexity, using a Mixed Linear statistical model for *Object* handshapes and *Handling* handshapes in signers, homesigners, and gesturers (Brentari et al. submitted).

## 4.2. Orientation in classifier constructions is arbitrarily distributed

Another phonological structure that has iconic roots but is ultimately distributed arbitrarily in ASL is the orientation of the handshape of classifier constructions (see chapter 8 for further discussion). For our purposes here, classifier constructions can be defined as complex predicates in which movement, handshape, and location are meaningful elements; we focus here on handshape, which includes the orientation relation discussion in section 2. We will use Engberg-Pedersen's (1993) system, given in (4), which divides the classifier handshapes into four groups. Examples of each are given in Figure 3.10.

(4) Categories of handshape in classifier constructions (Engberg-Pedersen 1993)
   a. **Whole Entity:** These handshapes refer to whole objects (e.g., 1-handshape: 'person' (Figure 3.10a)).
   b. **Surface:** These handshapes refer to the physical properties of an object (e.g., B-B-handshape: 'flat_surface' (Figure 3.10b)).
   c. **Limb/Body Part:** These handshapes refer to the limbs/body parts of an agent (e.g., V-handshape: 'by_legs' (Figure 3.10c)). In ASL we have found that the V-handshape 'by-legs' can function as either a body or whole entity classifier.
   d. **Handling:** These handshapes refer to how an object is handled or manipulated (e.g., S-handshape: 'grasp_gear_shift' (Figure 3.10d)).

Benedicto and Brentari (2004) and Brentari (2005) argued that, while all types of classifier constructions use handshape morphologically because at least part of the handshape is used in this way, only classifier handshapes of the handling and limb/

*Phonological use of orientation:*

ai. upright whole entity (1-HS 'person')
aii. upside down
bi. surface of table surface/extension (B-HS 'flat surface')
bii. surface upside down

*Morphological use of orientation:*

ci. upright body part (V-HS 'person')
cii. upside down
di. grasp from above handling (S-HS 'grasp-gear shift')
dii. grasp from below

Fig. 3.10: Examples of the distribution of phonological (top) and morphological (bottom) use of orientation in classifier predicates (ASL). Whole Entity and Surface/Extension classifier handshapes (10a) and (10b) allow only phonological use of orientation (so a change in orientation is not permissible), while Body Part and Handling classifier handshapes (10c) and (10d) do allow both phonological and morphological use of orientation so a change in orientation is possible.

body part type can use *orientation* in a morphological way. Whole entity and surface classifier handshapes cannot. This is shown in Figure 3.10, which illustrates the variation of the forms using orientation phonologically and morphologically. The forms using the whole entity classifier in Figure 3.10ai 'person' and the surface classifier in Figure 3.10bi 'flat surface' are not grammatical if the orientation is changed to the hypothetical forms as in 3.10aii ('person upside down') and 3.10bii ('flat surface upside down), indicated by an 'x' through the ungrammatical forms. Orientation differences in whole entity classifiers are shown by signing the basic form, and then sequentially adding a movement to that form to indicate a change in orientation. In contrast forms using the body part classifier and the handling classifier in Figure 3.10ci ('by-legs') and 3.10di ('grasp gear shift') are grammatical when articulated with different orientations as shown in 3.10cii ('by-legs be located upside down') and 3.10dii ('grasp gear shift from below').

This analysis requires phonology because the representation of handshape must allow for subclasses of features to function differently, according to the type of classifier handshape being used. In all four types of classifiers, part of the phonological orientation specification expresses a relevant *handpart's* orientation (palm, fingertips, back of hand, etc.) toward a place of articulation, but only in body part and handling classifiers is it allowed to function morphologically as well. It has been shown that these four

types of classifiers have different syntactic properties as well (Benedicto/Brentari 2004; Grose et al. 2007).

It would certainly be more iconic to have the orientation expressed uniformly across the different classifier types, but the grammar does not allow this. We therefore have evidence that iconicity is present but constrained in the use of orientation in classifier predicates in ASL.

## 4.3. Directional path movement and verb agreement

Another area in sign language grammars where iconicity plays an important role is verb agreement (see also chapters 7 and 10). Agreement verbs manifest the transfer of entities, either abstract or concrete. Salience and stability among arguments may be encoded not only in syntactic terms, but also by visual-spatial means. Moreover, path movements, which are an integral part of these expressions, are phonological properties in the feature tree, as are the spatial loci of sign language verb agreement. There is some debate about whether the locational loci are, in fact, part of the phonological representation because they have an infinite number of phonetic realizations. See Brentari (1998) and Mathur (2000) for two possible solutions to this problem.

There are three types of verbs attested in sign languages (Padden 1983): those that do not manifest agreement ('plain' verbs), and those that do, which divide further into those known as 'spatial' verbs, which take only take source-goal agreement, and 'agreement' verbs, which take source-goal agreement, as well as object and potentially subject agreement (Brentari 1988; Meir 1998, 2002; Meir et al. 2007). While Padden's 1983 analysis was based on syntactic criteria alone, these more recent studies include both semantics (including iconicity) and syntax in their analysis. The combination of syntactic and semantic motivations for agreement in sign languages was formalized as the 'direction of transfer principle' (Brentari 1988), but the analysis of verb agreement as having an iconic source was first proposed in Meir (2002). Meir (2002) argues that the main difference between verb agreement in spoken languages and sign languages is that verb agreement in sign languages seems to be thematically (semantically), rather than syntactically, determined (Kegl (1985) was the first to note this). Agreement typically involves the representation of phi features of the NP arguments, and functionally it is a part of the referential system of a language. Meir observes that typically in spoken languages there is a closer relationship between agreement markers and structural positions in the syntax than between agreement markers and semantic roles, but sign language verbs can agree not only with themes and agents, they can also agree with their source and goal arguments.

Crucially, Meir argues that 'DIR', which is an abstract construct used in a transfer (or directional) verb, is the iconic representation of the semantic notion 'path' used in theoretical frameworks, such as Jackendoff (1996, 320); DIR denotes spatial relations. It can appear as an independent verb or as an affix to other verbs. This type of iconicity is rooted in the fact that referents in a signed discourse are tracked both syntactically and visuo-spatially; however, this iconicity is constrained by the phonology. Independently a [direction] feature has been argued for in the phonology, indicating a path moving to or from a particular plane of articulation, as described in section 2 (Brentari 1998).

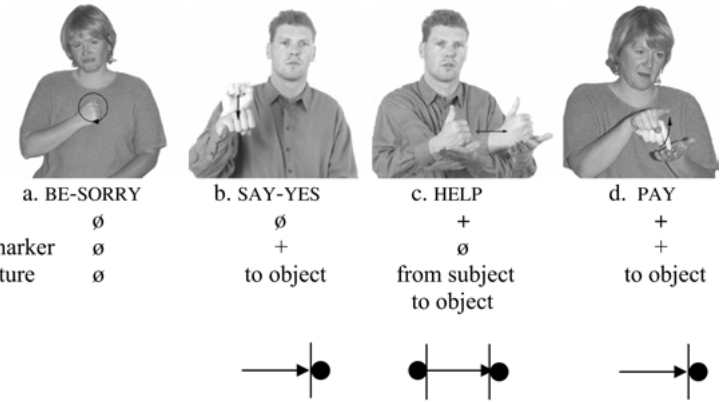



Fig. 3.11: Examples of verb agreement in ASL and how it is expressed in the phonology: BE-SORRY expresses no manual agreement; SAY-YES expresses the direction feature of agreement in orientation; HELP in path; and PAY in both orientation and path.

The abstract morpheme DIR and the phonological feature [direction] are distributed in a non-predictable (arbitrary) fashion both across sign languages (Mathur/Rathmann 2006, 2010) and language internally. In ASL it can surface in the path of the verb or in the orientation; that is, on one or both of these parameters. It is the phonology of the stem that accounts for the distribution of orientation and path as agreement markers, predicting if it will surface, and if so, where it will surface. Figure 3.11 provides ASL examples of how this works. In Figure 3.11a we see an example of the agreement verb, BE-SORRY, that takes neither orientation nor source-goal properties. Signs in this set have been argued to have eye gaze substituted for the manual agreement marker (Bahan 1996; Neidle et al. 2000), but there is debate about exactly what role eye gaze plays in the agreement system (Thompson et al. 2006). The phonological factor relevant here is that many signs in this set have a distinct place of articulation that is on or near the body. In Figure 3.11b we see an example of an agreement verb that takes only the orientation marker of agreement, SAY-YES; this verb has no path movement in the stem that can be modified in its beginning and ending points (Askins/Perlmutter 1995), but the affixal DIR morpheme is realized on the orientation, with the palm of the hand facing the vertical plane of articulation associated with the indirect object. In Figure 3.11c there is an example of an agreement verb that has a path movement in the stem − HELP − whose beginning and endpoints can be modified according to the subject and object locus. Because of the angle of wrist and forearm, it would be very difficult (if not impossible) to modify the orientation of this sign (Mathur/Rathmann 2006). In Figure 3.11d we see an example of the agreement verb PAY that expresses the DIR verb agreement on both path movement and orientation; the path moves from the payer to the payee, and the orientation of the fingertip is towards the payee at the end of the sign. The analysis of this variation depends in part on the lexical specification of the stem − whether orientation or path is specified in the stem of the verb or supplied by the verb-agreement morphology (Askins/Perlmutter 1995) − and in part on the phonetic-motoric constraints on the articulators involved in articulating the stem − i.e., the joints of the arms and hands (Mathur/Rathmann 2006).

In summary, iconicity is a factor that contributes to the phonological inventories of sign languages. Based on the work presented in this section, I would maintain that the distribution of the material is more important for establishing the phonology of sign languages than the material used – iconic or otherwise. One can generalize across sections 4.1–4.3 and say that, taken alone, each of the elements discussed has iconic roots, yet even so, this iconicity is distributed in unpredictable ways (that is, unpredictable if iconicity were the only motivation). This is true for which features – joints or fingers – will be the first indications of an emerging phonology (section 4.1), for the orientation of the hand representing the orientation of the object in space (section 4.2), and for the realization of verb agreement (section 4.3).

## 5. Conclusion

As stated in the introduction to this chapter, this piece was written in part to answer the following questions: 'Why should phonologists, who above all else are fascinated with the way things *sound,* care about systems without sound? How does it relate to their interests?' I hope that I have shown that by using work on sign languages, phonologists can broaden the scope of the discipline from one that includes not only analyses of phonological structures, but also how modality and iconicity infiltrates and interacts with phonetic, phonological, and morph-phonological structure. This is true in both sign and spoken languages, but we see these effects more vividly in sign languages. In the case of modality this is because, chronologically speaking, analyses of sign languages set up comparisons with what has come before (e.g., analyses of spoken languages grounded in a different communication modality) and we now see that some of the differences between the two languages result from modality differences. An important point of this chapter was that general phonological theory can be better understood by considering its uses in sign language phonology. For example, non-linear phonological frameworks allowed for breakthroughs in understanding spoken and sign languages that would not have been possible otherwise, but also allowed the architectural building blocks of a phonological system to be isolated and examined in such a way as to see how *both the visual and auditory systems* (the communication modalities) affect the ultimate shape of words and organization of units, such as features, segments, and syllables.

The effects of iconicity on phonological structure are seen more strongly in sign languages because of the stronger role that visual iconicity can play in these languages compared with auditory iconicity in spoken languages. Another important point for general phonological theory that I have tried to communicate in this chapter has to do with the ways in which sign languages manage iconicity. Just because a property is iconic, doesn't mean it can't also be phonological. Unfortunately some phonologists studying sign languages called attention away from iconicity for a long time, but iconicity is a pervasive pressure on the output of phonological form in sign languages (on a par with ease of perception and ease of articulation), and we can certainly benefit from studying its differential effects both synchronically and diachronically.

Finally, the more phonologists focus on the physical manifestations of the system – the vocal tract, the hands, the ear, the eyes – sign and spoken language phonology

will look different but in interesting ways. The more focus there is on the mind, the more sign language and spoken language phonologies will look the same in ways that can lead to a better understanding of a general (cross-modal) phonological competence.

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# 4. Visual prosody



## Abstract

*Prosody is the part of language that determines how we say what we say. By manipulating timing, prominence, and intonation, we separate constituents from one another and indicate ways in which constituents are related to one another. Prosody enables us to emphasize certain parts of an utterance, and to signal whether the utterance is an assertion or a question, whether it relies on shared knowledge, and other pragmatic information. This chapter demonstrates how sign languages organize a range of available articulators − the two hands, parts of the face, the head and body − into a linguistic system of prosody. It takes the position that prosody and syntax are separate, interacting components of the grammar in sign languages as in spoken languages. The article also shows that prosody is encoded by both manual and non-manual articulators, and that all of these articulators also subserve other, non-prosodic functions in sign language grammar. This state of affairs contradicts the common assumption that 'non-manuals' constitute a natural class in the grammar.*

## 1. Introduction

It's not just *what* you say, it's *how* you say it. Well understood by actors, this simple truth is less obvious to most people, though it is equally important to all of us in everyday communication through language. The 'how' of what we say − the division of our utterances into rhythmic chunks, the relative emphasis placed on parts of them, and the meaningful modulation of the signal through intonation − all make our linguistic interactions interpretable. Without this richly structured delivery system, it is quite likely that we would have difficulty communicating at all. The importance of this component of the linguistic system, called prosody, is often overlooked, even by linguists, because of our reliance on the written word in our analysis of language data. But the written word is only a shorthand code for representing language. Apart from a few punctuation conventions, it is missing the crucial contribution to language made by prosody.

Writing systems for sign languages are not widely used, and this may explain why researchers began paying attention to the prosodic system quite early in the history of the field − though most of them didn't call it that (cf. also chapter 43, Transcription).

Specifically, they noticed that different types of utterances in American Sign Language (ASL), such as questions, topics, and relative clauses, were consistently characterized by particular configurations of the face, head, and body, accompanying the signs made by the hands (Liddell 1978, 1980; Baker/Padden 1978). From that time on, descriptions of non-manual markers have made their way into nearly all linguistic studies of many sign languages, so important are they considered to be for the interpretation of the data at all levels of structure. For space reasons, this overview refers only to research contributing to a theory of sign language prosody, and must omit reference to many studies on non-manuals in ASL and other sign languages that do not deal with prosody.

The early work on signals of the kind to be discussed here did not in fact attribute them to prosody. Liddell's groundbreaking observations led him to argue that certain non-manual articulations correspond to syntactic markers of the sentence and clause types with which they co-occur, and, in the case of relative clauses, that the markers cue embedded sentences in ASL. This was welcome news, providing the first evidence for the existence of embedded sentences in the language, a claim that was later supported by rigorous syntactic tests (starting with Padden (1988), cf. also chapter 14 on sentence types and chapter 16 on coordination and subordination).

The pragmatic function of some non-manual markers in ASL was pointed out early on by Coulter (1979); see also Janzen/Shaffer (2002) for ASL, Engberg-Pedersen (1990) for Danish Sign Language (DSL) and chapter 21 on information structure. Eventually, linguists began to compare some of these functions, particularly articulations of the eyes and brows, to those of intonation (see Johnston (1989) for Australian Sign Language (Auslan); Woll (1981) and Deuchar (1984) for British Sign Language (BSL); Reilly/McIntire/Bellugi (1990) and Wilbur (1994) for ASL; Nespor/Sandler (1999) and Sandler (1999a,b) for Israeli Sign Language (Israeli SL)), and this comparison is echoed here.

If facial articulations correspond to intonation, then they cannot be adequately understood independently. Instead, they participate in a broader prosodic system, one that also includes chunking the words into units denoted by timing, conveyed by the hands. This means that the prosodic system is not solely non-manual, and indeed 'non-manuals' do not constitute a coherent linguistic category. Instead, prosody involves both manual and non-manual signals, and, conversely, both manual and non-manual signals serve other components of the grammar apart from prosody.

As in any new field, the study of prosody in sign language is characterized by differences among investigators in assumptions, methods, and analyses, differences which may confuse even the savviest of scholars. Finding the common ground, identifying the differences, and, where possible, choosing between different analyses and approaches are all equally important, and it is that difficult endeavor that this chapter seeks to elucidate. Relying mainly on data from ASL and Israeli SL, these pages focus on studies that tie particular non-manual and manual articulations specifically to prosody. Section 2 deals with the division of utterances into rhythmic constituents in a prosodic hierarchy. Intonation gives added meaning to these constituents, and its temporal alignment marks constituent boundaries, as section 3 explains. The third ingredient of prosody is phrase level prominence or stress, described in section 4. Each of these sections begins with a brief description of the basic characteristics of that level of structure in spoken language, as context.

No description is without a theory behind it, and the present overview is no exception. A model of sign language prosody emerges which carves up the territory into the

three subcomponents, rhythm (or timing), intonation, and stress, and describes particular phonetic cues attributed to each of them. The general picture is this: rhythmic and temporal structure are conveyed primarily by the hands, while the equivalent of intonation is articulated primarily by the face. Prominence is one of the indicators of rhythm and, as such, also relies on features associated with the manual articulators that convey the words of the text, but it is also enhanced by leans of the body.

Not all non-manual markers are prosodic, as explained above, and several examples of non-manual articulations with different or unresolved status are noted in section 5.1. The bulk of the chapter shows ways in which sign language prosody is similar to that of spoken language. But clearly that is not the whole story, as the physical transmission systems are so different in the two modalities. The issue of the relation between the linguistic and physical systems is broached in section 5.2, where the use of visual signals with spoken language prosody is also touched upon. Section 6 is a summary and conclusion, highlighting areas for future research.

## 2. Prosodic constituents

The utterances of language are divided into constituents denoted by timing. Prosodic constituents are hierarchically organized, each with its own phonetic and phonological properties, and interacting with other components of the grammar in different ways. First, prosodic constituents in spoken language are described, followed by a characterization of their sign language counterparts.

### 2.1. Prosodic constituents in spoken language

Much of the literature on prosody in spoken language adopts a hierarchy of prosodic constituents, shown in part in example (1) (adapted from Nespor/Vogel 1986).

(1) mora > syllable > prosodic word > phonological phrase > intonational phrase > phonological utterance

There is clearly a correspondence between prosodic and syntactic constituents like syntactic phrases such as noun phrases (corresponding roughly to phonological phrases) and clauses (corresponding roughly to intonational phrases), and some theories propose that phonological and intonational phrases are projected from syntactic constituents (Selkirk 1984, 1995; Nespor/Vogel 1986). In one possible prosodic rendering of the sentence shown in example (2), adapted from a sentence in Nespor and Vogel (1986), the parenthetical sentence *it is said* forms its own intonational phrase constituent (labeled with an 'I' subscript), resulting in a sentence with two major breaks separating three intonational phrases, (a) *The giant panda*, (b) *it is said*, and (c) *eats only bamboo in its natural habitat.* The last intonational phrase is divided into two less salient but still discrete constituents called phonological phrases (labeled with a 'P' subscript), *eats only bamboo* (a verb phrase), and *in its natural habitat* (a prepositional

phrase). In this example, each prosodic constituent corresponds to a syntactic constituent.

(2) [[The giant panda]$_P$]$_I$ [[it is said]$_P$]$_I$ [[eats only bamboo]$_P$] [in its natural habitat]$_P$]$_I$

Prosodic phrasing can vary and undergo restructuring, depending on such factors as rate of speech, size of constituent (Nespor/Vogel 1986), and semantic reasons related to interpretation (Gussenhoven 2004). For these and other reasons, prosodic and syntactic constituents are not always isomorphic − they don't always match up (Bolinger 1989). Example (3) shows the syntactic constituency of part of the children's story *The House that Jack Built*, and (4) shows that the prosodic constituent structure is different.

(3) *syntactic constituents:* This is [the cat that ate [the rat that ate [the cheese…

(4) *prosodic constituents:* This is the cat [that ate the rat [that ate the cheese…

We see such mismatches at the level of the word as well. In the sentence, *Robbie's been getting on my nerves*, *Robbie's* is one prosodic word (also called a phonological word) organized around a single main word stress, but two morphosyntactic words, *Robbie* and *is*. The fact that prosody and (morpho)syntax are not isomorphic motivates the claim that prosody is a separate component of the grammar. Specific arguments against subsuming particular intonational markers within the syntactic component are offered in Sandler and Lillo-Martin (2006) and further developed in Sandler (2011).

There is evidence in the literature for the integrity of each of the constituents in the hierarchy. Apart from phonetic cues associated with them, certain phonological rules require particular constituents as their domain. We will look at only one example of a rule of this sort in spoken language, at the level of the phonological phrase constituent (also called the intermediate phrase). The boundary of this constituent may be marked phonetically by timing cues such as added duration, sometimes a brief pause, and a boundary tone. The example, French liaison, occurs within phonological phrases but not across phonological phrase boundaries (Selkirk 1984; Nespor/Vogel 1986). The [s] in *les* and the [t] in *sont* are pronounced when followed by a word beginning with a vowel in the same phonological phrase (indicated by carats in (5)), but the [s] in *allés* is not pronounced, though followed by a word consisting of a vowel, because it is blocked by a phonological phrase boundary (indicated by a double slash).

(5) [Les^enfants]$_P$ [sont^allés]$_P$ // à l'école. [French]
'The children went to school.'

By respecting the phonological phrase boundary, such processes contribute to the temporal patterns of speech, and provide evidence for the existence of the prosodic category 'phonological phrase' within the prosodic hierarchy. Other rules respect prosodic constituent boundaries at different levels of the hierarchy, such as the intonational phrase or the phonological utterance (Nespor/Vogel 1986).

Some clarification of the role that such processes take in our understanding of prosody is called for. The prosodic constituents are determined on the basis of their syntactic and/or semantic coherence together with the phonetic marking typically

found at the relevant level of structure. Certain postlexical phonological processes, such as liaison and assimilations across word boundaries, may apply within a domain so determined. That is, their application is restricted by the domain boundary – they do not cross the boundary. Such processes, which may be optional, are not treated as markers of the boundary – it is phonetic cues such as phrase-final lengthening and unmarked prominence patterns that have that role. Rather, the spreading/assimilation rules are seen as providing further evidence for the existence of the boundaries, which themselves are determined on independent grounds.

In sum, prosodic constituents are related to syntactic ones but are not always coextensive with them; they are marked by particular phonetic cues; and their boundaries may form the domain of phonological rules, such as assimilation (external sandhi).

## 2.2. Prosodic constituents in sign language

Much has been written about the sign language syllable; suffice it to say that there is such a thing, and that it is characterized by a single movement or more than one type of movement occurring simultaneously (Coulter 1978; Liddell/Johnson 1989; Sandler 1989, 2012; Brentari 1990, 1998; Perlmutter 1992; Wilbur 1993, 2011 and chapter 3, Phonology). This movement can be a movement of the hand from one place to another, movement of the fingers, movement at the wrist, or some simultaneous combination of these. The words of sign language are typically monosyllabic (see Sandler/Lillo-Martin 2006, chapter 14 and references cited there). However, the word and the syllable are distinguishable; novel compounds are disyllabic words, for example. But when two words are joined, through lexicalization of compounds or cliticization, they may reduce to the optimal monosyllabic form (Sandler 1993, 1999). In other words, signs prefer to be monosyllabic.

Figure 4.1 shows how Israeli SL pronouns may cliticize to preceding hosts at the ends of phrases, merging two morphosyntactic words, each a separate syllable in citation form, to a single syllable. Under this type of cliticization, called coalescence (Sandler 1999a), the non-dominant hand articulates only the monosyllabic host sign, SHOP, while the dominant hand simultaneously articulates the host and clitic in reduced form (SHOP-THERE), superimposed on the same syllable. This is a type of non-isomorphism between morphosyntactic and prosodic structure: two lexical words form one prosodic word. It is comparable to *Robbie is* → *Robbie's* in English.

A study of the prosodic phonology of Israeli Sign Language found evidence for phonological and intonational phrases in that language (Nespor/Sandler 1999; Sandler 1999b, 2006). Phonological phrases are identified in this treatment on syntactic and phonetic grounds. Phonetically, the final boundary of a phonological phrase is characterized by hold or reiteration of the last sign in the phrase or pause after it. An optional phonological process affecting the non-dominant hand provides evidence for the phonological phrase constituent. The process is a spreading rule, called Non-dominant Hand Spread (NHS), which may be triggered by two-handed signs. In this process, the non-dominant hand, configured and orientedas in the triggering sign, is present (though static) in the signing signal while the dominant hand signs the rest of the signs in the phrase.

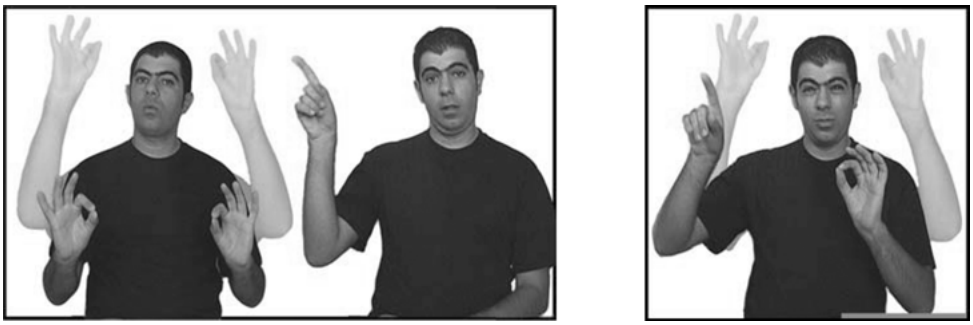

Fig. 4.1: Citation forms of SHOP, THERE, and the cliticized form SHOP-THERE

The domain of the rule is the phonological phrase: if the process occurs, the spread stops at the phonological phrase boundary, like liaison in French. Spreading of the non-dominant hand was first noted by Liddell and Johnson (1986) in their treatment of ASL compounds, and this spreading occurs in Israeli SL compounds uttered in isolation as well. However, since compounds in isolation always comprise their own phonological phrases, a simpler analysis (if ASL is like Israeli SL in this regard) is that NHS is a post-lexical phonological process whose domain is the phonological phrase.

Unlike French liaison, this rule does not involve sequential segments. Rather, the spread of the non-dominant hand from the triggering two-handed sign is simultaneous with the signing of other words by the dominant hand. Figure 4.2 illustrates NHS in a sentence meaning, 'I told him to bake a tasty cake, one for me and one for my sister'. Its division into phonological and intonational phrases is as follows: [[INDEX$_1$ TELL-HIM]$_P$ [BAKE CAKE]$_P$ [TASTY]$_P$]$_I$ [[ONE FOR-ME]$_P$ [ONE FOR-SISTER]$_P$]$_I$. In this sentence, the configuration and location of the non-dominant hand from the sign BAKE spreads to the end of the phonological phrase by remaining in the same configuration as in the source sign, BAKE, throughout the next sign, CAKE, which is a one-handed sign. The end of the phonological phrase is marked by a hold − holding the hand in position at the end of the last sign. The signs on either side of this boundary, HIM and TASTY (not shown here) are not affected by NHS.

[BAKE CAKE]$_P$

Fig. 4.2: Non-dominant Hand Spread from BAKE to CAKE in the same phonological phrase

Similar but not identical spreading behavior is described in ASL (Brentari/Crossley 2002). As that study was based on somewhat different definitions and assumptions, and used different methodology from the one described here, the results are difficult to compare at this point. However, like the Nespor and Sandler study, the ASL study does show spreading of the non-dominant hand beyond the domain of compound words. Explorations of the role of the non-dominant hand in prosody are found in Sandler (2006, 2012) and in Crasborn (2011).

The next constituent in the hierarchy is the intonational phrase, marked by a salient break that delineates certain syntactically coherent elements, such as (fronted) topics, extraposed elements, non-restrictive relative clauses, the two clauses of conditional sentences, and parentheticals (Nespor/Vogel 1986). This prosodic constituent achieves its salience from a number of phonetic cues (on ASL, see Wilbur 2000 and references cited there). In Israeli SL, in addition to the phonetic cues contributed by the boundary of the nested phonological phrase, intonational phrase boundaries are marked by change in the position of the head or body, and a change across the board in all elements of facial expression. An example is provided in section 3, Figures 4.3 and 4.4. The juncture between intonational phrases in both ASL (Baker/Padden 1978; Wilbur 1994) and Israeli SL (Nespor/Sandler 1999) is often punctuated by an eyeblink.

The whole body participates in the phonetic realization of sign language prosody. In her study of early and late learners of Swiss German Sign Language (SGSL), Boyes-Braem (1999) found that both groups tend to evenly match the temporal duration of two related constituents, while only the early learners produce rhythmic body sways which mark larger chunks of discourse of particular types. The particular characteristics and appearance of this body sway may be specific to SGSL. A recent study of prosody in BSL also documents a higher level of prosodic structure above the intonational phrase, and tests its perception experimentally (Fenlon 2010).

The validity of hierarchically organized prosodic constituents in a sign language is lent credence by an early study of pauses in ASL (Grosjean/Lane 1977). The researchers found highly significant differences in the length of pauses (for them, pauses are holds in final position), depending on the level of the constituents separated by them: between sentences > between conjoined clauses > between NPs and VPs > and within NPs or VPs.

## 3. Intonation

The intonational phrase is so named because it is the domain of the most salient pitch excursions of spoken language intonation. Let us see what this means in spoken language, and examine more closely its sign language equivalent: the intonation of the face.

### 3.1. Intonation in spoken language

Intonation can express a rich and subtle mélange of meanings in our utterances. Nuances of meaning such as additive, selective, routine, vocative, scathing, and many others

have been attributed to particular pitch contours or tunes, and the timing of these contours can also influence the interpretation (Gussenhoven 1984, 2004). Example (6) demonstrates how different intonational patterns can yield different interpretations of a sentence (from Pierrehumbert/Hirschberg 1990). In the notation used in this example, H and L stand for high and low tones, the asterisk means that the tone is accented, and the percent symbol indicates the end of an Intonational Phrase. These examples are distinguished by two tonal contrasts: the low tone on *apple* in example (a) versus the high tone on *apple* in (b); and the intermediate high tone before the disjunction *or* in (b), where there is no intermediate tone in (a).

(6) a. Do you want an apple or banana cake (an apple cake or a banana cake)
**L* H* L L%**

b. Do you want an apple or banana cake (fruit or cake)
**H* H H* L L%**

The examples illustrate a number of characteristics of prosody in spoken language. First, we see here that part of the meaning of the utterance is conveyed by the intonation and the way it aligns with the text. Second, at the phonological level, the atoms of the intonational system are just two tones, L (low) and H (high), which, accented or not accented, combine in different ways to form all the tunes of any language (Pierrehumbert 1980). Third, we see that pitch accents (asterisked) are assigned to prominent elements within a prosodic constituent, and that intonational contours, made up of several tones including a pitch accent and constituent boundary tones, like H* L L% shown here, tend to cluster at the edges of prosodic constituents. Since prosodic structure is hierarchical and constituents are nested in larger constituents, the combined tone patterns of phonological and intonational phrases produce the most salient excursions at the Intonational Phrase boundary.

Pierrehumbert and Hirschberg argue that intonation is componentially structured – that particular meanings or pragmatic functions are associated with individual tones, and putting them together produces a combined meaning (see also Hayes/Lahiri 1991). We will see that this componentiality characterizes sign language intonation as well.

Apart from favoring alignment with prosodic over syntactic constituents, a different kind of non-isomorphism between syntax and prosody is revealed by intonation. While certain tunes are typically identified with particular syntactic structures, pragmatic context such as shared knowledge, expectation, or uncertainty often result in an atypical intonational tune. The declarative, *You're going to Poughkeepsie,* can get a questioning, incredulous intonation, *You're going to Poughkeepsie?(!)* if the announcement of such a journey was unexpected. The reverse is also possible, as in rhetorical questions, which have the syntactic form of questions but declarative intonation. Intonation, then, expresses meaning, often determined by pragmatics. It can convey illocutionary force (marking declarative, interrogative, or vocative expressions, for example), and other discourse meanings like shared or expected information. Intonation can also mark emotional affect, in a system that has been termed paralinguistic (Ladd 1996).

## 3.2. Intonation in sign language

The idea that facial expression and certain other non-manual markers function in sign language like intonation in spoken languages has been in the air for a long time (e.g.,

Baker/Padden 1978; Reilly/McIntire/Bellugi 1990). On this intonation view, the facial pattern occurring on an utterance is predicted by semantic and pragmatic factors such as illocutionary force and other discourse relevant markers and relations, to which we will return shortly. Other researchers, following Liddell's (1980) early work on syntax, treat these markers as explicitly syntactic elements that necessarily occur on structures defined syntactically (and not pragmatically or semantically), structures such as yes-no questions, wh-questions, topics, relative clauses (e.g., Petronio/Lillo-Martin 1997; Neidle et al. 2000), and even non-wh A-bar positions (Wilbur/Patschke 1999). There is a tension between these two possibilities that has only recently begun to be addressed. The two views can be evaluated by investigating whether it is syntactic structure that makes the best predictions about the specification and distribution of the relevant markers, or whether they are best predicted by pragmatic/semantic factors. Proponents of the latter view argue that particular markers, such as furrowed brows on wh-questions, cannot be considered part of the syntactic component in sign languages. Here, only the pragmatic/semantic view is elaborated. See Sandler and Lillo-Martin (2006, chapters 15 and 23) and Sandler (2011b) for detailed discussion of the two perspectives, and Wilbur (2009) for an opposing view.

The motivations for viewing facial expression in particular as comparable to intonation in spoken language are shown in (7):

(7) Facial expression as intonation
   (a) It fulfills many of the same pragmatic functions as vocal intonation, such as cuing different types of questions, continuation from one constituent to another, and shared information.
   (b) It is temporally aligned with prosodic constituents, in particular with intonational phrases.
   (c) It can be dissociated from syntactic properties of the text.

In their paper about the acquisition of conditional sentences in ASL, Reilly, McIntire, and Bellugi (1990) explain that the following string has two possible meanings, disambiguated by particular non-manual markers: YOU INSULT JANE, GEORGE ANGRY. With neutral non-manuals, it means 'You insulted Jane and George got angry'. But the string has the conditional meaning 'If you insult Jane, George will be angry' when the first clause is characterized by the following markers: raised brows and head tilt throughout the clause, with head thrust at its close and blink at the juncture between the two clauses. There is an optional sign for IF in ASL, but in this string, only prosody marks the conditional. It is not unusual for conditionals to be marked by intonation alone even in spoken languages. While English conditionals tend to have *if* in the first clause, conditionals may be expressed syntactically as coordinated clauses (with *and*) in that language – *You walk out that door now and we're through* – or with no syntactic clue at all and only intonation – *He overcooks the steak, he's finished in this restaurant.*

The description by Reilly and colleagues clearly brings together the elements of prosody by describing the facial expression and head position over the 'if' clause, as well as the prosodic markers at the boundary between the two phrases. The facial expression here is raised brows, compatible with Liddell's (1980) observation that markers of constituents such as these occur on the upper face, which he associates with particular types of syntactic constituents. He distinguished these from articulations of

the lower face, which have adverbial or adjectival meanings, such as 'with relaxation and enjoyment', to which we return in section 5.1.

The Israeli Sign Language prosody study investigates the temporal alignment of intonational articulations with the temporal and other markers that set off prosodic constituents. As explained in section 2.2. and illustrated in Figures 4.4 and 4.5 below, in the sentences elicited for that study, all face articulations typically change at the boundary between intonational phrases, and a change in head or body position also occurs there.

There is a notable difference between the two modalities in the temporal distribution of intonation. Unlike intonational tunes of spoken language, which occur in a sequence on individual syllables of stressed words and at prosodic constituent boundaries, the facial intonation markers of sign language co-occur simultaneously and typically span the entire prosodic constituent. The commonality between the two modalities is this: in both, the most salient intonational arrays are aligned with prosodic boundaries.

Liddell's early work on non-manuals described configurations involving certain articulations, such as brow raise and head tilt, in a variety of different sentence types, as noted above. Is it a coincidence that the same individual articulations show up in different configurations? Later studies show that it is not. In an ASL study, forward head or body leans are found to denote inclusion/involvement and affirmation, while leans backward signify exclusion/non-involvement and negation (Wilbur/Patschke 1998). In Israeli SL, the meanings of individual facial expressions are shown to combine to create more complex expressions with complex meanings. For example, a combination of the raised brows of yes/no questions and the squint of 'shared information' is found on yes/no questions about shared information, such as *Have you seen that movie we were talking about?* (Nespor/Sandler 1999). Similarly, the furrowed brow of wh-questions combines with the shared information squint in wh-questions about shared information, such as *Where is that apartment we saw together?* (Sandler 1999b, 2003). Each of the components, furrowed brow, brow raise, and squint, pictured in Figure 4.3, contributes its own meaning to the complex whole in a componential system (cf. also chapter 14 on sentence types, chapter 15 on negation and chapter 21 on information structure).

A semantic/pragmatic explanation for facts such as these, one that links the meanings or pragmatic intents of different constituents characterized by a particular facial

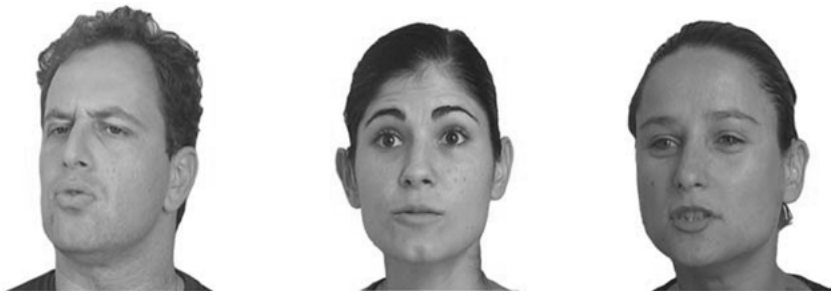

Fig. 4.3: Three common intonational facial elements: (a) furrowed brow (from a typical wh-question), (b) brow raise (from a typical yes/no question), and (c) squint (from a typical 'shared information' context).

expression, was first proposed by Coulter (1979). This line of reasoning is developed in detail for two Israeli SL intonational articulations, brow raise and squint (Dachkovsky 2005, 2008; Dachkovsky/Sandler 2009). Brow raise conveys a general meaning of dependency and/or continuation, much like high tone in spoken language. In questions, the continuation marked by brow raise leads to the answer, to be contributed by the addressee. In conditionals, the continuation marked by brow raise leads from the *if* clause to the consequent clause. Brow raise characterizes both yes/no questions and conditionals in many sign languages. The facial action squint, common in Israeli SL but not widely reported in other sign languages so far, instructs the interlocutor to retrieve information that is shared but not readily accessible. It occurs on topics, relative clauses, and other structures. Put together with a brow raise in conditionals, the squint conveys a meaning of an outcome that is not readily accessible because it is not realized − a counterfactual conditional.

The occurrence of the combined expression, brow raise and squint, is reliable in Israeli SL counterfactual conditionals (95% of the 39 counterfactual conditionals elicited from five native Israeli SL subjects in the Dachkovsky study). An example is, *If the goalkeeper had caught the ball, they would have won the game.* This sentence is divided into two intonational phrases. Figure 4.4 shows the whole utterance, and Figure 4.5 is a close-up, showing the change of facial expression and head position on the last sign of the first intonational phrase and the first sign of the second. Crucially, the release or change of face and body actions occurs at the phrase boundary.

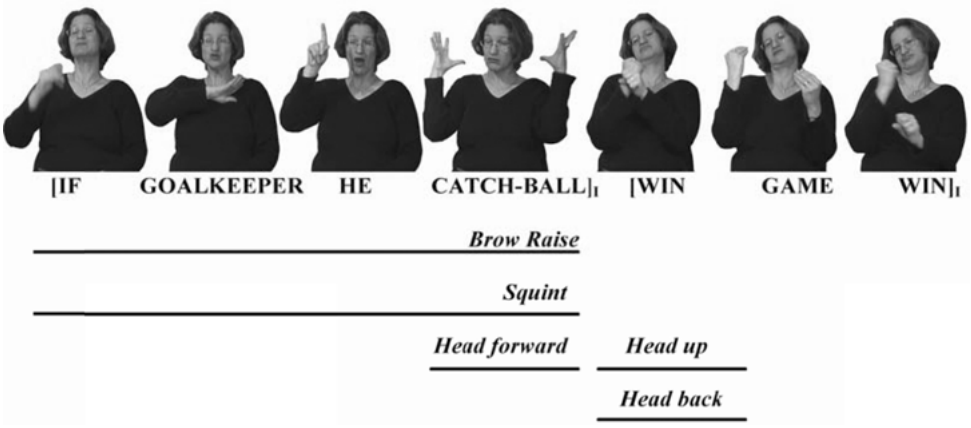


Fig. 4.4: Counterfactual conditional sentence with partial coding (from Dachkovsky/Sandler 2009)

A neutral conditional facial expression, extracted from the sentence, *If he invites me to the party, I will go,* characterized by brow raise without squint, is shown in Figure 4.6 for comparison.

In addition to non-isomorphism between morphosyntactic and prosodic constituency, demonstrated for Israeli SL in section 2.2, non-isomorphism is also found between syntactic structure and intonational meaning. For example, while wh-questions typically occur with the furrowed brow facial expression shown in Figure 4.3, present

Fig. 4.5: Intonational phrase boundary

Fig. 4.6: Neutral conditional facial expression

in 92% of the wh-questions in the Dachkovsky (2005) study, other expressions are also possible. Figure 4.7 shows a wh-question uttered in the following context: You went to a party in Haifa and saw your friend Yoni there. If you had known he was going, you would have asked for a ride. The question you ask him is, "Why didn't you tell me you were going to the party?" – syntactically a wh-question. As in spoken language, intonation can convey something about the (pragmatic) assumptions and the (emotional) attitude of the speaker/signer that cannot be predicted by the syntax. Here we do not see the furrowed brow (Figure 4.3a) typical of wh-questions. Instead, we see an expression that may be attributed to affect. As in spoken intonation (Ladd 1996), paralinguistic and linguistic intonation are cued by the same articulators, and distinguishing them is not always easy. See de Vos, van der Kooij, and Crasborn (2009) for a discussion of the interaction between affective and linguistic intonation in Sign Language of the Netherlands (NGT).

In sum, facial expression serves the semantic/pragmatic functions of intonation in sign language; it is componentially structured; and the temporal distribution of linguistic facial intonation is determined by prosodic constituency.

Fig. 4.7: Atypical facial expression on a wh-question

## 4. Prominence

In addition to timing and intonation, prominence or stress is important to the interpretation of utterances. The sentences in (9) are distinguished only by where the prominence is placed:

(9) a. Ron called Jeff an intellectual, and then he **insulted** him.
b. Ron called Jeff an intellectual, and then **he** insulted **him**.

It is the pattern of prominence that tells us whether calling someone an intellectual is an insult and it also tells us who insulted whom.

### 4.1. Prominence in spoken language

Typically, languages have default prominence patterns that place prominence either toward the beginning or toward the end of prosodic constituents, depending on the word order properties of the language, according to Nespor and Vogel (1982). In English, a head-complement language, the prominence is normally at the end: *John gave a gift to **Mary***. English is a 'plastic' intonation language (Vallduví 1992), allowing prominence to be placed on different constituents if they are focused or stressed, as (9) showed. The stress placement on each of the following sentences indicates that each is an answer to a different question: *John gave a gift to **Mary*** (either default or with *Mary* focused), *John gave a **gift** to Mary, John **gave** a gift to Mary,* or ***John** gave a gift to Mary.* The stress system of other languages, such as Catalan, is not plastic; instead of roaming freely, the focused words move into the prominent position of the phrase, which remains constant.

### 4.2. Prominence in sign language

How do sign languages mark prominence? In the Israeli SL prosody study, the manual cues of pause, hold, or reiteration and increased duration and size (displacement) con-

sistently fall on the final sign in the intonational phrases of isolated sentences, and the authors interpret these as markers of the default phrase-final prominence in Israeli SL. As Israeli SL appears to be a head-complement language, this prominence pattern is the predicted one.

A study of ASL using 3-D motion detection technology for measuring manual behavior determined that default prominence in ASL also falls at the ends of prosodic constituents (Wilbur 1999). That study attempted to tease apart the effects of phrase position from those of stress, and revealed that increased duration, peak velocity, and displacement are found in final position, but that peak velocity alone correlates with stress in that language. The author tried to dissociate stress from phrase-final prominence using some admittedly unusual (though not ungrammatical) elicited sentences. When stress was manipulated away from final position in this way, measurements indicated that added duration still always occurred only phrase-finally, suggesting that duration is a function of phrase position and not of stress. The author reports further that ASL is a non-plastic intonation language, in which prominence does not tend to move to focus particular parts of an utterance; instead the words or phrases typically move into the final prominent position of the phrase or utterance.

Certain non-manual cues also play a role in marking prominence. Contrastive stress in ASL is marked by body leans (Wilbur/Patschke 1998). In their study of focus in NGT, van der Kooij, Crasborn, and Emmerik (2006) also found that signers use leans (of the head, the body, or both) to mark contrastive stress, but that there is a tendency to lean sideways rather than backward and forward in that language. The authors point out that not only notions such as involvement and negation (Wilbur/Patschke 1998) affect the direction of body leans in NGT. Pragmatic aspects of inter-signer interaction, such as the direction in which the interlocutor leaned in the preceding utterance, must also be taken into account in interpreting leans. Signers tend to lean the opposite way from that of their addressee in the context-framing utterance, regardless of the semantic content of the utterance, i.e., positive or negative. Just as pragmatic considerations underlie prosodic marking of information that is old, new, or shared among interlocutors, other pragmatic factors such as the inter-signer interaction described in the NGT study must surely play a role in sign language prosody in general.

## 5. Residual issues

Two additional issues naturally emerge from this discussion, raised here both for completeness and as context for future research. The first is the issue of the inventory of phonetic cues in the sign language prosodic system, and the second is the role of modality on prosody. Since the physical system of sign language transmission is so different from that of spoken language, the first problem for sign language researchers is to determine which phonetic cues are prosodic. This chapter attempts to make a clear distinction between the terms, *non-manuals* and *prosodic markers*. The two are not synonymous. For one thing, the hands are very much involved in prosody, as we have seen. For another, not all non-manual markers are prosodic. Just as manual articulations encode many grammatical functions, so too do non-manual articulations. This means that neither 'manuals' nor 'non-manuals' constitutes a natural class in the gram-

mar. Discussion of how the articulatory space is divided up among different linguistic systems in 5.1 underscores the physical differences between the channels of transmission for prosody in spoken and sign languages, which brings us to the second issue, in 5.2, the influence of modality on the form and organization of prosody.

## 5.1. Not all non-manual articulations are prosodic

Physical properties alone cannot distinguish prosodic units from other kinds of elements in language. In spoken language, duration marks prosodic constituent boundaries but can also make a phonemic contrast in some languages. Tones are the stuff of which intonation is made, but in many languages, tone is also a contrastive lexical feature. Word level stress is different from phrase level prominence. In order to determine to which component of the grammar a given articulation belongs, we must look to function and distribution.

In sign language too, activation of the same articulator may serve a variety of grammatical functions (see also Pfau/Quer (2010) for discussion of the roles of non-manual markers). Not all manual actions are lexical, and not all non-manual articulations are prosodic. A useful working assumption is that a cue is prosodic if it corresponds to the *functions* of prosodic cues known from spoken language, sketched briefly in sections 2.1, 3.1, and 4.1. A further test is whether the *distribution* of the cue in question is determined by the domain of prosodic constituents, where these can be distinguished from morpho-syntactic constituents.

It is clear that the main function of the hands in sign languages is to articulate the lexical content, to pronounce the words. But we have seen here that as articulators they also participate in the prosodic system, by modulating their behavior in accordance with the temporal and stress patterns of utterances. Different phonological processes involving the non-dominant hand observe prosodic constituent boundaries at the prosodic word and phonological phrase level, though in the lexicon, the non-dominant hand is simply part of the phonological specification of a sign. The head and body perform the prosodic functions of delineating constituency and marking prominence, but they are also active in the syntax, in their role as a logophoric pronoun expressing point of view (Lillo-Martin 1995).

Similarly, while articulations that are not manual − movements of the face, head, and body − often play an important role in prosody, not all non-manual articulations are prosodic. We will first consider two types of facial action, one of which may not be prosodic at all, while the other, though prosodic, is not part of the grammar; it is paralinguistic. We then turn to actions of the head and eyes.

Actions of the lower face convey adverbial or adjectival meaning in ASL (Liddell 1980), Israeli SL (Meir/Sandler 2008), and other sign languages. As a group, these may differ semantically and semiotically from the actions of the upper face attributed to intonation, and the way in which they align temporally with syntactic or prosodic constituents has yet to be investigated. A range of other articulations are made by the mouth. Borrowed mouthing from spoken language that accompanies signing may respect the boundaries of the prosodic word in Israeli SL (Sandler 1999), similarly to the way in which spread of the non-dominant hand respects phonological phrase boundaries. But we do not yet have a clear picture of the range and distribution of mouth

action with respect to prosodic constituents of sign languages generally (see Boyes-Braem/Sutton-Spence 2001).

Another type of facial action is affective or emotional facial expression. This system uses (some of) the same articulators as linguistic facial expression, but has different properties in terms of temporal distribution, number of articulators involved, and pragmatic function (Baker-Shenk 1983; Dachkovsky 2005, 2010; de Vos/van der Kooij/Crasborn 2009). It appears that some intonational facial configurations are affective, and not part of the linguistic grammar, as is the case in spoken language (Ladd 1996).

Negative headshake is an example of a specific non-manual action whose role in the grammar is not yet fully determined (cf. chapter 15 on negation). Sometimes attributed to prosody or intonation, this element is at least sometimes a non-linguistic gesture, as it is for hearing speakers in the ambient culture. It may occur without any signs, but it may also negate an utterance without a negative manual sign. A comparative study of negation in German Sign Language and Catalan Sign Language indicates that the distribution of the headshake varies from sign language to sign language (Pfau/Quer 2007). The authors assume that the signal is part of the syntax. It is not yet clear whether this signal has prosodic properties – or even whether it belongs to the same grammatical component in different sign languages.

Eye gaze is also non-manual, but may not participate in the prosodic system. In Israeli SL, we have found that this element does not perform any expressly prosodic function, nor does it line up reliably with prosodic constituency. Researchers have argued that gaze may perform non-linguistic functions such as turn-taking (Baker 1977) or pointing (Sandler/Lillo-Martin 2006) and/or syntactic functions related to agreement (see Neidle et al. (2000) and Thompson et al. (2006) for opposing views of gaze as agreement, the latter an eye tracking study). The eyebrows and the upper and lower eyelids participate in prosody, but the eyeballs have something else in mind.

## 5.2. Prosody in sign and spoken language

Sign language has more articulators to work with, and it seems to utilize all of them in prosody. The brows, upper and lower eyelids, head and body position, timing and prominence properties conveyed by the hands, and even the dual articulator, the non-dominant hand, all participate. The availability of many independent articulators conspires with the capacities of the visual system to create a signal with a good deal of simultaneous information. Prosody in spoken language also involves a more simultaneous layering of information than other aspects of language in that modality (hence the term 'suprasegmental'), yet it is still quite different in physical organization than that of sign language.

Pitch contours of spoken intonation are transmitted by the same conduit as the words of the text – vocal cord vibration. In sign language, intonation is carried by articulations of the upper face while the text is conveyed by the hands. In addition, the upper face has different articulators which may also move independently. This independence of the articulators has one obvious result: different intonational 'tones' (such as brow raise and squint) can co-occur with one another in a simultaneous array together with the whole constituent with which it is associated. Intonation in spoken language is conveyed by a linear sequence of tones, most of which congregate at the

boundaries of intonational phrases. Do differences such as these result in greater flexibility and range of expression in sign language prosody? Do they influence the grammatical organization of the system? These are intriguing questions for future research.

Also of interest is the use of facial signals by speakers, for example, of raised brows to mark prominence (Swerts/Krahmer 2009), and of raised brows and head tilt to accompany questions (Srinivastan/Massaro 2003). In fact, there is experimental evidence that the upper face has a special role in the visual prosody accompanying spoken language, as it does in sign language (Swerts/Krahmer 2008). In sign languages, intonation and prosodic constituency are systematically marked, and constitute a linguistic system. Since it is possible to transmit spoken language effectively without visual cues (on the telephone, to blind people, or in the dark), it is reasonable to surmise that the visual prosody of spoken language is augmentative and paralinguistic. However, empirical comparison of the patterning and role of visual prosody in sign and spoken language has not yet been attempted.

## 6. Conclusion

Sign languages have rich prosodic systems, exploiting phonetic possibilities afforded by their articulators: the face, the hands, the head, and the torso. Each of these articulators participates in other grammatical components, and their prosodic status is identified on semantic/pragmatic grounds as well as by the nature of the constituents with which they are temporally aligned. Utterances are divided into constituents, marked mainly by the action of the hands, and are modulated by intonation-like articulations, expressed mainly by the face. The prosodic system is nonisomorphic with syntax, although it interacts with that level of structure, as it does with the phonological level, in the form of rules such as Non-dominant Hand Spread.

The field is young, and much territory is uncharted. Some controversies are not yet resolved, many of the facts are not yet known or confirmed, and the prosody of many sign languages has not been studied at all. Similiarly, all is far from settled in spoken language research on prosody. Interesting theoretical issues that are the subject matter of current prosodic research are waiting to be addressed in sign language inquiries too − issues related to the nature and organization of the prosodic system, as well as its interaction with syntax and other components of the grammar.

A key question for future research follows from the non-trivial differences in the physical form of prosody in the spoken and sign modalities: which properties of prosody are truly universal?

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# II. Morphology

## 5. Word classes and word formation



### Abstract

*This chapter deals with three aspects of words in sign languages: (i) the special nature of the sub-lexical elements of signed words and the consequences for the relationship between words; (ii) the classification of words into word classes; and (iii) the morphological means for creating new words in the signed modality. It is shown that although almost all of the structures and phenomena discussed here occur in spoken languages as well, the visual-spatial modality has an impact on all three aspects in that sign languages may show different preferences than spoken languages. Three central morphological operations are discussed: compounding, affixation, and reduplication. Sign languages endow these operations with flavors that are available only to manual-spatial languages: the existence of two major articulators, and their ability to move in various spatial and temporal patterns. These possibilities are exploited by sign languages, resulting in strong preference for simultaneous morphological structures in both inflectional and derivational processes.*

### 1. Introduction

Words have to perform several 'jobs' in a language: they provide the users of that language with means to refer to whatever concept the users want to express, be it an entity, an idea, an event, or a property. Words also have to combine with each other to allow users to convey information: to say something about something or someone. In order to fulfill the first task, there must be ways to create new words as the need arises to refer to new concepts. Regarding the second task, when combined to form larger units, words should be able to perform different roles, such as arguments, predicates, and modifiers. Different words may be specialized for particular roles, and languages may have means for creating words for specific roles.

Sign languages are natural languages produced in a physical modality different from that of spoken languages. Both types of language have to perform the same communicative functions with the same expressive capabilities, yet the physical means available to each type of language vary greatly. Sign languages are produced by hands, body,

and face; they are transmitted through space, and perceived by the eyes. Spoken languages are produced by the speech organs, transmitted as sound waves, and are perceived by the ears. Might these disparities make any difference to the nature of the elements that make up each system? To their organization? To the processes they undergo? Focusing on words, we ask whether words, the relationship between words, and the means for creating new words are affected by the particular modality of the language (see also chapter 25 on language and modality).

This chapter deals with three aspects of words in sign languages: the special nature of the sub-lexical elements of signed words and the consequences for the relationship between words; the classification of words into word classes; and the morphological means for creating new words in the signed modality. The modality issue runs across the entire chapter. In each section, I examine the ways in which modality affects the linguistic structures and processes described.

## 2. The signed word

Sign languages have words, that is, conventionalized units of form-meaning correspondence, like spoken languages. These units have psychological reality for their users (Zeshan 2002). They are composed of sub-lexical units and are therefore characterized by duality of patterning (Stokoe 1960). They are characterized by specific phonological structures and are subject to certain phonological constraints (Sandler 1999; see chapter 3, Phonology). Sign language words are usually referred to as *signs*, and we will adopt this terminology here as well.

Obviously, signs differ from words in their physical instantiation. The physical differences result in structural differences as well. Signs are much more simultaneously organized than words (Stokoe 1960), and tend to be monosyllabic (Sandler 1999). But signs differ from words in another important respect: they are much better at iconically depicting the concepts they denote (see Taub 2001 and references cited there). Sign languages make use of this capability. The lexicons of sign languages contain many more iconic and partly iconic signs than those of spoken languages, since spoken languages are limited to acoustic iconicity. Iconicity results from the nature of the sub-lexical elements building up a sign, which in turn has an effect on how signs are related to each other.

### 2.1. The nature of sub-lexical units

One of the design features of human language is duality of patterning (Hockett 1960), the existence of two levels of combinatorial structure, one combining meaningless elements (phonemes) into meaningful elements, the other combining meaningful elements (morphemes and words) into larger meaningful units. Sign languages are also characterized by duality of patterning. Signs are not holistic units, but are made up of specific formational units − hand configuration, movement, and location (Stokoe 1960). However, these formational units are in many cases not devoid of meaning. Take the verb EAT in Israeli Sign Language (Israeli SL) and other sign languages as

well, for example. The hand assumes a particular shape (  ), moving toward the mouth from a location in front of it, and executes this movement twice. 'Eat' means "to put (food) in the mouth, chew if necessary, and swallow" (*Webster's New Word Dictionary*, Third College Edition). The sign EAT is iconic, since there is a regular mapping between its formational elements and components of its meaning: the  handshape corresponds to holding a solid object (food); the mouth corresponds to the mouth of the eater, the agent argument; the movement towards the mouth corresponds to putting the object into the mouth; and the double movement indicates a process. Many signs are only partially iconic: some formational elements correspond to meaning components, but not all. Other signs are arbitrary; none of their formational components can be said to correspond to a meaning component in any obvious way (though some researchers claim that no signs are completely arbitrary, and that the sign formational elements are always meaning-bearing, e.g., Tobin 2008). The lexicon of any sign language, then, consists of signs that are arbitrary and signs that are iconic to different degrees, yet all signs make use of the same formational elements.

Spoken language lexicons are not that different; they also have both arbitrary and non-arbitrary words. The difference between the two types of languages is in the relative proportions of the different kinds of words. In spoken languages, non-arbitrary words are quite marginal, making it possible (and convenient) to ignore them. In sign languages non-arbitrary signs constitute a substantial part of the lexicon. Boyes Braem (1986) estimates that at least a third of the lexical items of Swiss-German Sign Language are iconic. Zeshan (2000) estimates that the percentage might be even higher (at least half of the signs) for Indopakistani Sign Language (IPSL).

Iconic signs present a challenge for the traditional division between phonemes and morphemes, since the basic formational units, the phonemes of sign languages, may be meaning-bearing and not meaningless. Meaningfulness is usually regarded as the factor distinguishing phonemes from morphemes: phonemes are meaningless, while morphemes are meaningful units. Yet phonemes are also the basic building blocks of meaning bearing units in a language. But in sign languages, those basic building blocks are also meaning-bearing. Can they be regarded as morphemes, then? This would also seem problematic, since they are not composed of more basic formational elements, and the units they attach to are not words, stems, or roots, but rather other basic formational units. Johnston and Schembri (1999, 118) propose that these units function simultaneously as phonemes and morphemes, since they serve as the basic formational building blocks and at the same time as minimal meaning-bearing units. They propose the term 'phonomorphemes' to capture the nature of these basic elements. This dual nature of the basic formational units is even more evident in classifier constructions (see chapter 8 on classifiers).

## 2.2. The structure of the lexicon: sign families

Leaving theoretical issues aside, the meaningfulness of the formational building blocks of signs has consequences for the organization of the sign language lexicon. Signs that share a formational element (or elements) often also share some meaning component. For example, many signs in Israeli SL that are articulated on the temple express some kind of mental activity (KNOW, REMEMBER, LEARN, WORRY, MISS, DREAM, DAY-DREAM); signs

articulated on the chest often denote feelings (LOVE, SUFFER, HAPPY, PROUD, PITY, HEARTACHE). Many signs with a  handshape denote activities performed by the legs (JUMP, GET-UP, FALL, WALK, RUN, STROLL). Fernald and Napoli (2000) enumerate groups of signs, or sign families, in American Sign Language (ASL) that share formational elements, be it location, movement, handshape, or any combination of these. They show that the phenomenon of word families is very robust in ASL, characterizing the entire lexicon. Works on other sign languages (e.g., Brennan (1990) on British Sign Language (BSL); Johnston and Schembri (1999) on Australian Sign Language (Auslan); Meir and Sandler (2008) on Israeli SL) show that this is characteristic of other languages in the signed modality. Signs in such a 'family' are related to each other not by inflectional or derivational means, yet they are related nonetheless.

Fernald and Napoli posit a new linguistic unit, the 'ion-morph', a combination of one or more phonological features that, within a certain set of signs, has a specific meaning. Take, for example, the signs MOTHER and FATHER in ASL: they have the same movement, orientation, and handshape. They differ with respect to the location: chin for MOTHER, forehead for FATHER. Within this restricted set of signs, the combination of specific movement, orientation, and handshape have the meaning of 'parent'. The chin and the forehead, in turn, are ion-morphs denoting female and male in signs expressing kinship terms, such as SISTER-BROTHER, NIECE-NEPHEW, GRANDMOTHER-GRANDFATHER.

Fernald and Napoli (2000, 41) argue that ion-morphs are relevant not only for sign languages, but for spoken languages as well. A case in point is phonosymbolism, the ability of certain sounds or combination of sounds to carry specific 'sound images' that go with particular semantic fields, such as *fl-* representing a liquid substance in motion, as in *flow*, *flush*, *flood*, or *fluid*. Yet one can find word families even in more grammatical domains. For example, most question words in English begin with *wh-*. The labial glide carries the interrogative meaning within a specific set of words, and it may contrast with the voiced interdental fricative in pairs like '*then/when*' and '*there/where*', the latter carrying the meaning of 'definiteness', as in *the/that/this/those.*

The examples from both sign and spoken languages clearly show that there are ways other than inflection and derivation to relate words to one another. Whether these relations are morphological in nature is a difficult theoretical question, which can be conveniently set aside when dealing with spoken languages, since word families are less central to the structure of their lexicons. In sign languages, in contrast, they are an important characteristic of the lexicon. They may also play a role in creating new words (as suggested by Fernald and Napoli 2000), since language users may rely on existing ion-morphs when new lexical items are coined. Such cases again raise the question of whether or not derivational morphology is at play here.

The special nature of the sub-lexical units in signs affects the lexicon in another respect as well. When phonemes are combined to create a sign, the meaning of the resulting unit is often componential and transparent. This means that signs in the lexicon of a sign language need be less conventionalized than words of a spoken language, since their meaning can often be computed. Johnston and Schembri (1999, 126) make a distinction between *signs* and *lexemes*, the latter having a meaning "which is (a) unpredictable and/or somewhat more specific than the sign's componential meaning potential even when cited out of context, and or (b) quite unrelated to its componential meaning components (i.e., lexemes may have arbitrary links between form and meaning)." Lexemes, then, can be completely arbitrary, but more importantly, they are com-

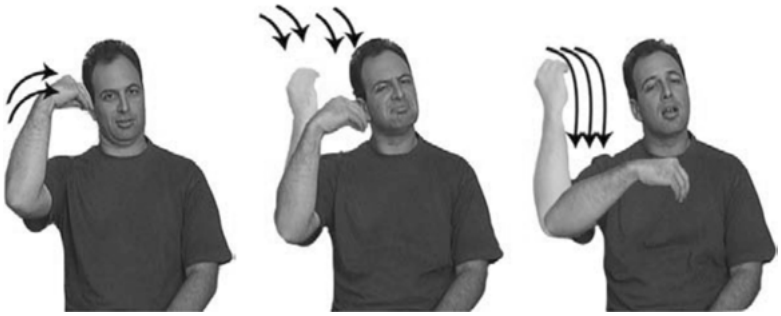
pletely conventionalized, and can therefore be thought of as stored in the lexicon of the language. Signs, in contrast, are more productive than lexemes. They can be invented 'on the spot', because of the transparency of their components, and are therefore less lexicalized and less conventionalized than lexemes. A signer, for example, can invent a sign meaning 'the three of them were walking together' by extending three fingers and moving the hand in space. Such a sign can be understood in the appropriate context even if there is no conventional sign with that meaning in the specific sign language used by the signer. Johnston and Schembri show that signs and lexemes have different phonological, morphological, and semantic characteristics, and suggest that only lexemes should be part of the lexicon. An interesting question that arises is whether signs (as opposed to lexemes) are words, and if they are, whether they form a separate word class. One specific phenomenon that has been referred to in this context is the issue of classifier constructions, whose word status is an unresolved problem in sign language literature (see chapter 8, Classifiers). Classifier constructions are often excluded from analyses of word classification because of their unclear status. We return to this issue in section 4.

The lesson to be learned from the nature of signs and their components is that the line between the lexicon and the morphological component may be less definite than is usually assumed. Having raised the problematic issues, we now turn to those that are more straightforward within the realm of morphology. We examine which morphological operations are available to sign languages, and how these operations are used to distinguish between different types of words and to create new words.

## 3. Sign language morphological processes

Morphology provides machinery for creating new words and for creating different forms of a word. The former is the realm of derivation, the latter of inflection. Derivational and inflectional processes differ in their productivity, regularity, and automaticity. Inflectional processes are regarded as regular and automatic, in that they apply to all members of a given category, while derivational processes are usually less regular and non-automatic (though, as with any linguistic categorization, this distinction is often blurred and not as dichotomous as it is presented). In spite of this functional difference, the morphological mechanisms used for both derivation and inflection are the same.

The main three morphological operations are compounding, affixation, and reduplication. Words formed by such operations are complex, in the sense that they contain additional morphological content when compared to the bases they operate on. However, morphological complexity need not coincide with added phonological complexity, since morphological operations can be sequential or simultaneous. A sequential operation adds phonological segments onto a base, suffixes (as in *bak**er***) and prefixes (as in ***un**happy*). In a simultaneous operation, meaningful units are added not by adding segments but rather by changing them. The plurality of ***fee**t*, for example, is encoded by changing the quality of the vowel of the singular form ***foo**t*. Both types of operation are found in spoken and in sign languages, but there is a difference in preference. In spoken languages, the sequential type is very common while simultaneous operations



(a) (b) (c)

Fig. 5.1: Three forms of the sign LEARN (Israeli SL): (a) base form (b) iterative (c) durational. Copyright © 2011 by Sign Language Lab, University of Haifa. Reprinted with permission.

are rarer. Sign languages, in contrast, show a marked preference towards simultaneous morphological operations. Sequential affixal morphology is very infrequent, and (apart from compounding) has been reported in only a few sign languages. This tendency towards simultaneous structuring characterizes all linguistic levels of sign languages, and has been attributed to the visuo-spatial modality (Emmorey 2002 and references cited there; Meier et al. 2002).

Sequential morphology in the signed modality is quite similar to its spoken language counterpart: elements in a sequence (words and affixes) form a complex word by virtue of being linearly concatenated to one another. The Israeli SL compound VOLUNTEER is formed by combining the two signs HEART and OFFER into a complex lexical unit. In the process, several changes, some of which are modality-driven, may take place, and these are described in section 5.1.1. But by and large, sequential operations in both modalities are quite similar.

However, when turning to simultaneous morphology, the analogy is less clear. What would simultaneous morphology look like in a sign language? Which phonological features are changed to encode morphological processes? It turns out that it is the movement component of the sign that is the onemost exploited for morphological purposes. Take for example the sign LEARN in Israeli SL (Figure 5.1). The base form has a double movement of the hand towards the temple. Several repetitions of the sign with its double movement yield an iterative meaning ‘to study again and again’. If the sign is articulated with a slower and larger single movement, repeated three times, then the verb is inflected for a continuative aspect, meaning ‘to study for a long time’.

A change in the movement pattern of a sign distinguishes nouns from formationally similar verbs in several sign languages (see section 4.4.1). Repetition of a noun sign in several locations in space denotes plurality (see chapter 6, Plurality). A change in the direction of a specific class of verbs (agreement verbs) indicates a change in the syntactic arguments of the verb in many sign languages (see chapter 7, Verb Agreement). In addition to change in movement, change in handshape with classifying verbs can also be analyzed as simultaneous inflection (and as a certain kind of verb-argument-agreement, see chapter 8, Classifiers).

Thus simultaneous morphology in sign languages is implemented by changing features of the movement of the sign, and to a lesser degree by handshape change. It is

simultaneous in the sense that it does not involve adding phonological segments. The signs ASK and QUESTION are related to each other more like the English noun-verb pair *cóntrast-contrást* than the pair *govern**ment**-govern*. Both signs consist of one syllable. They differ in the prosodic features imposed on the syllabic structure. This type of simultaneous morphology is often described as comparable to the templatic morphology characteristic of Semitic languages, where morphological distinctions are encoded by associating phonological material to different prosodic templates (Sandler 1989; Sandler/Lillo-Martin 2006).

The two types of sign language morphology are characterized by different properties (Aronoff/Meir/Sandler 2005). Sequential operations are sparse; they are arbitrary in form; the affixes are related to free forms in the language and therefore can be regarded as being made grammatical from free words; they are derivational and less regular. Simultaneous operations are numerous; many of them are productive; they are related to spatial and temporal cognition, and most of them are non-arbitrary to various degrees. They can be inflectional or derivational. It follows, then, that there is partial correlation between simultaneity vs. sequentiality and the inflection vs. derivation dichotomy: sequential processes in sign languages are derivational. Simultaneous processes can be both inflectional and derivational. Thus inflection in sign languages is confined to being simultaneously instantiated. Derivational processes not only make use of simultaneous morphology, but also take the form of sequential morphology. These differences are summarized in Table 5.1. Both morphologies play a role in distinguishing word classes in sign languages and in deriving new lexical items.

Tab. 5.1: Two types of sign-language morphology

| SIMULTANEOUS | SEQUENTIAL |
|---|---|
| – Adds morphological material by changing features of formational elements (mainly the movement component) | – Adds morphological material by adding phonological segments to a base |
| – Preferred in the sign modality | – Less preferred in the sign modality |
| – Both inflectional and derivational | – Only derivational |
| – Numerous in different sign languages | – Relatively sparse in different sign languages |
| – Motivated to various degrees, related to spatial cognition | – Tend to be more arbitrary |
| – Not grammaticized from free words | – Grammaticized from free words |

# 4. Word classes

## 4.1. Introduction

Word classes are often referred to as ‘parts of speech’, from Latin *pars orationis*, literally ‘piece of what is spoken’ or ‘segment of the speech chain’. Although the two terms

are used interchangeably in current linguistic practice (a practice which I follow in this chapter as well) it should be pointed out that, for the Greeks and Romans, the primary task was to divide the flow of speech into recognizable and repeatable pieces (hence parse). Categorizing was secondary to identification (Aronoff, p.c.). In this chapter, however, we will concern ourselves with categorization and classification.

There are various ways to classify the words of a given language. However, the term 'word classes' usually refers to classification of words according to their syntactic and morphological behavior, e.g., the ability to appear in a certain syntactic environment, to assume a specific syntactic role (argument, predicate, modifier), and to co-occur with a particular set of inflectional affixes. Many of the words belonging to the same class also share some aspect of meaning. For example, words which typically occur in argument position and take number and case inflections often denote entities, whereas words occurring in predicate position and taking tense inflection often denote events. Yet there is no full overlap between a semantically based classification and a morpho-syntactic one, making the classification of any given language challenging, and a cross-linguistic comparison even more so.

The first major division of words in the lexicon is into content words and function words. Content word classes are generally open (i.e. they have large numbers and accept new members easily and regularly) and they tend to have specific meaning, usually extra-linguistic (they are used to refer to the world or to a possible world). They tend to be fairly long, and their text frequency is rather low (Haspelmath 2001). Function words usually belong to small and closed classes. They are usually defined by their function as they do not have concrete meaning, they tend to be quite short, and their text frequency is high. A few function word classes in sign languages are explored in other chapters of this volume: pronouns (chapter 11) and auxiliary verbs (chapter 10). Other function word classes mentioned in the sign language literature are numerals (see e.g., Fuentes/Tolchinsky 2004), question words and negative words (Zeshan 2004a,b; see also chapters 14 and 15). In this chapter the focus is on content class words. Function words will be mentioned only when they are relevant for diagnosing specific content class words.

The major content word classes are nouns, verbs, adjectives, and adverbs. It is an empirical question whether this classification is universal, and whether the same set of criteria can be applied cross-linguistically to identify and define the different classes in every language. Clearly, languages vary greatly in their syntactic and morphological structures. Therefore syntactic and morphological criteria can be applied only on a language-particular basis. For a cross-linguistic study, a semantically-based classification would be much more feasible, since all languages presumably have words to refer to different concept classes such as entities, events, and properties. But, as pointed out above, semantic criteria often do not fully overlap with morpho-syntactic criteria for any particular language. The challenge, then, is to develop a set of criteria that would be descriptively adequate for particular languages, and at the same time would enable cross-linguistic comparison. As Haspelmath (2001) points out, the solution that is usually adopted (often implicitly) is to define word classes on a language-particular basis using morpho-syntactic criteria, and then use semantic criteria for labeling these classes: the word class that includes most words for things and persons is called 'noun'; the one that includes most words for actions and processes is called 'verb'; etc. It is also usually the case that the correspondences 'thing-noun' and 'action-verb' are the

unmarked extension of the respective word class. Marked extensions are often indicated by derivational affixes. This methodology implicitly assumes some kind of semantic basis for word classification, and that this basis is universal. Such assumptions should be tested by studying languages that are typologically diverse as much as possible. Sign languages, as languages produced in a different modality, constitute a very good test case.

## 4.2. Word classes in the signed modality

Sign languages, like spoken languages, have lexicons consisting of lexemes of different types that refer to different notions (entities, actions, states, properties, etc.) and combine with each other to form larger units, phrases, and sentences. However, as a group, sign languages differ from spoken languages in three major respects relevant for the present discussion. Firstly, and most obviously, they are articulated and transmitted in a different modality from spoken languages. Secondly, sign languages as a group are much younger than spoken languages. And finally, the field of sign language linguistics is young, having emerged only a few decades ago.

The modality difference raises several questions:

(i) Would languages in a different modality display different kinds of word classes? For example, would the spatial nature of sign languages give rise to a word class that denotes spatial relations?
(ii) Would iconicity play a role in differentiating between word classes?
(iii) Do languages in a different modality have different set of properties to distinguish between word classes?
(iv) Do we need to develop a totally different set of tools to categorize signs?

Sign languages as a group are also much younger than spoken languages. Spoken languages are either several millennia or several hundred years old, or they are derived from old languages. In contrast, the oldest sign languages known to us today are about 300 years old or so (for BSL, see Kyle and Woll 1985; for French Sign Language (LSF), see Fischer 2002) and some are much younger: Israeli SL is about 75 years old (Meir/Sandler 2008), and Nicaraguan Sign Language (ISN) is about 35 years old (Senghas 1995). It may very well be that sign languages existed in older times, but they left no records and therefore cannot be studied. All we know about sign languages comes from studying the sign languages available to us today, and these are young. Young spoken languages, creoles, are characterized by dearth of inflectional morphology (McWhorter 1998). Furthermore, the lexicons of both creoles and pidgins are described as consisting of many multifunctional words, that is, words used both as nouns and verbs, or nouns and adjectives. For example, *askim* in Tok Pisin can function both as a noun and as a verb (Romaine 1989, 223). As we shall see, multifunctionality is characteristic of sign languages as well. Therefore, word classification in young languages cannot rely on morphology.

These two factors, modality and young age, contribute to the fact that sign languages as a group form a distinct typological morphological type (Aronoff/Meir/Sandler 2005). As new languages they hardly have any sequential morphology. They lack nominal

inflections such as case and gender inflections. They also do not have tense inflections on verbs. These inflectional categories are key features in determining word classes in many spoken languages (though, of course, many spoken languages lack such inflectional categories, and therefore similar difficulties for word classification arise). On the other hand, as visuo-spatial languages, they are characterized by the rich spatial (simultaneous) morphology described in section 3. Can spatial modulations play a role in determining word classes as morphological inflections of spoken languages? Would they identify the same word classes found in spoken languages?

In addition to the youth of the languages, the field of sign language linguistics is also new, dating back to the early 1960s. In analyzing the linguistic structure of sign languages, sign linguists often rely on theories and methodologies developed on the basis of spoken languages. Since linguistics as a field is much older than sign linguistics, it makes sense to rely on what is known about how to study spoken languages. It also has the advantage of making it possible to compare findings in the two types of languages. However, it runs the risk of analyzing sign languages through the lens of spoken languages, and missing important phenomena if they are unique to sign languages (see, e.g., Slobin 2008 on this issue).

These three factors − modality, youth of language, and youth of field − make the study of word classes in sign languages challenging and non-trivial. Indeed systematic studies of word classification in sign languages are very few. Though terms such as *noun, verb, adjective, pronoun,* etc. are abundant in the sign language literature, there have been very few attempts at principled word classification of any studied sign language, and very few researchers explicitly state on what grounds the terms 'noun', 'verb', etc. are used. However, as the sign language linguistics field expands, more linguistic operations and structures are discovered which can be helpful in determining word classes in sign languages. We turn to look at some classifications that have been suggested, and to examine the means by which sign languages differentiate between word classes.

## 4.3. Word classifications suggested for sign languages

The earliest attempt to provide criteria for identifying word classes of a sign language lexicon is found in Padden (1988). She suggests the following criteria for identifying the three major content word classes in ASL: Nouns can be modified by quantifiers, adjectives can inflect for intensive aspect, and verbs cannot be pre-modifiers of other signs. Under this classification, nouns and verbs are defined on distributional syntactic grounds, and adjectives on morphological grounds. Notice that verbs are only defined negatively, probably because there is no inflection common to all and only verbs in the language. Also, it is not clear that this set of criteria applies to all and only the members of a certain class.

Zeshan (2000) suggests a word classification of IPSL according to the spatial characteristics of signs. One class consists of signs that cannot move in space at all, a second class consists of signs that are produced in neutral space and can be articulated in various locations in space, and the third class consists of directional signs, that is signs that move between locations in space associated with referents. The criterion of spatial behavior is clearly modality specific, since words in spoken languages do not have

spatial properties. Therefore, such an analysis, even if it provides a descriptively adequate analysis of a particular language, does not allow for cross-modality comparisons and generalizations. In addition, it is not clear whether such a classification has any syntactic and semantic corollaries within the language. For example, the class of signs that cannot move in space includes signs meaning 'understand', 'woman' and 'I' (Zeshan 2000, 58). These signs do not seem to have any semantic commonality, and it is doubtful whether they have anything in common syntactically. Therefore, the usefulness of this classification does not extend beyond a purely formational classification.

Recently, a comprehensive and methodological attempt to establish a set of criteria for defining word classes in sign languages has been posited by Schwager and Zeshan (2008). Their goal is to develop a cross-linguistically applicable methodology that would give adequate descriptive results for individual languages. They explicitly take the semantics as a starting point, since the semantic classification is cognitively-based and hence language independent. They compile a set of binary semantic features that define three basic concept classes: entity, event, and property. After assigning signs to different classes based on their semantics, Schwager and Zeshan proceed to examine how signs in each concept class map to syntactic roles and morphological operations. Four basic syntactic roles are listed: argument, predicate, argument modifier, and predicate modifier. As for morphological criteria, a list of 17 morphological processes that have been described in the sign linguistics literature is compiled. These processes are classified according to the concept classes they co-occur with.

In order to test the validity of their approach, they apply it to corpora compiled from three unrelated sign languages: German Sign Language (DGS), Russian Sign Language (RSL), and Sign Language of Desa Kolok (KK), a sign language that developed in a small village community in Bali with high incidence of hereditary deafness. Words with comparable meanings were identified and extracted from the corpora, and were analyzed according to the procedure described above. This comparison pinpoints both similarities and differences between the languages. Even at the semantic level, signs referring to similar concepts may not belong to the same concept class in the two languages. For example, the sign DEAF in DGS may refer to a person or a property, while in KK it refers only to a person. Therefore, in DGS this sign will be listed both as an entity and as a property, while in KK it is classified only as an entity. In considering the combination of concept classes with syntactic roles, some more interesting differences emerge. DGS, but not KK, has event signs that can be used in argument position. The sign WORK, for example, can be used in predicate position, but also in argument position, as in (1) (Schwager/Zeshan 2008, 534, example 26). Also, in DGS signs denoting properties can assume a modifier or a predicate position, whereas in KK they are restricted to predicate position.

(1) WORK FIND DIFFICULT#INTS(intensive) [DGS]
'It is very difficult to find a job.'

The list of morphological modulations serves as a useful tool for identifying the morphological nature of different sign languages. KK has far fewer morphological processes than DGS and RSL, especially in the event class. Of the 13 processes listed for events, KK has only 3, while DGS and RSL have 11 each. Therefore KK is much more isolating than the two other languages, and morphological operations are much less helpful in establishing word classes in this language.

These results show that, as in spoken languages, different sign languages vary in terms of their word classes. However, it might be that the variation in the signed modality is less extreme than that found among languages in the spoken modality. Further comparative studies of sign languages, and of sign vs. spoken languages, is needed to assess this intuitive observation.

One type of evidence that is not used in their analysis is distributional evidence, such as the co-occurrence of signs with certain function word classes. Distributional properties are language-specific, and hinge on identifying the relevant function words and syntactic environments for each language. Yet some cross-linguistic generalizations can be made. For examples, nouns are more likely to co-occur with pointing signs (often termed INDEX or IX), and can serve as antecedents for pronouns. Verbs are more likely to co-occur with auxiliary verbs. As I point out below, some such observations have already been made for different languages, and it is hoped that they will be incorporated in future investigations of sign language word classes.

In spite of the lack of distributional evidence, Schwager and Zeshan's analysis shows that it is possible to arrive at a systematic, theoretically sound approach to word classification in sign languages. Such an analysis provides descriptions of word classes of specific languages, but also allows for cross-linguistic and cross-modality comparisons.

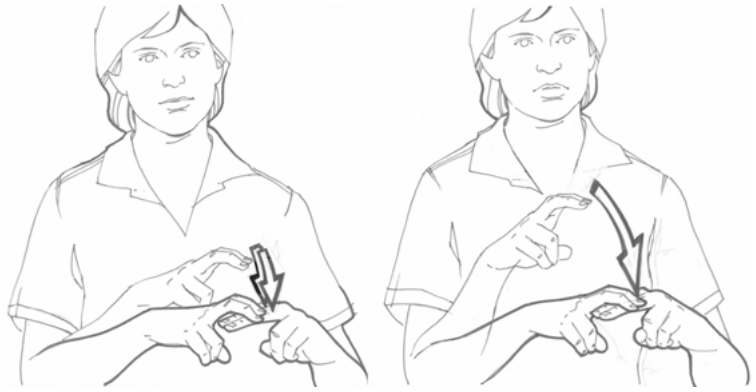
## 4.4. Means for differentiating between specific word classes

Though very few works try to establish general criteria for determining word classes of the entire lexicon of a sign language, many works target more restricted domains of the lexicon, and describe certain structures and processes that apply to specific classes or sub-parts of classes. These involve both morphological and distributional criteria.

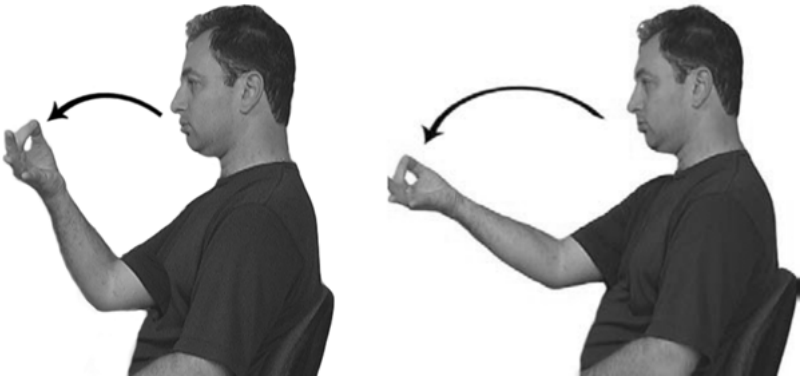
### 4.4.1. Noun-verb pairs

Descriptions of various sign languages often comment that many signs are multifunctional, and can serve both as a nominal and as a verb (denote an entity or an event). This is not surprising given the young age of sign languages, but it has also been argued to be modality driven. The following paragraph is from an introduction to the first dictionary of Israeli SL (Cohen/Namir/Schlesinger 1977, 24):

> Two concepts which in spoken language are referred to by words belonging to different parts of speech will often have the same sign in sign language. The sign for sew is also that for tailor, namely an imitation of the action of sewing ... eat and food are the same sign ... and to fish is like fisherman ... In English, as in many other languages, words of the same root belonging to different parts of speech (like 'bake' and 'baker') are often distinguished inflectionally. They are denoted by the same sign in sign language since it has neither prefixes nor suffixes. These, being non-iconic, would seem to be out of tune with a language in which many signs have some degree of transparency of meaning, and are therefore unlikely to arise spontaneously in a sign language.



a. ASL: CHAIR SIT



b. Israeli SL: QUESTION ASK

Fig. 5.2: a. ASL noun-verb pair: CHAIR-SIT; b. Israeli SL noun-verb pair: QUESTION-ASK. Figure a reprinted wth permissions from Padden (1988). Figure b Copyright © 2011 by Sign Language Lab, University of Haifa. Reprinted with permission.

Given the propensity of sign languages towards iconicity, and the non-iconicity of sequential derivational affixes, those affixes comparable to, e.g., *-tion*, *-ize*, and *-al* in English are not expected to be found in sign languages. Yet several studies of noun-verb pairs show that it is not impossible to distinguish formationally between word classes in a sign language. However, one has to know what to look for. It turns out that subtle differences in the quality of the movement component of certain signs may indicate the word class of specific signs.

The first work to show that nouns and verbs may exhibit systematic formational differences is Supalla and Newport (1978). They describe a set of 100 related noun-verb pairs, where the nouns denote an instrument, and the verb an action performed with or on that instrument, e.g., SCISSORS and CUT-WITH-SCISSORS, CHAIR and TO-SIT (see Figure 5.2a) or IRON and TO-IRON. These pairs differ systematically in the properties of

the movement component: in nouns it is reduplicated, restricted, and constrained; the movement of the related verbs is not.

Following their seminal work, similar phenomena have been attested in various sign languages. Sutton-Spence and Woll (1999, 109) report that in BSL noun-verb pairs, e.g., SERMON-PREACH, nouns have a restrained, abrupt end and verbs do not. This specific example shows that signs exhibiting this alternation are not necessarily restricted to instrument-action pairs. Similarly, in Israeli SL formationally related nouns and verbs, the verbs typically have a longer movement, as in QUESTION vs. ASK (Meir/Sandler 2008, see Figure 5.2b). In Russian Sign Language as well, qualities of the movement component were the most reliable properties distinguishing nouns from verbs (Kimmelman 2009): nouns but not verbs (in noun-verb pairs) tend to have repeated movements, and verbs tend to have wider movement amplitude than the corresponding nouns. Johnston (2001) provides an explanation for the repeated movement of nouns but not their paired verbs in Auslan. In this language, the best exemplars of the alternation are signs referring to actions which are inherently reversible, such as OPEN-SHUT (e.g., turning a knob, opening and shutting a drawer, turning a key). The signs representing these actions and entities are iconic, their direction of movement depicting the direction of the action. It is this iconicity that is the basis for the noun-verb distinction: a single movement in one of the two possible directions is interpreted as a process (one of the two possible processes), while a repeated bi-directional movement is interpreted as naming a salient participant in the action, the participant on which the action in both directions is performed (the knob, the drawer, or the key in the actions mentioned above).

The formational difference between nouns and verbs may be rooted in iconicity, as suggested by Johnston, but in some sign languages this formational difference has expanded to non-iconic cases as well, suggesting that the form is taking a life of its own. Hunger (2006) measured the duration (in terms of numbers of frames) of 15 noun-verb pairs in Austrian Sign Language (ÖGS) both in isolation and in connected speech. Her results show that verbs do indeed take twice as long to produce as nouns. Interestingly, the longer duration of verbs characterizes even verbs which are not inherently durational (e.g., BOOK-OPEN, PHOTOGRAPH, LOCK). Therefore, Hunger concludes that the longer duration of verbal signs cannot be attributed to iconicity effects. Rather, this formational difference "can be interpreted as a distinctive marker for verbal or nominal status" (p. 82).

The lesson to be learned from these studies is that word classes can be distinguished formationally in the signed modality, by recruiting the movement component of signs for the task. Although this device may be rooted in iconicity, in some languages it seems to have already extended beyond the iconically-based set of signs, and is on its way to becoming a formal morphological entity.

### 4.4.2. Inflectional modulations

One of the most commonly used criteria for determining word classes in spoken languages is morphological inflections. Inflectional affixes are very selective with respect to the lexical base they attach to (Zwicky/Pullum 1983). A group of words that take a particular inflectional affix can therefore be regarded as belonging to one class. Notice,

however, that the term 'affix', which is commonly used for a concrete sequential morpheme, can be also used to refer to a process or a change in features that is expressed simultaneously on the inflected word.

In sign languages, inflections take the form of modulations to the movement component of the sign. Numerous inflections have been described in the literature, the main ones being:

| | |
|---|---|
| *Verbs*: | (a) Encoding arguments: verb agreement; reciprocal; multiple; exhaustive. |
| | (b) Aspect: habitual; durational; continuative; iterative; protractive; delayed completive; gradual. |
| *Nouns*: | plurality. |
| *Predicative adjectives*: | pre-dispositional; susceptative; continuative; intensive; approximative; iterative; protractive. |

What all these inflections have in common is that they make use of the movement component of the sign in order to encode specific grammatical categories. For example, the intensive inflection of adjectives in Israeli SL imposes lengthening of the movement on the base sign (Sandler 1999). In ASL this inflection takes the form of increased length of time in which the hand is held static for the first and last location (Sandler 1993, 103−129). Many aspectual modulations, such as the durational and iterative, impose reduplicated circular movement on the base sign.

Most of the inflections occur on verbs and adjectives, suggesting that inflectional modulations are restricted to predicate position. Since several inflections occur on both verbs and adjectives (e.g., continuative, iterative, protractive), it may be that these inflections are diagnostic of a syntactic position more than a specific word class. This, however, should be determined on a language-specific basis.

The use of these inflections for determining word classes is somewhat problematic. Firstly, morphological classes often do not coincide with concept classes. No single morphological operation applies across the board to all members of a particular concept class. For example, Klima and Bellugi (1979) describe several adjectival inflections, but these co-occur only with adjectives denoting a transitory state. Verb agreement, which in many spoken languages serves as a clear marker of verbs, characterizes only one sub-class of verbs in sign languages, agreement verbs. Secondly, many of these operations are limited in their productivity, and it is difficult to determine whether they are derivational or inflectional (see Engberg-Pedersen 1993, 61−64, for Danish Sign Language (DSL); Johnston/Schembri 1999, 144, for Auslan). Thirdly, since all these inflections involve modulation of the movement component, sometimes their application is blocked for phonological reasons. Body anchored verbs, for instance, cannot inflect for verb agreement. Inflectional operations, then, cannot serve by themselves as diagnostics for word classes. But, as in spoken languages, they can help in establishing word classes for particular languages, with corroborative evidence from semantic, syntactic, and distributional facts.

### 4.4.3. Word-class-determining affixes

Although a language may lack formational features characterizing the part of speech of base words, it may still have certain derivational affixes that mark the resulting word

as belonging to a certain part of speech. The forms of English *chair*, *sit*, and *pretty* do not indicate that they are a noun, a verb, and an adjective respectively. But *nation*, *nationalize* and *national* are marked as such by the derivational suffixes *-tion*, *-ize*, and *-al* in their form.

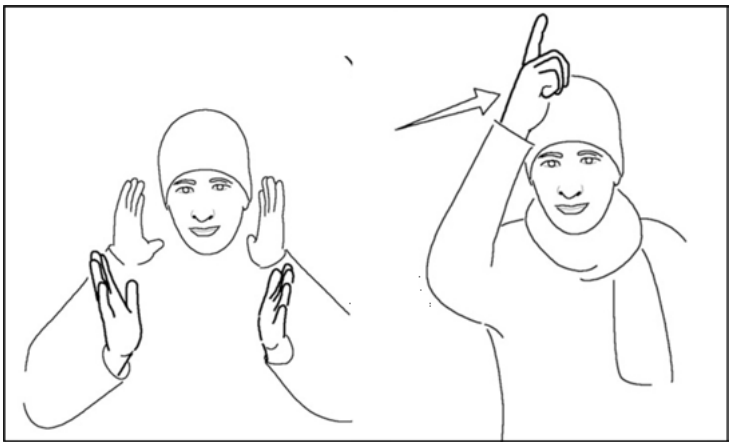
Can we find similar cases in sign languages? In general, sequential affixation is quite rare in sign languages, as discussed above. Of the descriptions of affixes found in the literature, very few refer to the part of speech of the resulting words. Two relevant affixes are described in Israeli SL, and two in Al-Sayyid Bedouin Sign Language (ABSL), a language that emerged in a Bedouin village in Israel in the past 70 years.

Aronoff, Meir and Sandler (2005) describe a class of prefixes in Israeli SL that derive verbs. This class includes signs made by pointing either to a sense organ − the eye, nose, or ear − or to the mouth or head. Many of the complex words formed with them can be glossed 'to X by seeing (eye)/hearing (ear)/thinking (head)/intuiting (nose)/saying (mouth)', e.g., EYE+CHECK 'to check something by looking at it'; NOSE+SHARP 'discern by smelling'; MOUTH+RUMORS 'to spread rumors'. But many have idiosyncratic meanings, such as NOSE+REGULAR 'get used to' and EYE+CATCH 'to catch red handed' (see Figure 5.3). Although the part of speech of the base word may vary, the resulting word is almost always used as a verb. For example, the word EYE/NOSE+SHARP means 'to discern by seeing/smelling', though SHARP by itself denotes a property. In addition to their meaning, distributional properties of these complex words also support the claim that they are verbs: they co-occur with the negative sign glossed as ZERO, which negates verbs in the language. Aronoff, Meir and Sandler conclude that the prefixes behave as verb-forming morphemes.

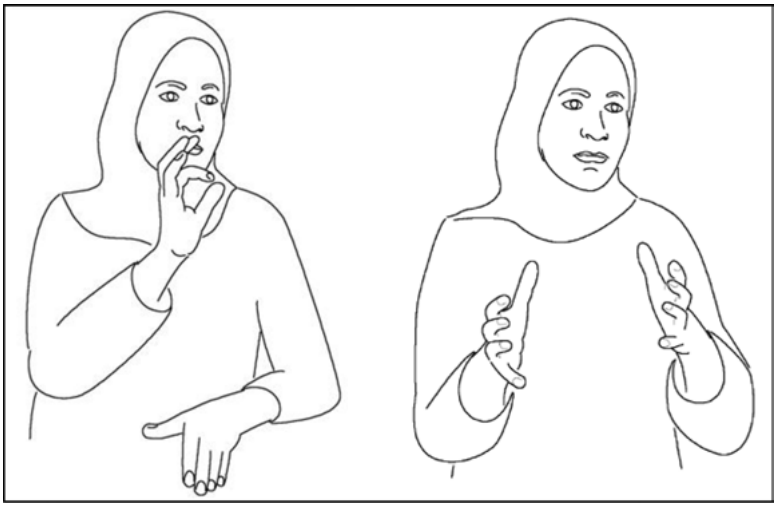
EYE CATCH

Fig. 5.3: Israeli SL sign with a verb-forming prefix: EYE+CATCH 'to catch red handed'. Copyright © 2011 by Sign Language Lab, University of Haifa. Reprinted with permission.

Another Israeli SL affix is a suffix glossed as -NOT-EXIST, and its meaning is more or less equivalent to English *-less* (Meir 2004; Meir/Sandler 2008, 142−143). This suffix attaches to both nouns and adjectives, but the resulting word is invariably an adjective: IMPORTANT+NOT-EXIST means 'of no import', and SUCCESS+NOT-EXIST 'without success, unsuccessful'. The main criterion for determining word class in this case is semantic: the complex word denotes a property ('lacking something').



a. PRAY THERE



b. DRINK TEA+ROUND-OBJECT

Fig. 5.4: Two ABSL complex words with suffixes determining word class: a. Locations: PRAY+THERE 'Jerusalem'; b. Objects: DRINK-TEA+ROUND-OBJECT 'kettle'. Copyright © 2011 by Sign Languge Lab, University of Haifa. Reprinted with permission.

An interesting class of complex words has been described in ABSL, whose second member is a pointing sign, indicating a location (Aronoff et al. 2008; Meir et al. 2010). The complex words denote names of locations − cities and countries, as in LONG-BEARD+THERE 'Lebanon', HEAD-SCARF+THERE 'Palestinian Authority', PRAY-THERE 'Jerusalem' (see Figure 5.4a). If locations are regarded as a specific word class, then these words contain a formal suffix indicating their classification (parallel to English *-land* or *-ville*).

Finally, another set of complex words in ABSL refers to objects, and contains a component indicating the relative length and width of an object by pointing to various parts of the hand and arm, functionally similar to size and shape specifiers in other sign languages (Sandler et al. 2010; Meir et al. 2010). The complex signs refer to objects, and are therefore considered as nouns, though the base word may be a verb as well: CUT+LONG-THIN-OBJECT is a knife, DRINK-TEA+ROUND-OBJECT is a kettle (Figure 5.4b).

### 4.4.4. Co-occurrence with function words

Function words are also selective about their hosts. Therefore, restrictions on their distribution may serve as an indication of the word class of their neighbors. Padden (1988) defines the class of nouns on distributional grounds, as the class of signs that can be modified by quantifiers. Hunger (2006), after establishing a formational difference between nouns and verbs in ÖGS, notices that there are some distributional corollaries: modal verbs tend to occur much more often next to verbs than next to nouns. On the other hand, indices, adjectives, and size and shape classifiers (SASS) are more often adjacent to nouns than to verbs.

Another type of function words that can be useful in defining word classes is the class of negation words. Israeli SL has a large variety of negators, including, inter alia, two negative existential signs (glossed as NEG-EXIST-1, NEG-EXIST-2) and two signs that are referred to by signers as 'zero' (glossed as ZERO-1, ZERO-2). It turns out that these two pairs of signs have different co-occurrence restrictions (Meir 2004): the former co-occurs with nouns (signs denoting entities, as in sentence (2), below), the latter with verbs (signs denoting actions, as in sentence 3). In addition, signs denoting properties are negated by NOT, the general negator in the language, and cannot co-occur with the other negators (sentence 4).

(2) $\text{IX}_1$COMPUTER NEG-EXIST-1/*ZERO-1/2/*NOT [Israeli SL]
'I don't have a computer.'

(3) $\text{IX}_3$ SLEEP ZERO1/2/*NEG-EXIST-1/2
'He didn't sleep at all/He hasn't slept yet.'

(4) CHAIR $\text{IX}_\text{A}$ COMFORTABLE NOT/*ZERO-1/2/*NEG-EXIST-1/2
'The chair is/was not comfortable.'

Finally, in Israeli SL a special pronominal sign evolved from the homophonous sign PERSON, and is in the process of becoming an object clitic, though it has not been fully grammaticalized yet (Meir 2003, 109–140). This sign co-occurs with verbs denoting specific types of actions, but crucially it attaches only to verbs. This conclusion is supported by the fact that all the signs that co-occur with this pronominal sign are also negated by the ZERO signs described above.

### 4.4.5. Co-occurrence with non-manual features

Non-manual features such as facial expressions, head nod, and mouthing play various grammatical roles in different sign languages (Sandler 1999). In this, they are quite

similar to function words, and their distribution may be determined by the word class of the sign they co-occur with. In various sign languages, some facial expressions have been described as performing adverbial functions, modifying actions or properties (e.g., ASL: Baker/Cokely 1980; Liddell 1980; Anderson/Reilly 1998; Wilbur 2000; Israeli SL: Meir/Sandler 2008; BSL: Sutton-Spence/Woll 1999). These facial expressions can be used as diagnostic for word classes, since their meaning is clearly compatible with specific concept classes. Israeli SL has facial expressions denoting manner such as 'quickly', 'meticulously', 'with effort', 'effortlessly', which modify actions, and can be used as diagnostics for verbs.

In some sign languages (i.e., many European sign languages) signers often accompany manual signs with mouthing of a spoken language word. Mouthing turns out to be selective as well. In the studies of noun-verb pairs in ÖGS and Auslan, it was noticed that mouthing is much more likely to occur with nouns rather than with verbs. In ÖGS, 92% percent of the nouns in Hunger's (2006) study were accompanied by mouthing, whereas only 52% of the verbs were. In Auslan, about 70% of the nouns were accompanied by mouthing, whereas only 13% of the verbs were (Johnston 2002).

### 4.4.6. Conclusion

At the beginning of this section we questioned whether sign languages are characterized by a different set of word classes because of their modality. We showed that it is possible to arrive at a theoretically based classification that can be applied to both types of languages, using similar types of diagnostics: meaning, syntactic roles, distribution, morphological inflections, and derivational affixes. The main diagnostics discussed in this section are summarized in Table 5.2 below. The main content classes, nouns, verbs, and adjectives, are relevant for languages in the signed modality as well. On the other hand, there are at least two types of signs that are clearly spatial in nature: one is classifier construction (see chapter 8), whose word class status has not been determined yet, and might turn out to require different classification altogether. The other type consists of two sub-classes of verbs, agreement verbs and spatial verbs, the classes of verbs that 'move' in space to encode agreement with arguments or locations. These classes are also sign language specific, though they belong to the larger word class of verbs.

Are there any properties related to word classes that characterize sign languages as a type? Firstly, more often than not, the form of the sign is not indicative of its part of speech. For numerous sign languages, it has been observed that many signs can be used both as arguments and as predicates, denoting both an action and a salient participant in the action, and often a property as well. This is, of course, also true of many spoken languages. Secondly, morphological inflection is almost exclusively restricted to predicate positions. Nominal inflections such as case and gender are almost entirely lacking (for number see chapter 6, Plurality). Thirdly, space plays a role in determining sub-classes within the class of verbs; although not all sign languages have the tri-partite verb classification into agreement, spatial, and plain verbs, only sign languages have it.

It is important to note that there are also differences between individual sign languages. The sequential affixes determining word classes are clearly language specific, as are the co-occurrence restrictions on function words. Inflectional modulations, which

Tab. 5.2: Main diagnostics used for word classification in different sign languages

| | | **Nouns** | **Verbs** | **Adjectives** |
|---|---|---|---|---|
| **semantic** | Concept class | Entity | Event | Property |
| **syntactic** | Syntactic position | Argument Predicate | Predicate | Modifier Predicate |
| | Syntactic co-occurrences | Quantifiers Specific negators Determiners | Specific negators Pronominal object clitic | |
| **morphological** | Formational characterization | Short and/or reduplicated movement (with respect to comparable verbs) | Longer non-reduplicated movement (with respect to comparable nouns) | |
| | Inflectional modulations | Plurality | (a) Encoding arguments: verb agreement; reciprocal; multiple; exhaustive. (b) Aspect: habitual; durational; continuative; iterative; protractive; delayed completive; gradual. | Predispositional; susceptative; continuative; intensive; approximative; iterative; protractive. |
| | Word-class determining affixes | SASS suffixes | 'sense'-prefixes | Negative suffix ('not-exist') |
| | Co-occurrence with facial expressions | Mouthing | Adverbial facial expressions | |

are pervasive in sign languages, also vary from one language to another. Not all sign languages have verb agreement. Aspectual modulations of verbs and adjectives have been attested in several sign languages. Specific modulations, such as the protractive, predispositional, and susceptative modulations, have been reported of ASL, but whether or not they occur in other sign languages awaits further investigation.

## 5. Word formation

Morphology makes use of three main operations: compounding, affixation, and reduplication. These operations can be instantiated sequentially or simultaneously. The visuo-spatial modality of sign languages favors simultaneity, and offers more possibili-

ties for such structures and operations, which are highlighted in each of the following sub-sections.

Three additional means for expanding the lexicon are not discussed in this chapter. The first is borrowing, which is discussed in chapter 35. The second is conversion or zero-derivation, that is, the assignment of an already existing word to a different word class. As mentioned above, many words in sign languages are multifunctional, serving both as nouns and verbs or adjectives. It is difficult to determine which use is more basic. Therefore, when a sign functions both as a noun and as a verb, it is difficult to decide whether one is derived from the other (which is the case in conversion), or whether the sign is unspecified as to its word-class assignment, characteristic of multifunctionality. Finally, backformation is not discussed here, as I am not aware of any potential case illustrating it in a sign language.

## 5.1. Compounding

A compound is a word composed of two or more words. Compounding expands vocabulary in the language by drawing from the existing lexicon, using combinations of two or more words to create novel meanings. Compounding seems to be necessarily sequential, as new lexical units are formed by the sequential co-occurrence of more basic lexical items. Yet sign languages may potentially offer simultaneously structured compounds too. Since the manual modality has two articulators, the two hands, compounds may be created byarticulating two different signs simultaneously, one with each hand. We will discuss sequential compounds first, and then turn to examine several structures that could be regarded as simultaneous compounding.

### 5.1.1. Sequential compounding

Compounds are words. As such, they display word-like behavior on all levels of linguistic analysis. They tend to have the phonological features of words rather than phrases. For example, in English and many other languages, compounds have one word stress (e.g., a *gréenhouse*), like words and unlike phrases (*a greén hóuse*). Semantically, the meaning of a compound is often, though not always, non-compositional. A greenhouse is not a house painted green, but rather "a building made mainly of glass, in which the temperature and humidity can be regulated for the cultivation of delicate or out-of-the season plants" (*Webster's New World Dictionary*, Third College Edition). It is usually transparent and not green. Syntactically, a compound behaves like one unit: members of a compound cannot be interrupted by another unit, and they cannot be independently modified. *A dark greenhouse* is not a house painted dark green. These properties of compounds may also serve as diagnostics for identifying compounds and distinguishing them from phrases.

*Properties of sign language compounds*: Sign languages have compounds too. In fact, this is the only sequential morphological device that is widespread in sign languages. Some illustrative examples from different languages are given in Table 5.3. As in spoken languages, sign language compounds also display word-like characteristics. In their

seminal study of compounds in ASL, Klima and Bellugi (1979, 207–210) describe several properties that are characteristic of compounds and distinguish them from phrases. Firstly, a quick glance at the examples in Table 5.3 shows that the meaning of compounds in many cases is not transparent. The ASL compound BLUE^SPOT does not mean 'a blue spot', but rather 'bruise'. HEART^SUGGEST (in Israeli SL) does not mean 'to suggest one's heart' but rather 'to volunteer', and NOSE^FAULT ('ugly' in Auslan) has nothing to do with the nose. Since the original meaning of the compound members may be lost in the compound, the following sentences are not contradictory (Klima/Bellugi 1979, 210):

(5) BLUE^SPOT GREEN, VAGUE YELLOW [ASL]
'That bruise is green and yellowish.'

(6) BED^SOFT HARD
'My pillow is hard.'

Compounds are lexicalized in form as well. They tend to have the phonological appearance of a single sign rather than of two signs. For example, they are much shorter than the equivalent phrases (Klima/Bellugi 1979, 213), because of reduction and deletion of phonological segments, usually the movement of the first segment. The transitory movement between the two signs is more fluid. In some cases, the movement of the

Tab. 5.3: Examples of compounds in sign languages

| | | |
|---|---|---|
| ASL<br>(Klima/Bellugi 1979) | BED^SOFT<br>FACE^STRONG<br>BLUE^SPOT<br>SLEEP^SUNRISE | 'pillow'<br>'resemble'<br>'bruise'<br>'oversleep' |
| BSL<br>(Brennan 1990) | THINK^KEEP<br>SEE^NEVER<br>WORK^SUPPORT<br>FACE^BAD | 'remember'<br>'strange'<br>'service'<br>'ugly' |
| Israeli SL<br>(Meir/Sandler 2008) | FEVER^TEA<br>HEART^OFFER<br>RESPECT^MUTUALITY | 'sick'<br>'volunteer'<br>'tolerance' |
| Auslan<br>(Johnston/Schembri 1999) | CAN'T^BE-DIFFERENT<br>RED^BALL<br>NOSE^FAULT | 'impossible'<br>'tomato'<br>'ugly' |
| ABSL<br>(Aronoff et al. 2008) | CAR^LIGHT<br>PRAY^HOUSE<br>SWEAT^SUN | 'ambulance'<br>'mosque'<br>'summer' |
| IPSL<br>(Zeshan 2000) | FATHER^MOTHER<br>UNDERSTAND^MUCH<br>POTATO^VARIOUS | 'parents'<br>'intelligent'<br>'vegetable' |
| New Zealand Sign Language (NZSL)<br>(Kennedy 2002) | NO^GERMS<br>MAKE^DEAD<br>READY^EAT | 'antiseptic'<br>'fatal'<br>'ripe' |

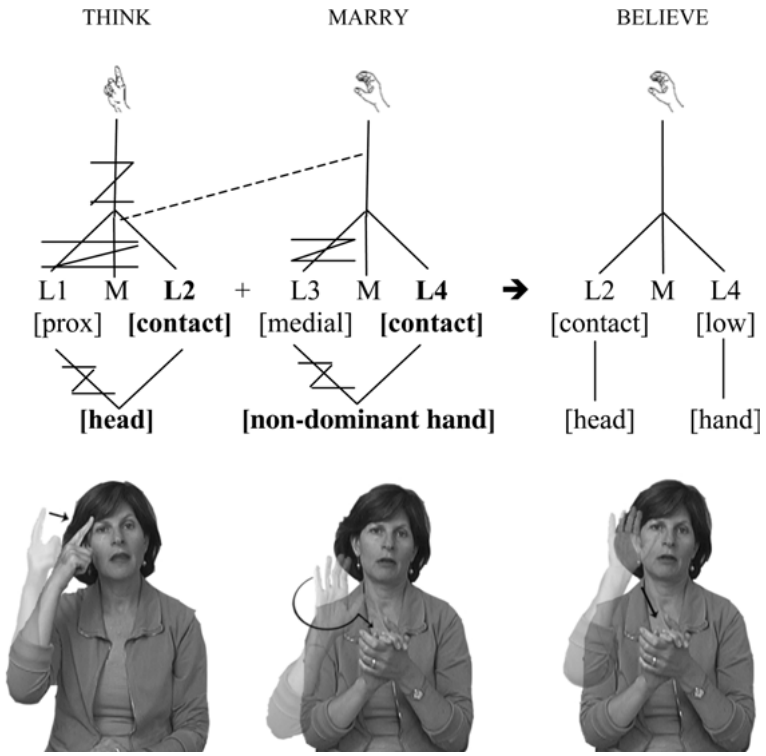



Fig. 5.5: The ASL signs (a) THINK and (b) MARRY, and the compound they form, (c) BELIEVE. Reprinted with permission from Sandler and Lillo-Martin (2006).

second component is also deleted, and the transitory movement becomes the sole movement of the compound, resulting in a monosyllabic sign with only one movement, like canonical simplex signs (Sandler 1999).

Changes contributing to the 'single sign' appearance of compounds are not only in the movement component, but also in hand configuration and location. If the second sign is performed on the non-dominant hand, that hand takes its position at the start of the whole compound. In many cases, the handshape and orientation of the second member spread to the first member as well (Liddell/Johnson 1986; Sandler 1989, 1993). Similar phenomena have been attested in Auslan as well (Johnston/Schembri 1999, 174). They point out that in lexicalized compounds often phonological segments of the components are deleted, and therefore they might be better characterized as blends.

As a result of the various phonological changes that can take place, a compound may end up looking very much like a simplex sign: it has one movement and one hand configuration. In the ASL compound BELIEVE (in Figure 5.5), for example, the first location (L1) and the movement (M) segments of the first member, THINK, are deleted. The second location (L2) becomes the first location of the compound, and the movement and final location segments are those of the second member of the compound,

MARRY. The only indication that BELIEVE is a compound is the fact that it involves two major locations, the head and the non-dominant hand, a combination not found in simplex signs (Battison 1978). These phonological changes are represented in (7), based on Sandler (1989):

(7) The phonological representation of the ASL compound BELIEVE

*Morphological structure*: Compounding takes advantage of linear structure, but it also involves reorganization and restructuring. The members of a compound may exhibit different types of relationship. Endocentric compounds are those that have a head. The head represents the core meaning of the compound and determines its lexical category. The English compound *highchair* is endocentric, headed by the noun *chair*. Semantically, a highchair is a type of a chair, and morphologically it is a noun, the lexical category of its head. A compound such as *scarecrow* is exocentric: it is neither a 'crow' nor a 'scare'. Endocentric compounds are further classified according to the position of the head in the compound: right-headed (the head occurs in final position, as in *highchair*) and left-headed (the head occurs in initial position, as in Hebrew *ganyeladim* 'kindergarten', literally 'garden-children'). It is commonly assumed that the position of the head in compounds is systematic in a language (Fabb 1998). English, for example, is characterized as right-headed, while Hebrew is left-headed.

Not much has been written on headedness in sign language compounds. Of the ASL examples presented in Klima and Bellugi, many are exocentric, e.g., SURE^WORK 'seriously', WILL^SORRY 'regret', WRONG^HAPPEN 'accidentally', FACE^STRONG 'resemble', WRONG^HAPPEN 'fate'. Most of the endocentric compounds described there are left-headed, EAT(FOOD)^NOON 'lunch', THINK^ALIKE 'agree', FLOWER^GROW 'plant', SLEEP^SUNRISE 'oversleep', but at least one, BLUE^SPOT 'bruise', is right-headed. In Israeli SL, compounds that have Hebrew counterparts are usually left-headed (PARTY^SURPRISE 'surprise party'), though for some signers they may be right-headed. Compounds that do not have Hebrew counterparts are often exocentric, e.g., FEVER^TEA 'sick', SWING^PLAY 'playground'. Verbal compounds are often right-headed, as in HEART^SUGGEST 'volunteer', and BREAD^FEED 'provide for'.

A third type of compound structure is the coordinate compound, where the members are of equal rank, as in *hunter-gatherer*, someone who is both a hunter and a gatherer. In a special type of coordinate compounds, the members are basic category-level terms of a superordinate term. The meaning of the compound is the superordinate term. This class of compounds, called also *dvandva* compounds (etymologically derived from Sanskrit *dvamdva*, literally, a pair, couple, reduplication of *dva* two), is not productive in most modern European languages, but occurs in languages of other families. Such compounds exist in ASL (Kilma/Bellugi 1979, 234–235): CAR^PLANE^TRAIN 'vehicle', CLARINET^PIANO^GUITAR 'musical instrument', RING^BRACELET^NECKLACE 'jewelry', KLL^STAB^RAPE 'crime', MOTHER^FATHER^BROTHER^SISTER 'family'. Like other compounds, they denote one concept, the movement of each component sign is reduced, and transitions between signs are minimal. However, there is a lot of individual variation in form and in the degree of productivity of these forms. Younger signers use them very little, and consider them to be old-fashioned or even socially stigmatized.

### 5.1.2. Simultaneous compounding

In principle, simultaneous compounding in sign languages can be of two types. In the first, each hand may produce a different sign, but the production is simultaneous. The second type combines certain phonological parameters from two different sources to create a single sign. In the latter type not all the phonological specifications of each compound member materialize, and therefore they may also be characterized as blends.

Examples of the first type are exceedingly rare. Two BSL examples are mentioned in the literature: MINICOM (a machine which allows typed messages to be transmitted along a telephone line, in Brennan 1990, 151), and SPACE-SHUTTLE (Sutton-Spence/Woll 1999, 103). The compound MINICOM is composed of the sign TYPE and the sign TELEPHONE produced simultaneously: the right hand assumes the  handshape of the sign TELEPHONE, but is positioned over the left hand that produces the sign TYPE.

However, according to some analyses, simultaneous compounding is very widespread in sign languages. Brennan (1990) uses the term 'classifier compounds' for signs in which the non-dominant hand, and sometimes both hands, assumes a handshape of a classifier morpheme. For example, in the sign AQUADIVER the non-dominant hand in a  handshape represents a surface, and the dominant hand in an upright  handshape moving downwards represents a person moving downwards from the surface. According to Brennan's analysis, any sign containing a classifier handshape on the non-dominant hand is a compound, even some so-called 'frozen' lexical items. A sign such as WRITE (in Israeli SL and many other sign languages), whose dominant hand has a  handshape depicting the handling of a long thin object and moving it over a flat surface (represented by the non-dominant hand) is also a classifier compound under this account. Johnston and Schembri (1999, 171) refer to such constructions as "simultaneous sign constructions" rather than compounds, because they point out that such constructions may be phrasal or clausal. It should be pointed out that however these signs originated, they are lexical signs in every respect, and under most analyses, they are not regarded synchronically as compounds.

Two types of word formation process combine handshape from one source and movement and location from another: numeral incorporation, where the handshape represents a number (Stokoe et al. 1965; Liddell 1996 and works cited there), and initialization, in which the handshape is drawn from the handshape inventory of the manual alphabet (Stokoe et al. 1965; Brentari/Padden 2001). In addition, these processes are not usually analyzed as compounds, but rather as some kind of incorporation, affixation, or combination of two bound roots (e.g., Liddell 1996 on numeral incorporation). Whatever the analysis, they both combine elements from two sources, and in this they resemble compounding, but they do so simultaneously, a possibility available only for languages in the signed modality.

*Numeral incorporation* is usually found in pronominal signs and in signs denoting time periods, age, and money. In these signs the number of fingers denotes quantity. For example, the basic form of the signs HOUR, DAY, WEEK, MONTH, and YEAR in Israeli SL is made with a  handshape. By using a , , , or  handshape, the number of units is expressed. That is, signing the sign for DAY with a  handshape means 'two days'. A  handshape would mean 'three days', etc. This incorporation of number in the signs

is limited in Israeli SL to five in signs with one active hand, and to 10 in symmetrical two-handed signs. Number signs in many sign languages have specifications only for handshape, and are therefore good candidates for participating in such simultaneous compounding (but see Liddell 1996 for a different analysis). But there are also restrictions on the base sign, which provides the movement and location specifications: usually it has to have a  handshape, which can be taken to represent the number one. However, some counter-examples to this generalization do exist. In DGS, the sign YEAR has a  handshape, but this handshape is replaced by the above handshapes to express 'one/two/three etc. years'. Numeral incorporation has been reported on in many sign languages, e.g., ASL, BSL, Israeli SL, DGS, Auslan, and IPSL, among others. But there are sign languages that do not use this device. In ABSL numeral incorporation has not been attested, maybe because time concept signs in the language do not have a  handshape (for numeral incorporation see also chapters 6 and 11).

*Initialization* is another type of simultaneous combination of phonological specifications from two different sources: a spoken language word and a sign language word. The handshape of an initialized sign represents a letter of the fingerspelled alphabet, corresponding to the first letter of the written form of an ambient spoken language word. This initialized handshape is usually added to a sign that already exists in the language, lending it an additional − often more specific − meaning for which there is no other sign. For example, the ASL signs F̲AMILY, A̲SSOCIATION, T̲EAM, and D̲EPARTMENT all share the movement and location of the sign GROUP, and are distinguished by the handshapes F, A, T, or D. As Brentari and Padden (2001, 104) point out, some initialized signs in ASL are not built on native signs, but they still form a semantic and a formational 'family'. Color terms, such as B̲LUE, P̲URPLE, Y̲ELLOW, and G̲REEN, are characterized by the same movement and location, although there is no general color sign on which they are based. The same holds for color terms and kinship terms in LSQ (Machabee 1995, 29−61, 47). In other cases, the movement and location may present iconically some feature of the concept. In LSQ, the sign for 'Roman' is performed with an R handshape tracing the form of a Roman military helmet above the head (Machabee 1995, 45). Initialization is found in other sign languages as well, e.g., Irish Sign Language (Ó'Baoill/Matthews 2002) and Israeli SL (Meir/Sandler 2008, 52). However, it is much less common in languages with a two-handed fingerspelling system, such as BSL, Auslan, and New Zealand Sign Language. In a one-handed fingerspelling system, each letter is represented solely by the handshape, which may then be easily incorporated in other signs, taking their location and movement features. In a two-handed system, each letter is identified by a combination and location (and sometime movement as well), so that it is much less free to combine with other phonological parameters (Cormier/Schembri/Tyrone 2008). More common in these languages are single manual letter signs, which are based on a letter of an English word, but with very limited types of movement of the dominant hand against the non-dominant hand.

## 5.2. Affixation

Though compounding is common in all studied sign languages, sequential affixation is very rare. This is partly due to the general preference in manual-visual languages for