Part 2: **Phonology**

Chapter 0 Preliminary considerations

0.1 What is phonology?

This part deals with the various properties of the perceivable form of sign languages, and the related phonological representations and processes. While Stokoe, in the first analysis of the building blocks of ASL (1960), preferred to use modality-specific terms (namely "cherology" and "chereme" instead of "phonology" and "phoneme"), the term "phonology" is now commonly adopted for this domain of sign language grammar. Stokoe used alternative, sign language-specific terms in order to highlight the differences between sign and speech; after all *phono* refers to sound (while Greek *χείρ* means 'hand'). Modality differences certainly affect what the phonology of sign languages looks like, but we suggest that specific grammars do not deal explicitly with these differences, but rather focus on the similarities when it comes to phonological form. This is what this part of the Blueprint implicitly tries to do, and we therefore adopt the by now common strategy of using "phonology" in a modality-independent way, that is, as dealing with the smallest elements of language that can distinguish meaning but do themselves not carry meaning.

0.2 Organization of the Phonology Part

This part is divided into three chapters: (i) sublexical structure, dealing with the phonology below the level of the syllable (which in sign language tends to overlap with the word); (ii) prosody, dealing with the syllable and prosodic constituents above the word up to the utterance level; (iii) and finally phonological processes. Both at the lexical level and at the supra-lexical level, manual and non-manual features may play an important role. In the specific examples from individual sign languages we provide, the emphasis may implicitly lie on either one of them, but the grammar writer should keep an open eye to both manual and non-manual phenomena at all levels of phonological organization.

0.3 How to use the Phonology Part

The overall organization of this part reflects, on the one hand, the different units of phonological organization from the phonemic level up to the utterance level (this is done in Chapters 1 and 2). On the other hand, it also includes a separate chapter in which phonological processes are illustrated. The structure of this latter chapter also reflects the various levels of phonological organization, presenting the processes as affecting phonological units of increasing size. The grammar writer may decide to organize/distribute the content of this part differently, that is, in such a way that

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phonological processes are not discussed within a separate chapter, but rather as subsections of the relevant phonological levels. Phonemic processes, for instance, could be addressed at the end of the chapter on sublexical structure (Chapter 1), while a discussion of processes affecting the syllable might be included at the end of the syllable section (Section 2.1.1), etc. This way, the content of Chapter 3 would be redistributed as subsections of either Chapter 1 or Chapter 2.

Chapter 1 Sublexical structure

1.0 Definitions and challenges

1.0.1 What should go into this chapter and what should not?

The sublexical phonological structure contains all the formal aspects of signs (in terms of phonological features) without reference to their morphological or other functions. Descriptions of typical iconic meanings associated with certain phonological features (for instance, a certain handshape or location being used exclusively or predominantly iconically) can be included in the respective subsections; if this concerns handshapes from the manual alphabet or the counting system, they will be included in Section 1.1.3. Notes on language-specific phonetic features (exceptional or language-specific articulations, for instance) could be made within each of the subsections.

As most of the discussion of sublexical structure is devoted to manual articulations, the section on non-manuals comes all the way at the end. However, the grammar writer can consider presenting an overview of the relative role of manual and non-manual articulators at the beginning of Chapter 1 on sublexical structure, that is, before proceeding to the details of the manual components.

1.0.2 Methodological challenges

The key task for the grammar writer in this chapter is to describe only the phonological patterns observed in the language, and not all of the subtle phonetic distinctions. Phonological properties are those that recur systematically in many forms in the lexicon, in other words, that are *contrastive*. Their phonetic form (the precise articulation) will vary from context to context, depending on the signing speed, the neighboring sign forms, etc. It is important that the grammar focuses on what is constant across these variable forms: their phonological representation. On the basis of the comparison of phonological forms, the elements of the phonological grammar of the language can be extracted.

In the prototypical case, phonological forms can be illustrated with minimal pairs for each feature, but in languages with small lexicons, this strategy may at times prove difficult. It may be worthwhile to address this point in the introduction

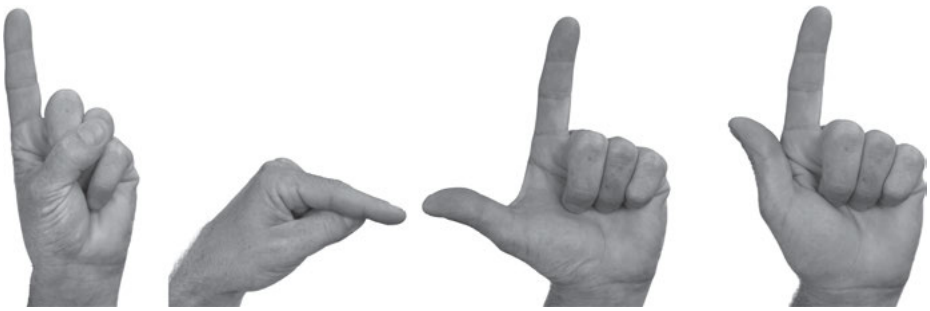
to the phonology part of the grammar, but the grammar writer should still attempt to provide minimal pairs in illustrating instances of phonological properties. Near-minimal pairs could be an alternative, with a short note explaining what the additional contrast in the pair is.

The distinction between phonological features that must be discussed and further phonetic distinctions that are not to be discussed is not an easy matter and depends on a detailed phonological analysis. For instance, looking at the orientation of signs in the language, one can take a phonetic point of view and say that virtually any palm and (extended) finger orientation occurs in the language. In that case, there is little to say in the section on orientation [Phonology – Section 1.1.2]. However, with additional effort, one can also attempt to abstract away from these phonetic forms by looking at the side of the articulator that faces the (final) location of the sign, which is called "relative orientation".

1.1 Active articulators

This section describes the lexical patterns that can be found with regard to hand configuration of the two primary active articulators, the two hands. Hand configuration is understood to comprise both handshape and orientation (Sandler 1989). Phonemic handshapes can be listed in Section 1.1.1, with notes about exceptional handshapes and/or the subclass of handshapes found in the manual alphabet and in number signs to be added in Section 1.1.3. If the description of the handshapes is made in terms of the features they are composed of (selected vs. unselected fingers and their configuration), this can be made explicit in Sections 1.1.1.1 and 1.1.1.2, respectively.

The terms "handshape" and "active articulator" are not completely synonymous, and depending on the perspective of the grammar writer, an explicit choice should be made for using either one versus the other or for using both. A handshape is a *phonetic* realization of a bundle of articulator features, a concrete realization that is always depicted in terms of the configuration of the whole hand. An example involving the ☝-hand is shown below.



Different realizations of the ☝-hand, from left to right: ☝-hand, index extended, thumb folded over fist; ☝-hand, index bent, thumb folded over fist; ☝-hand, index extended, thumb extended; ☝-hand, index extended, thumb parallel to index

The *phonological* concept of "active articulator" highlights that only a subset of the hand, such as a single selected finger, can be the phonologically specified active articulator (Crasborn 2001). In the example of the selected index finger, even the question of whether it is bent or extended at the proximal interphalangeal joint is a matter of phonetics (see second image above). The same holds for whether the thumb is extended or parallel to the index finger (third and fourth picture). That is to say, the position of the thumb or of the other fingers is predicted to be variable across different realizations (van der Kooij 1998). These specific generalizations hold for NGT and BSL (cf. Fenlon et al. 2013), and may be different for other sign languages. As most descriptive works make use of visualizations in the form of drawings or photographs, a specific handshape must be determined as the prototypical realization of the extended finger in this example. Ideally, the grammatical descriptions in this section also provide a more abstract analysis in terms of active articulator features, and the set of descriptive handshapes are likely to form part of dictionaries for the language.

1.1.1 Phonemic handshapes

A description of the phonemic handshapes used in the language is created on the basis of an analysis of the lexicon of the language. If applicable, handshapes that are only used for specific domains (such as initialized signs [Lexicon – Section 2.2.2.1]) can be grouped together. Otherwise a grouping by number of selected fingers is to be preferred. A further discussion of handshapes in terms of the two following subsections (Selected fingers and Finger configuration) is optional. Its inclusion will depend on the depth of the phonological analysis performed for the language.

1.1.1.1 Selected fingers

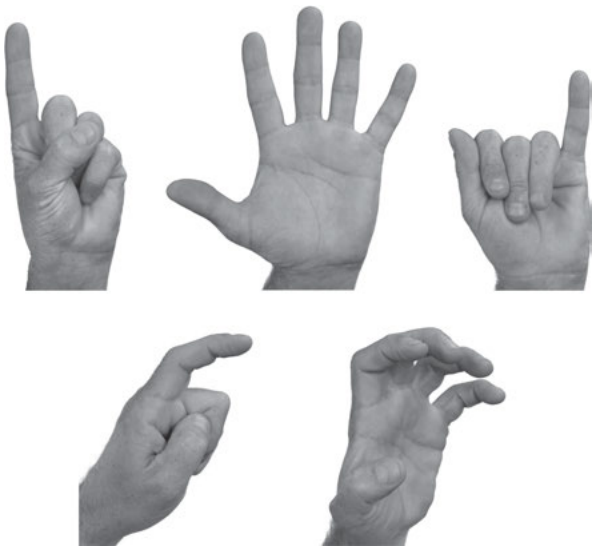
Aside from the list of handshapes, a list can be created of which (combinations of) selected finger(s) has been established to be active in the language. For instance, can all individual fingers act as a selected finger on their own, whether in extended or bent configuration? A tabular overview of selected finger combinations and the handshapes listed in Section 1.1.1 in which they occur will help the reader see more structure in the list of handshapes. Alternatively, such a table can also be used in 1.1.1 to order the presentation of handshapes.

It may be helpful to present to the reader how the identification of selected vs. unselected fingers is commonly done, that is, by looking at three criteria (Sandler 1989; Brentari 1998): (i) selected but not unselected fingers can be in a specific configuration; (ii) selected but not unselected fingers can have hand-internal movement; and (iii) it is typically the selected fingers that contact a location.

The unselected fingers in a handshape are typically in a predictable position, but this need not always be the case. If necessary, the configuration of (some of) the unselected fingers can also be described in this section. In the example of the ☝-handshape above, the thumb tends to be adducted or folded over the middle, ring, and pinkie fingers, so that it is "out of the way". If in the language there is a (non-distinctive) contrast between signs that have the thumb extended vs. folded away, while still having the index finger as the only selected finger, then this could be described.

1.1.1.2 Finger configuration

The possible configurations of different groups of selected fingers (sometimes referred to as "finger position") need to be characterized in this section. Which configurations (such as extended, curved, or clawed) are observed in the language, and which configurations are found for which (sets of) selected fingers? The below figure provides examples of handshapes with different fingers extended and in different configurations.

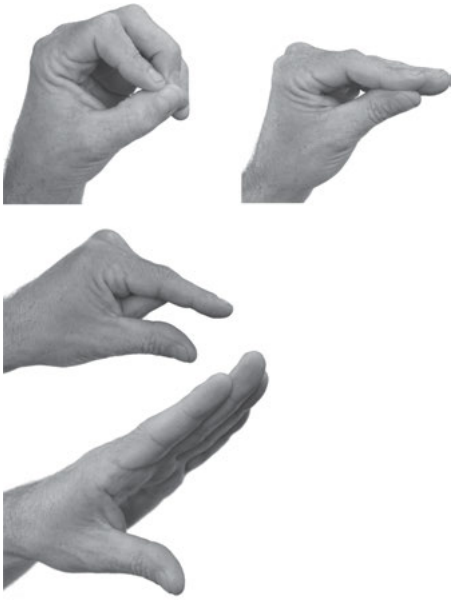


First row: index finger extended (1-hand), all fingers extended (5-hand), pinky extended (I-hand); second row: index finger curved, all fingers curved

If the language supports generalizations such as the one described for the index finger above, whereby bent configurations are the phonetic by-product of articulating extended fingers together with a certain combination of location and

orientation features (van der Kooij 2002), it would be useful to make this explicit in this section. That leaves open the option of including them here in the list of configuration features. Similarly, if the configuration "clawed' is only found in combination with tense movement, it could be explicitly excluded from the list of finger configurations but mentioned as an alternative articulation in a footnote, for instance.

In addition, the configuration in terms of an aperture relation between the thumb and (some of) the other fingers needs to be specified, as well as any possible restrictions on combinations of aperture features and other configuration features. The number of distinctions for the language at hand therefore needs to be established by the grammar writer. The below image illustrates handshapes with different aperture relations between thumb and other fingers.



First row: O-hand (closed, curved), Closed Beak-hand (closed); Second row: Q-hand (half open); Third row: Beak-hand (open)

Finally, any possible changes in finger configurations should be mentioned in the section on secondary movements [Phonology – Section 1.3.2] / secondary movements. For example, can all aperture relations be dynamic in nature, changing from open to closed or vice versa, or is this somehow restricted to certain selected fingers, for instance, or only to closing movements?

1.1.2 Orientation

The primary challenge for describing possible orientations observed in the lexicon of the language lies in choosing a consistent perspective with associated terminology. The orientation of signs can be characterized in different ways. In terms of *articulation*, the rotation of the forearm can be characterized by its extremes supine and prone, and anything in between (with neutral for the midway position). Alternatively, the orientation of the whole hand in terms of the direction in which the palm and fingers (imagining they were fully extended) can be specified for a sign; this is called *absolute orientation*. Finally, the *relative orientation* refers to the side of the hand that faces the location or the end point of the path movement in a sign.

The two NGT examples below illustrate the various possible positions.

	WHAT-IF	TO-THANK	(NGT)
Articulatory orientation	neutral	supine	
Absolute orientation – palm	contralateral	backward	
Absolute orientation – fingers	upward	upward	
Relative orientation	thumb side	palm side	

While each of these could be useful in characterizing the form of signs in a dictionary, both articulatory and absolute orientation are likely to be very hard to describe in terms of language-specific properties. Almost any possible (combination of) articulator and absolute orientation value(s) is likely to be found in the language, and the grammar will gain little insight into language-specific properties. By contrast, among the six possible values of the relative orientation – i.e. thumb (radial) side, pinky (ulnar) side, palm side, back of hand side, fingertip side, and wrist side – it could well be that one or more of the values is not found in any particular language. As in other parts of the grammar, if nothing specific can be said about orientation other than "a wide range of forms is observed", it is perhaps better to leave the section blank than to include a random list of example forms. Thus, this section as a whole is optional.

1.1.3 The manual alphabet and number signs

Phonological properties of manual alphabets and number signs (numerals [Lexicon – Section 3.10.1]) can be specifically highlighted if they are analyzed as the cause of exceptions to the phonological patterns described in the section on contrastive (phonemic) handshapes [Phonology – Section 1.1.1]. Sign languages commonly manifest exceptional handshapes that are specific to their use in fingerspelled words and in lexicalized signs derived from fingerspelling [Lexicon – Section 2.2.2]. Examples are the letter F and its use in the NGT signs FRENCH and FAMILY. In NGT, this handshape is characterized by an uncommon position of the selected fingers (not simply closed aperture between index and thumb, but a position of the thumb on the medial side of the flexed index finger – see leftmost image below).


#F FRENCH FAMILY (NGT)

Similarly, the number system in some sign languages has been identified as the location of exceptional handshapes. They should be listed in the grammar to the extent that they have been identified.

1.1.4 Other active articulators

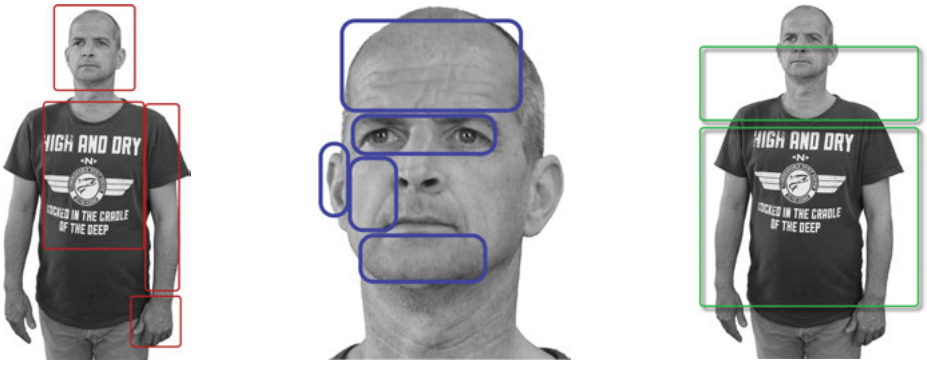
In some languages, the arms or legs are used as the active articulators in some signs, as in the AdaSL signs FOOTBALL and REFUSE (Nyst 2007). There may also be signs where none of the extremities are involved in the articulation. While this is common for bound morphemes such as adverbial mouth gestures [Lexicon – Section 3.5], it appears to be less common for free morphemes that are content words. An example is the NGT sign MENSTRUAL-PERIOD, where the tongue pushes the cheek outwards. Both types can be discussed in the section on non-manuals [Phonology – Section 1.5].

If the mouth or other non-manual articulators act as the only active articulator in a lexical item, this can be described in the present section.

1.2 Location

An inventory of locations on the body, the head, the arm, the non-dominant hand, and in the space in front of the signer can be presented as a simple list of phonologically distinctive locations clustered per major area. Research has indicated that sign languages tend to make more fine-grained location distinctions on the head (e.g. chin, side of mouth, cheek) than on the body, as the head is the area of highest visual acuity (signers usually look at each other's face while communicating), and the grammar writer may wish to address this fact in this section. In the light of findings for some sign languages such as NGT and VGT (van der Kooij 2002; Demey 2005) that certain locations only occur when they are iconically motivated, special attention should be devoted to the relative frequency of different locations and the possible exceptions that are motivated by form-meaning relationships.

Thus, in this section, an effort should be made to address (list) all phonologically distinctive locations. Yet minor locations (or settings) within the major body areas will likely make another appearance in the section on path movements [Phonology – Section 1.3.1]. For instance, a downwards movement on the chest is in some theories analyzed as a change in setting from 'high' to 'low', but it is more intuitive to discuss this under movement. A graphic visualization of the body and spatial locations and possibly location-internal distinctions can be useful for the reader, cf. the fictitious example below.



Body: head-trunk-shoulders-upper arm-hand (left image); Face: forehead-ears-eyes-cheek-chin (middle image); Space: high-low (right image)

Location distinctions in space that are not used in the lexicon but only in morpho-syntactic or gestural constructions are not to be discussed in this section, but can be referred to by section number.

1.3 Movement

The movement component of signs can be described in terms of primary or path movements and secondary or articulator-internal movements (Sandler 1996; Brentari 1998). The former involve movement of the whole hand (on the body or in space) while the latter consist of changes in orientation and/or hand configuration, as well as finger movements like finger wiggling. The terminology may be a bit confusing in that some signs have only a secondary movement. Some phonological models try to describe all movements as changes in one of the other parameters, such as changes in location and changes in finger configuration. This may indeed be an alternative way of structuring this section.

Besides providing a list of attested phonological movements, a key question that should be addressed in this section is which types of movements may combine in signs. Can all path movements combine with all secondary movements, and can all types of secondary movements combine with each other? This issue should be addressed in the subsection on secondary movement.

Some phonological models have used the syllable [Phonology – Section 2.1.1] / syllable concept as a central organizing template for movement in signs (Wilbur 1990; Corina 1996; van der Kooij & Crasborn 2008). If consistently applied, this movement section could also be organized along the lines of syllable structure and constraints on the syllable. If characterized as a syllable-level phenomenon, movement and movement combinations could thus be readdressed in the section on syllables.

The manner of movement typically affects the whole sign, and possible movement manners – such as tense vs. lax movement and quick vs. slow movement – can therefore best be described in this introductory section (but might make another appearance in the prosody [Phonology – Chapter 2] chapter)

Timing properties of movements such as alternating two-handed movements and movement repetition may either be specific to either path or secondary movements or apply to all movement components equally. Depending on their distribution, such features can either be discussed in this introductory section or in the two following subsections.

1.3.1 Path movements

Path movements or changes in location may be a simple change from start to end location, or may have a specific shape. Patterns and exceptions in the movement shape need to be discussed in this section. Typical shapes that occur in many sign languages are straight, circle, arc, spiral, and waves. For non-straight movements, it could further be specified whether the non-straight shapes may occur in all possible

different planes, or whether, for example, arc-shaped movements only occur in a plane parallel to the body.

1.3.2 Secondary movements

Secondary movements refer to changes in handshape and/or orientation. It has been observed for many sign languages (basically, all sign languages studied to date) that in a handshape change, only the finger configuration may change, and not the finger selection (this is sometimes referred to as the "Handshape Change Constraint"). Signs with changes in finger selection are exceptions that can be explained by their etymology, for example, by the fact that they are based on the fingerspelling system, as is true for the NGT sign BLUE (Dutch *blauw*) below, which consists of a sequence of a B- () and an L- () handshape.

BLUE (NGT)

Finger configuration changes can be subdivided into aperture changes, finger configuration changes proper (bending, clawing, extending), and other changes such as wiggling fingers.

Changes in orientation may be difficult to establish in terms of phonological contrast, as the phonetic orientation of the hand in space is likely to change a bit in every articulation. Many changes in absolute orientation can be considered as phonetic by-products of path movements. This can be the case in arc-shaped path movements as in NGT MORNING, but also in straight path movements as in NGT SAY (see pictures below; cf. Crasborn 2001). Like elsewhere in this chapter, this section should only describe those types of orientation change that can be considered phonological features of the lexicon. Rotations of the forearm (90 or 180 degrees) are rarely a by-product of other articulations, and are a recurrent phonological category in many sign languages (as in NGT DIFFICULT).

MORNING

SAY

DIFFICULT

(NGT)

As mentioned above, this section should also include a discussion of possible and non-attested combinations of secondary movements with (i) path movements and (ii) other secondary movements.

1.4 Two-handed signs

There are different ways of describing the phonological patterns observed in two-handed signs. Many grammar writers will be familiar with Battison's (1978) classification of signs according to the two parameters of movement (one or both hands moving) and handshape (same or different). As a common observation on many sign languages, the grammar writer can examine to what extent Battison's (1978) Symmetry Condition and Dominance Condition apply to the sign language under investigation. According to the former, in signs with two moving hands, the handshapes must be identical and in a similar (identical or mirrored) orientation. According to the latter, if the handshapes of a two-handed sign are different, then one hand acts as the location of the other, moving, hand, and in addition, only a limited number of handshapes can act as a location. The grammar writer should specify what these handshapes are, and what the specific exceptions to the two conditions are (if any). Examples of different types of two-handed signs from LSE are presented below, where in each case the weak hand has the -handshape (one of the handshapes that is allowed to occur both in symmetrical and in asymmetrical signs).

Later phonological analyses of most sign languages have suggested a distinction between symmetric signs and asymmetric signs that more elegantly captures the patterns that can be observed (van der Hulst 1996). The distinction between the two lies in the role of the non-dominant hand: does it function as an active articulator (a moving hand), or is it merely the place of articulation (the passive articulator, cf. spoken language phonetics)? If the language provides evidence for the latter distinction, it is to be preferred that this contrast be used in the grammar – as is done in the following two subsections. Alternatively, a language-specific typology can be created. The elegance of this alternative description lies in accounting for the fact that in

GOALKEEPER

IN-FAVOUR (LSE)

CENTER

DATABASE (LSE)

asymmetrical signs, there is no additional location specification: the weak hand is the only location in the sign. Symmetrical signs, by contrast, have an independent location specification. Note that in asymmetrical signs, the two handshapes may also be identical.

1.4.1 Symmetrical signs

For symmetrical signs, any phonotactic restrictions on the location, handshape, or orientation can be described here. For the movement, the types of alignment between the two hands in time needs to be discussed: are alternating movements possible or not, and are the alternating movements synchronous or do the two hands move one at a time?

1.4.2 Asymmetrical signs

For asymmetrical signs, the possible locations on the weak hand can be discussed in the section on location [Phonology – Section 1.2]. What is useful to spell out in this

section is the extent to which locations on the non-dominant hand can be exhaustively described by specifying only a *side* of the hand (such as palm side and finger tips), or whether the handshape on the non-dominant hand is also phonologically distinctive. For some sign languages, it has been suggested that a specification of handshapes is only needed for those signs that are actually morphologically complex, the handshape of the weak hand (possibly together with its orientation) forming a separate morpheme (Brennan (1990) on BSL; van der Kooij (2002) on NGT). In the latter case, it could be decided to discuss such forms only in the morphology chapter. For some other languages, like ASL in Battison's (1978) analysis, there is an exhaustive list of handshapes that can occur on the weak hand.

If the choice of handshape on the weak hand is a phonologically distinctive property of the lexicon of the language, then this needs to be made explicit in this section, possibly with additional discussion on the range of handshapes observed on the weak hand.

1.5 Non-manuals

Non-manuals are separated into mouth actions and other non-manuals. They are described in this section only insofar as they are part of the phonological description of lexical signs. Non-manuals that function as intonational elements are to be discussed in the chapter on prosody [Phonology – Chapter 2].

Mouth actions are in turn divided into those that are formed on the basis of spoken language words (whether reduced or not; in either case, they are called "mouthings"), and those that are not ("mouth gestures") (Boyes Braem & Sutton-Spence 2001).

In the prototypical case, a mouth action is a phonological feature of a manual sign, but if the language also features lexical elements that only consist of non-manual elements (as in the NGT example MENSTRUAL-PERIOD mentioned above), these also should be mentioned in this section.

1.5.1 Mouth gestures

Mouth gestures bear no synchronically relevant relationship to spoken language words, even though some might be diachronically derived from mouthings. A core issue to discuss for mouth gestures is the extent to which they pattern as phonological elements, recurring in different lexical items. In many sign languages, many mouth gestures would appear to occur only in single lexical items. For instance, the mouth gesture 'sh' (IPA [ʃ::]) in NGT only occurs with the lexical item BE-PRESENT. They could thus be argued to be more profitably described in the lexicon, only providing in this section an indication of the variety of forms and which of them do appear to act as phonological elements.

In terms of the form of the mouth gestures, there are no conventions, and the grammar writer is urged to make explicit descriptions in terms of articulation and provide videos of the form.

1.5.2 Mouthings

While it is clear from the definition that mouthings are (parts of) spoken language words, this section needs to discuss the extent to which it is common in the language to accompany signs with mouthings, and whether this is restricted to certain users or uses of the language. In the section dealing with the non-native lexicon [Lexicon – Chapter 2], the role of mouthings in the lexicon is further discussed.

Further, the extent to which manual forms can be combined with different mouthings can be discussed if this has been studied, including what the semantic relations between sign and mouthings are. For instance, it is relevant to distinguish cases where the mouthings distinguish manual forms that without the mouthings would be homonyms coming from unrelated semantic fields (like DOCTOR and BATTERY in NGT) from cases where the mouthings specify the semantics of a broader concept expressed by the manual form – as is true for the Dutch mouthings *broer* ('brother') and *zus* ('sister') accompanying the sign SIBLING in NGT.

In terms of representing the form of mouthings in the grammar, it is common to use the orthographic form of the language, at least for languages that use a roman script. One could also consider using an IPA transcription, although ideally a "viseme" transcription combined with a reference to the source word would be used.

1.5.3 Other non-manuals

Non-manuals that are not articulated solely by the mouth can be characterized in this section only to the extent to which they form part of lexical items. Little standardization has been observed in this domain, but a distinction that could be used is between those non-manual forms that are part of an affective display (whether universal or culture-specific), and those that appear to be specific to the language.

Non-manual features that are not part of a lexical item (nor constitute one themselves) should be addressed in the chapter on prosody [Phonology – Chapter 2].

Elicitation materials

Citation forms of lexical items are often harvested from dictionaries. Comparing such forms can lead to a first impression of the contrastive or restrictive use of phonological elements. Information about phonetic variation can be used to

corroborate these impressions. They can be obtained by (i) investigation of phonetic variation in sentence or discourse context, possibly complemented by (ii) eliciting multiple citation forms from multiple signers. To elicit citation forms, people have used both written word lists and pictures. In both cases, the semantics of the elicited sign is not self-evident, and need not map one-on-one to the spoken language word or the picture.

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Chapter 2 Prosody

2.0 Definitions and challenges

2.0.1 What is prosody?

Prosody is a cover term for properties like intonation, rhythm, stress, and prominence. It thus has to do with the phonological structure of utterances above the phonemic level and may encode both strictly grammatical functions like the force of an utterance (declarative, interrogative, or imperative [Semantics – Section 1.13]) and broader communication functions like irony, sarcasm, etc. While these functions are mainly instantiated by manipulating the tune of the utterance in spoken languages, they are mainly encoded by non-manual components (facial expressions and body positions) in sign languages, although the non-dominant hand and movement also play a non-marginal role.

The grammar writer may propose a spoken language example and a sign language example to highlight the contrast. To illustrate, examples from Italian and LIS are given below. In these two languages, declarative sentences are distinguished from polar (yes/no) questions only by their prosodic features. Simplifying a bit, a final falling (low tone) vs. raising (high tone) contour is used to contrast declarative and polar sentences in Italian (a/a'), while a neutral vs. raised eyebrow position produces the same contrast in LIS (b/b'). Ironic or sarcastic intent can be added to the LIS examples, if uttered with a quick smile or a grin; while appropriate manipulation of the prosodic tune would do the same work for the Italian examples.

	L		H	
a.	hai mangiato 'You ate.'	a'.	hai mangiato 'Have you eaten?'	(Italian)
			raised eyebrows	
b.	INDEX$_2$ EAT DONE 'You ate.'	b'.	INDEX$_2$ EAT DONE 'Have you eaten?'	(LIS)

Structurally, two major prosodic domains are distinguished, and this basic distinction is reflected in the structure of this chapter:

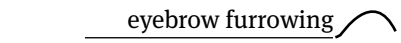
(i) the (sub-)lexical domain (syllable [Phonology – Section 2.1.1] and foot [Phonology – Section 2.1.2])

(ii) the domains above the lexical unit (prosodic word [Phonology – Section 2.2.1], different types of prosodic phrases)

2.0.2 Prosodic markers

In the introductory section to prosody, the grammar writer may decide over two possible classifications for prosodic markers, rather than just listing them. One classification is based on the active articulators and distinguishes manual vs. non-manual markers; the other is based on what is actually marked and distinguishes between boundary markers vs. domain markers. Eventually, both classifications can be adopted at once by distinguishing manual vs. non-manual markers first and then within each category further distinguishing between boundary markers and domain markers (or vice-versa).

Boundary markers (e.g. eye blinks, single head nods, etc.), also referred to as "punctual markers", are typically placed at one or both boundaries of a prosodic constituent. Domain markers (e.g. eye aperture, eyebrow position, body leans, etc.) normally spread over the entire prosodic domain they mark. Some markers, such as head nod for instance, can be used as both punctual and (when repeated) as domain markers. While the boundary markers are typically characterized by a categorical behavior (either they are present or absent), the domain markers may exhibit a more gradient pattern. For instance, non-manual markers in ASL wh-questions [Syntax – Section 1.2.3] / wh-questions display a gradient pattern. While the non-manual marker 'eyebrow furrowing' spreads over the entire clause, the peak of intensity is found on the wh-word, which in the below example appears in clause final position:



BOBBY BUY YESTERDAY WHAT

'What did Bobby buy yesterday?' (ASL, adapted from Bahan 1996: 75)

Turning to the classification based on the articulators, the main manual indicators of prosodic domains include: the movement component, the non-dominant hand in asymmetric two-handed sign [Phonology – Section 1.4], and hand switching. Movement is crucial in determining the rhythmic pattern, and the distribution and duration of pauses (holds) are the key indicators of major prosodic constituents like intonational phrases and utterance phrases. In this sense, movement is used as a boundary marker. The non-dominant hand may remain in place after a two-handed sign has been produced and spread across other signs. When used with prosodic functions only, the spreading domain of the non-dominant hand is normally limited to smaller prosodic constituents, like the phonological phrase, but when used with a semantic impact, as in buoys [Lexicon – Section 1.2.3] / buoys, it can even spread across multiple utterances. The grammar writer should then distinguish cases in which the non-dominant hand has prosodic functions from cases in which it functions as a primarily semantic tool. The maintenance of the non-dominant hand therefore constitutes a domain marker. Sometimes switching of the dominant hand

may indicate the presence of a prosodic boundary. The inventory of manual prosodic features is summarized here:

Inventory of manual prosodic features
(i) modulation of movement (rhythm, length, and tension)
(ii) spreading of non-dominant hand
(iii) hand switching

The term non-manual marker (NMM) covers all aspects of sign language production that are not tied to the manual component. This includes facial expressions, eye gaze, head and body movements, etc. A non-exhaustive inventory of NMMs is presented below. The grammar writer may use it as a tentative check-list to see which marker is active in the language to be described.

Inventory of NMMs
(i) facial expressions
    a. eyebrows
        – raised: normally associated to topic, if-clause, etc.
        – lowered: normally associated to wh-constructions and focus
        – degree of raising = intensity
    b. eye aperture
    c. eye gaze
    d. cheeks
    e. mouth
    f. lips
    g. chin position
(ii) mouthing and mouth gestures
(iii) head position
    a. nod
    b. rotation
    c. tilt
(iv) shoulder position
(v) body position

While spoken language phonology, especially in the sublexical domain, only marginally relays on simultaneity (McCarthy 1981; Selkirk 1982), the grammar of sign languages exploits this option to the opposite extreme. Layering is thus a crucial concept in the description of sign languages, at all levels of linguistic description (Wilbur 2000). At the sublexical level, layering is mainly manifested by manual components, although lexical non-manuals are also commonly used. Above the lexical unit, it is mostly non-manual components that are involved. The grammar writer may use this generalization to classify the various prosodic markers operating in the language. An NGT example illustrating the layering of different types of non-manual prosodic

markers is given below (non-manuals somewhat simplified in the gloss): eyebrow and head position mark two larger prosodic constituents, and immediately before the second one, spreading of a mouthing (Dutch *vergadering* 'meeting') from a noun onto an indexical sign marks a smaller prosodic constituent (a prosodic word).

 2_2.0.2_1_NGT_YESTERDAY EVENING INDEX2 MEETING INDEX3A BE-PRESENT

school *morgen* *avond* *vergadering* *shhh*
raised eyebrows raised eyebrows + head forward
SCHOOL INDEX_{3b}, TOMORROW EVENING MEETING INDEX_{3b}, INDEX_2 BE-PRESENT_{3b} INDEX_2
'As for the meeting tomorrow evening at the school, will you be there?'

When looking at non-manual domain markers, the grammar writer should pay careful attention in the description of their alignment, especially in the case of multiple layering, since different NMMs may mark different prosodic domains, that is, one NMM may have a slightly larger spreading domain than the other one.

Crucially, it may frequently be the case that a prosodic function is expressed by a cluster of co-occurring markers (i.e. by layering). For instance, the interrogative intonation (which in the linguistic literature is sometimes simply glossed as 'q' or 'y/n') may well systematically involve a number of non-manual articulations (e.g. raised eyebrows, chin up, forward lean). In this case, it may be convenient to provide a summary table like the one below, in which the grammar writer indicates which function goes with which marker(s). This, however, is optional, as many of these specific prosodic functions align with syntactic functions and will therefore also be addressed in the respective chapters in the Syntax Part of the grammar.

Table Phonology-1: Example of a table that specifies which non-manual prosodic markers go with a specific grammatical function, in this case: a polar question

Prosodic function	Prosodic markers
Polar question	— raised eyebrows — chin up — forward lean

2.0.3 Methodological challenges

The domain of prosody reflects, maybe more than others, the relative youth of the field of sign language linguistics and the fact that most of what we know comes from one sign language only, namely ASL. Systematic works outside the domain of the prosodic word are still missing. This is reflected in a quite uneven development of the substructure of the table of contents and its manual counterparts.

One major methodological challenge is (in)consistency of prosodic markers within and across signers. In very few cases, researchers are able to determine which element is necessary and which element is sufficient to mark for some specific phenomenon/prosodic domain. This makes the form-to-function mapping an extremely delicate component of the grammar. The grammar writer should then mention whether the specific marker under discussion is a necessary and/or sufficient element for the specific phenomenon or domain.

2.0.4 Outline of the chapter

This chapter starts by defining two separate types of prosodic domains: domains at the lexical level [Phonology – Section 2.1] and domains above the lexical level [Phonology – Section 2.2]. The following section is devoted to intonation [Phonology – Section 2.3]. In the final section, interactions [Phonology – Section 2.4] with pragmatics (in the broad sense of the term) are discussed. Notice further that the two domains of prosody, sublexical and above the lexical unit, intersect in certain ways with two other modules of grammar, namely morphology (at the lexical level) and syntax (above the lexical unit). We suggest the grammar writer pinpoint which prosodic aspect correlates with which grammatical process (e.g. movement reduction and reduplication in plural formation or brow position for clause-type marking).

2.1 The lexical level

This section includes guidelines to describe prosodic constituency that pertains up to the lexical level. This includes the syllable [Phonology – Section 2.1.1] and possibly the foot [Phonology – Section 2.1.2]. The prosodic word is a constituent classified above the lexical level because it may include more than one lexical entry (e.g. pronoun clitics and some compounds [Morphology – Chapter 1]). Notice that the focus here is mainly on the core lexicon [Lexicon – Section 1.1] of sign language possibly excluding classifiers [Lexicon – Section 1.2.1].

2.1.1 Syllable

Traditionally, the syllable is defined as the prosodic level above the phonemic level and below the foot (the immediately higher prosodic level). Within this level, phonemes are organized according to prosodic features (e.g. the sonority hierarchy, etc.).

The sign language syllable is usually considered a sequential unit composed by at least a handshape, a location, and a movement. The number of syllables of a sign is

provided by the number of sequential movements. The LIS sign for BEAT includes two sequential movements and therefore should be counted as disyllabic.

BEAT (LIS)

2_2.1.1_1_LIS_beat_Video

In this section, the grammar writer may also want to stress the particular role played by the movement component in the structural organization of the syllable. Indeed, movements represent the nucleus of the sign language syllable, determine the syllable weight, and influence the higher levels of prosodic organization (Perlmutter 1992; van der Kooij & Crasborn 2008; Sandler 2008; Jantunen & Takkinen 2010). The grammar writer may decide whether to treat these topics within this section or separately by introducing additional sub-headers to this section.

As for syllable weight, simple movements count as light weight units, thus resulting in light syllables, while complex movements count as heavy weight units, thus resulting in heavy syllables. The grammar writer should provide an example of each syllable type. Syllables composed by one type of movement only are considered light syllables. The LIS sign for BEAT shown above contains two light syllables. Syllables composed by a complex movement (i.e. two simultaneous movements, typically a secondary movement, e.g. orientation or handshape change, co-occurring with a path movement) are considered heavy syllables. For instance, the sign for IMPORTANT in LIS contains one heavy syllable composed of a directional path movement overlapping with a handshape change.

2_2.1.1_2_LIS_important

In addition, different types of secondary movements may combine, such as an orientation change and a handshape change. However, it is important to note that not all combinations between movement types may be allowed within one language. It is possible that this is due to constraints operating at the syllabic level. If this is the case, then the grammar writer should list and describe the constraints in this section (eventually with a reference to the section on phonological movement

[Phonology – Section 1.3]). If these constraints depend on the relative prominence of the movements in a heavy syllable, then the grammar writer may also use the sonority hierarchy shown below to capture the generalization.

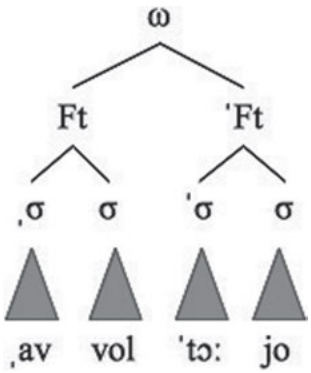
At the syllabic level, prominence is normally marked by manipulating the movement component or by looking at the pattern of handshape change. Movement prominence determines the degree of "sonority" of a syllable (i.e. the ability of a sign to be perceived at greater distance). Sonority is measured on the basis of the joint(s) used to articulate a single movement. The closer a joint is to the body of the signer, the higher its sonority. In this way, the joints involved in the movement of a sign can be lined up according to a scale of sonority, a sonority hierarchy (Brentari 1998).

Sonority hierarchy
shoulder > elbow > wrist > base joints > non-base joints

Low level of sonority: FEAR (LIS)
High level of sonority: SCOTLAND/DEBT (LIS)

2.1.2 Foot

Foot is defined as a prosodic unity above the syllable but below the word. It is the level at which stress patterns are organized by alternating strong and weak syllables within a foot. An example is the Italian word *avvoltoio* ('vulture'), consisting of four syllables (σ) organized in two feet (Ft), each of them containing a strong and a weak syllable, as shown below.



(Italian)

This area of prosodic structure is quite unexplored in sign language. The reason is probably that signs are most commonly monosyllabic in the sign languages that have undergone detailed phonological analysis so far (such as ASL, Israeli SL, and NGT).

This makes the emergence and the identification of an intermediate level between the syllable and the word unlikely. Therefore, depending on the status of prototypical signs in a language, this section may be relevant or not relevant. If the to-be-described sign language is more ASL-like (tendency for signs to be monosyllabic), the section will probably be irrelevant, and the grammar writer may decide not to include it in the grammar. If the sign language is more LIS-like (tendency for signs to be at least disyllabic), then this part of the prosodic organization becomes more relevant. The grammar writer may then consider the alternation between strong and weak syllables within a sign. A relevant question is whether stress patterns can be related to the syllabic level.

In principle, a careful description of the compatibility between multi-syllabic signs and heavy syllables should be illustrated. The existence of constraints on possible word-internal syllable sequences may be governed at this level of the prosodic structure. Specifically, the grammar writer may discuss which of the following patterns is attested in the language: light+heavy, heavy+light, and heavy+heavy (possibly non-repeated). An example of each is given below.

- light+heavy syllable alternation: SOUTH-AFRICA (LIS)
- heavy+light syllable alternation: GOOD-MORNING (LSF: potentially a compound)
- heavy+heavy syllable (repeated) alternation: DIRTY (LIS)
- heavy+heavy syllable (non-repeated) alternation: NO-VALUE (LIS: monomorphemic sign)

The alternation between strong and weak syllables determines prominence among word-internal adjacent syllables. This can be marked in sign languages by variation in the muscle tension during the articulation of the syllabic movement: the higher the tension the more stressed/prominent the syllable. If the grammar writer chooses not to include a section on the foot, then the description of what combination of syllable types is possible in the language should be moved to the section addressing the prosodic word [Phonology – Section 2.2.1].

2.2 Above the lexical level

This section includes guidelines to describe prosodic constituents that pertain to the lexical level and units of prosodic structure above the lexical level. This is the part of the grammar where the contribution of non-manual components is most relevant and where layering is most complex to describe.

One crucial aspect is how to correctly identify the various prosodic domains and how to describe them. The grammar writer may use a manual vs. non-manual classification for the relevant prosodic markers and then further specify their prosodic features distinguishing between domain markers and boundary markers. Alternatively,

a classification based on prosodic features (domain vs. boundary marker) can be made first and then the manual vs. non-manual distinction can be used to further characterize the phonological shape of the marker. Below, we adopt the former option, as the division between domain and boundary markers is relevant for all prosodic domains, while the same is less true for the division between manual and non-manual markers.

For each section, which corresponds to a specific prosodic unit, the grammar writer should describe the active markers by indicating type (domain vs. boundary marker), phonetic properties (manual vs. non-manual and further description if needed), distribution (e.g. total vs. partial spreading for domain marker, single edge vs. both edges for boundary markers), whether they are in complementary distribution or they instantiate layering and how prominence is marked. The grammar writer may decide to address each of these aspects in separate subsections.

The grammar writer may also introduce a table in which all the markers are summarized by their prosodic function, so that an overview of the prosodic structure of the language can be immediately accessible. An example of such table is given below. Each cell should contain the main phonetic features of each marker.

Table Phonology-2: Example of a table that provides an overview of manual and non-manual markers and their prosodic functions

	Domain marker		**Boundary marker**		**Comments**
	Manual	Non-manual	Manual	Non-manual	
Prosodic word					
Phonological phrase					
Intonational phrase					
Utterance phrase					

2.2.1 Prosodic word

The prosodic word is an intermediate prosodic constituent higher than the syllable (or foot, if relevant) but lower than the phonological phrase. Normally, it includes single signs, but it may also include more than one lexical sign, as in the case of cliticization and compounds [Morphology – Chapter 1]/ compounds.

Functional words tend to be phonologically weak and often cliticize onto lexical hosts in sign languages much like in spoken languages (cf. English *he's* or French

j'aime). A case often occurring in sign languages is cliticization of a (weak) pointing sign to a lexical host. Cliticization may induce specific phonological processes like handshape assimilation [Phonology – Section 3.1.1] and coalescence [Phonology – Section 3.1.2].

Compounds also constitute potential prosodic words. Lexical compounds tend to conform as a unit to well-formedness constraints of the core native lexicon [Lexicon – Section 1.1], but non-lexicalized compounds also may be subject to phonological constraints.

In addition to providing examples for each of these cases, the grammar writer should also provide the list of markers that are active at this level indicating whether these identify the prosodic domain or its boundaries, and whether these are manual or non-manual. For instance, the contrastive phonological components of a sign may serve as domain markers. Specifically, prosodic words may have a maximum of one contrastive value in each of the phonological components: handshape, place of articulation, movement, orientation, and non-manuals (Tang et al. 2010: 521). In the case of cliticization and compounds, phonological processes may reduce the effects of the violation of this constraint. To illustrate, handshape assimilation within a cliticized prosodic word reduces the number of contrastive handshapes within the prosodic word. These markers are typically manual markers, although lexical non-manual markers may also be involved in this type of constraints. As for non-manual markers, it has, for instance, been observed that spreading of the mouthing from a lexical sign onto an adjacent functional sign may be indicative of cliticization, as in the following NGT example, which features three instances of spreading of mouthing.

/doɐp/	/jɔŋən/	/wo:n/
VILLAGE INDEX	BOY PERSON	LIVE INDEX

'There was a boy who lived in a village.' (NGT, Crasborn et al. 2008: 59)

An example of a boundary marker optionally indicating the presence of prosodic words is provided by the pattern of final lengthening in HKSL. In this language, no lengthening is observed at the level of the prosodic word, while higher prosodic units like phonological phrases and intonational phrases are marked by weak and strong lengthening, respectively. This type of marking identifies the right-edge of the constituent (Tang et al. 2010).

Prominence at this level may reveal a differentiated pattern depending on the phonological shape of the sign. For instance, in NGT prominence in disyllabic signs depends on the type of movement. If the movement of the second syllable is a repetition of the movement of the first syllable, than prominence is on the first syllable. If the movement of the second syllable is different from that of first one, then prominence is marked on the second syllable (van der Kooij & Crasborn 2008; Crasborn, van der Kooij & Ros 2012).

2.2.2 Phonological phrase

The level where prosodic words are organized in larger units is the phonological phrase. An example of domain markers accompanying phonological phrases is provided by Israeli SL (Nespor & Sandler 1999). In this language, manual and non-manual markers can be used to identify the domain of a phonological phrase. The manual device is a phonological process called non-dominant hand spreading: the non-dominant hand of a two-handed sign is held in place at the end of the sign until the right edge of the phonological phrase, while the other hand keeps on articulating signs. The non-manual device consists of special facial expressions whose spreading domain is the phonological phrase. Various articulators may contribute to these expressions.

As far as domain boundaries are concerned, two possible situations can be encountered if the language under discussion uses more than one marker. Either the markers are in complementary distribution or they are layered. An example of boundary markers that are in complementary distribution is provided by right-edge markers in Israeli SL. These are: (i) small pause, (ii) increase in sign duration realized by a final hold, and (iii) movement iteration (Nespor & Sandler 1999). The grammar writer should also mention whether manual and non-manual markers are allowed to co-occur in the same phrase. A relevant example is provided by HKSL, where manual (weak final lengthening) and non-manual (eye-blinking) edge markers co-occur (Tang et al. 2010).

An example of how prominence is marked at this prosodic level is provided by Israeli SL, where non-dominant hand spreading indicates that prominence is given to the right-edge boundary of the prosodic constituent.

2.2.3 Intonational phrase

At the level of the intonational phrase, phonological phrases are organized into larger prosodic units. Intonational phrases are normally associated with several syntactic constructions: topicalizations [Syntax – Section 2.3.3.3], parentheticals, non-restrictive relative clauses [Syntax – Section 3.4.7.3], etc.

Intonational phrase markers tend to co-occur more easily than phonological phrase makers. Therefore, layering is expected to occur more easily at this level than others. A list of the most common intonational phrase boundary markers is given below. The grammar writer may use this list as a way to identify the relevant markers for the language being described.

Prosodic boundaries marking the intonational phrase

a. Right edge sign lengthening (roughly twice as long as within the intonational phrase)

b. Change in head position
c. Change in body position
d. Across-the-board change of all facial expressions
e. Eye blinking
f. Change in brow position

The following example from Israeli SL illustrates a case of prosodic layering at the level of intonational phrases. The discussion following the example illustrates how a similar example could be discussed in the grammar.

	$[[\text{BOOK-THERE}]_{p}$	$[\text{HE WRITE}]_{p}]_{I}$	$[[\text{INTERESTING}]_{p}]_{I}$
brows	up _____		down _____
eyes	squint _____		droop _____
mouth		'O' _____	down _____
head	tilt _____		
mouthing	'book' _____		'interesting' __
torso	lean _____		
hold	=		
reduplication	–1	× 3	× 4
speed			slow
size		big	big

(Israeli SL, Sandler 1999b: 206)

The sequence contains two intonational phrases, the first one is a topic including a relative clause and is composed of two phonological phrases; while the second intonational phrase only contains the matrix predicate. The position of eyebrows, head, and torso simultaneously changes at the edge of the first intonational phrase, illustrating a typical case of multi-layered domain marking (each marker spreads over the same prosodic domain). Repetitions and modification of sign size marks the edge of each intonational phrase showing that also boundary markers – in this case, manual boundary markers – may co-occur. The fact that both repetitions and size modification target the last sign of the first intonational phrase shows that these are right-edge markers. In principle, non-manual boundary markers (e.g. eye blink) might also play a role (Sze 2008; Herrmann 2010), but these are not included in the above example.

At the intonational phrase level, prominence can be marked in various ways. In Israeli SL, final lengthening (e.g. the presence of a right-edge marker) is interpreted as an instance of prominence. In ASL, prominence at the intonational phrase level is marked by a peak of velocity in the sign stream. Specifically, the right edge of intonational phrases tends to have the highest velocity peak.

2.2.4 Phonological utterance

A deep understanding of this level of prosodic organization is still missing for sign languages. On the one hand, it is the level where intonational phrases [Phonology – Section 2.2.3] are organized; on the other hand, it is the level that interfaces with other aspects of linguistic and non-linguistic communication (e.g. turn regulation [Phonology – Section 2.4.1]). While its edges can be matched with the locutory act, much less is known about phonological phenomena scoping inside this domain.

An example of how boundary markers are used at this level is provided by NGT, where handshape holds, syllable repetitions, strong movements, or insertion of a dummy element (e.g. a pointing sign or PALM-UP) may mark the right-edge of the phrase. These markers are in complementary distribution and are also used to mark prominence at the level of the phonological utterance (van der Kooij & Crasborn 2008; Crasborn, van der Kooij & Ros 2012).

2.3 Intonation

This section may be partially redundant, as it overlaps with material contained in the previous section, and also with information provided in sections within the Syntax Part. Still, the grammar writer is encouraged to include a section on intonation with cross-references to other sections in which the topic of intonational tunes (that may accompany specific syntactic constructions) are discussed.

Intonation is the association of one (or more) prosodic marker to a specific function, roughly comparable to tunes in spoken languages. These are basically groups of non-manual expressions (mainly facial expressions) that consistently mark for specific meanings. An example are the layered NMMs accompanying wh-questions in ASL, which can be considered a wh-intonation.

headshake
eyebrow furrowing
BOBBY BUY YESTERDAY WHAT
'What did Bobby buy yesterday?' (ASL, Bahan 1996: 75)

In other cases, multiple layers combine to produce more complex meaning and add semantic nuances to a tune. This is the case of conditionals in Israeli SL. In this sign language, *if*-clauses are usually marked by brow raise (as in many other sign languages); however, counterfactual conditionals combine the standard brow raise with lower-lid squint (Dachkovsky 2008).

The grammar writer should discuss the main tunes and their distribution in terms of spreading domain. A summary table like the following one can also be provided at the end of the section.

Table Phonology-3: Example of a table that provides an overview of different types of non-manual markers, their prosodic/grammatical function, and their spreading domain

	Type of marker	Spreading domain	Comments
Polar question			
Wh-question			
Relative clause			
If-clause			
Focus			
Topic			
...			

2.4 Interaction

2.4.1 Turn regulation

A variety of turn-taking signals have been identified in various sign languages, including many non-manual cues (Baker 1977; Groeber & Pochon-Berger 2014; Martinez 1995). However, given the many-to-many mapping of non-manuals to grammatical and information-structural functions, it is not always easy to straightforwardly establish that a certain non-manual signal (say, a head nod to mark the end of a turn) has a specific turn-regulating function.

A more principled problem that the grammar writer will be faced with is to decide whether these signals are in fact lexicalized and/or grammaticalized, and thus deserve a place in the grammar. An example is eye gaze, which has been argued to serve various functions, and for which it is often noted that gaze towards the interlocutor is a consistent signal associated with turn-yielding (Martinez 1995). Is this simply a consequence of the perceptual need to look at the interlocutor, or is it a prosodic cue that interacts with other parts of the language? This has not been straightforwardly established for any cue in any sign language, as far as we know. The decision to include this section in the grammar may therefore be based on the wish to deal with interactive functions of language more generally.

Additionally, the grammar writer should deliberate whether to include turn-regulation in the section on prosody – as suggested here – or to create a separate section that may include other forms (like lexical markers that are not specifically prosodic in nature) and will extend more broadly to the organization of discourse.

That being said, it is important to distinguish the *forms* that are observed to play a role from the *functions* that they perform. A function like turn-maintenance or continuation can be signaled by forms such as gazing away from the addressee and the continued presence of non-dominant hand holds across sentence boundaries. A function like turn-yielding or turn-ending can be marked by a long hold, that is, a prosodic

modification of the manual movement. These lengthening phenomena are typically prosodic in nature: they modify the lexical movement of the sign in specific sentence contexts or discourse contexts. In terms of non-manual features, aside from eye gaze, the use of non-manual question markers is likely to be relevant to turn-regulation (the prototypical question requiring an answer), whatever their exact form may be. Furthermore, it has been observed that head movements are also associated with turn-regulation, in the sense that head orientation may accompany gaze direction and thus reflect presence or absence of eye gaze towards the interlocutor.

Aside from these signer-side behaviors, there may be specific prosodic features on the side of the addressee that deserve separate mention, such as repeated movement and long holds of attention-getting particles like HEY. Again, it is necessary to make a careful decision whether or not to treat these phenomena as specifically prosodic, or to include them in a more general section on interaction or discourse (if at all).

2.4.2 Back-channeling

As for back-channeling, the same general considerations as discussed in the previous paragraph apply. If they are treated, it would be sensible to devote a separate section to them. Here, too, there is relatively little literature on sign languages that can help the grammar writer make the judgment that these signals are grammaticalized in the language to be described.

Elicitation materials

To the best of our knowledge, to date, no elicitation materials specifically targeting prosodic structure are available. Most of the studies either report translation tasks from written input (Nespor & Sandler 1999; van der Kooij & Crasborn 2008) or are based on corpus data (Crasborn, van der Kooij & Ros 2012). As mentioned in the methodological caveats at the beginning of this document, either strategy has its own pros and cons, especially when the distribution and spreading of NMMs are concerned. More controlled elicitation material has been used in Tang et al. (2010). Currently, this material is not available.

References

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Chapter 3 Phonological processes

3.0 Definitions and challenges

3.0.1 What is a phonological process?

A phonological process is the result of applying a set of constraints or rules manipulating the phonological shape of (underlying) input forms in order to obtain some output forms. Phonological processes may be the reflection of the competing pressure to maximize ease of articulation on the one hand and ease of perception on the other hand. These may yield language-specific phonological patterns. Another type of phonological process affecting the lexicon is the adaptation of the form of loan words from another (sign) language.

One special case of the latter are processes affecting loan signs [Lexicon – Chapter 2] / loan signs containing phonemic material in the original language that are not part of the phonemic inventory of the target language. Languages may adopt different strategies in order to accommodate this situation; one of these is adapting the form of the loan sign to the phonemic inventory of the target language. For instance, LIS does not have the 🖐-handshape in its phonemic inventory. Hence, in order to accommodate the borrowing of the sign WORKSHOP from ASL (left image), the 🖐-handshape is used (right image).

WORKSHOP (ASL)

WORKSHOP (LIS)

3.0.2 Caveats

Phonological processes are normally dependent on specific domains of application (phoneme, syllable, prosodic word, etc.) but can be further constrained by non-phonological factors such as morphological boundaries. This is particularly evident in spoken languages where morphology is mainly concatenative. However, in the case of sign language, the grammar writer should pay careful attention to the potential interactions between phonological processes and non-concatenative morphology.

The grammar writer should concentrate mainly on processes active in the synchronic grammar. Phonological processes whose outcomes are visible diachronically and which result in lexically specified allophonic alternation are not considered here (for an interesting overview of historical phonological changes in ASL, see Frishberg 1975). However, the grammar writer may eventually mention them in a separate subsection.

3.0.3 Outline of the chapter

Phonological processes are ordered with respect to the phonological component affected by the process itself rather than with respect to the main phonological domain of application. This strategy is chosen because specific processes are expected to be frequently observed across sign languages, while their phonological domains of application may vary from language to language. For instance, assimilation affecting the shape of phonemes is quite a widespread phenomenon in sign languages; however, whether this is bound to the prosodic word or other prosodic levels may be subject to language-specific variation. Therefore, we treat assimilation as a process affecting the phoneme, rather than a process applying within, say, the domain of the phonological word in a specific sign language. The grammar writer may choose a different perspective and decide to organize phonological processes according to other criteria. For instance, phonological processes could also be described at the end of each relevant prosodic domain (i.e. intrasyllabic processes may be presented at the end of the section where the syllable [Phonology – Section 2.1.1] is discussed, processes having the prosodic word as domain could be presented in the section on the prosodic word [Phonology – Section 2.2.1], etc.). If the grammar writer adopts this alternative partition, then this entire chapter – or a good part of it – may not appear in the final reference grammar.

3.1 Processes affecting the phonemic level

This section includes guidelines to describe phonological processes that affect the phonemic level. First, the definition of the process is given, then it is illustrated by means of examples.

3.1.1 Assimilation

Assimilation is a phonological process allowing one or more features of a phoneme to take the same value of another phoneme within a certain domain. The result is that the form undergoing the phonological change becomes more like a nearby form.

Assimilation can be partial (only some features are copied) or total (all features are copied). With respect to the source of assimilation, we can distinguish:

- Regressive assimilation if the source of assimilation is a following form;
- Progressive assimilation if the source of assimilation is a preceding form;
- Bidirectional assimilation if both a preceding and a following form are necessary to create the appropriate context.

Assimilation may target any of the phonological parameters of a sign. Here we present one example from handshape assimilation (also see Corina 1990). The grammar writer may decide to structure this section by including dedicated subsections in which assimilation is discussed per parameter.

An example of assimilation is provided by ☝-handshape signs in ASL (Lucas, Bayley & Valli 2001). Assimilation may target different features like [±hook], or the number of selected fingers. In this example, the case of finger selection is presented. Signs with a ☝ handshape may assimilate selected fingers and thumb extension from either preceding or following signs, resulting in full progressive or regressive assimilation, such that, for instance, a first person pronoun INDEX$_1$ (lexically specified for ☝-handshape) may be articulated with all fingers and thumb extended (🖐-handshape).

Analogously, other parameters may show either total or partial assimilation. The difference between assimilation and coarticulation (variable and gradient assimilation depending on aspects of the articulation like signing speed; Ormel et al. 2013) may at times be hard to make.

In some cases, assimilation may be highly constrained by the context in which it is found. If present, the grammar writer should treat these cases separately. An example of this type of assimilation is provided by assimilation in the context of cliticization in Israeli SL, that is, within a prosodic word [Phonology – Section 2.2.1]. In this context, handshape assimilation is always uni-directional: handshape features spread from the lexical host onto the pointing sign, no matter whether the host precedes or follows the clitic element. In the following example from Israeli SL, for instance, the first person pointing pronoun cliticizes onto the main verb READ. As a result of this process, the pointing sign assimilates the 🤟-handshape from the following sign, which is the handshape of the dominant hand ('dh') in the lexical sign READ.

INDEX$_1$(🤟) READ(dh:🤟) (Israeli SL, Sandler 1999b: 196)

3.1.2 Coalescence

Coalescence is the fusion of two phonetic units into a single one. An example is provided by pronoun cliticization in Israeli SL, where the dominant hand of a symmetrical two handed-sign may become the host of a pointing sign (Sandler 1999b). This is illustrated by the Israeli SL sign SHOP. In its citation form, the sign SHOP is realized as

a symmetrical two handed sign with two -handshapes, as shown in the left image below. As a symmetrical two handed sign, SHOP satisfies the phonological requirement for coalescence to appear.

SHOP SHOP-THERE

(Israeli SL, Sandler 2006: 198)

The right image shows how fusion is realized. At the beginning of the cliticized form SHOP-THERE, the sign SHOP is produced by the two hands in the same configuration (as in the citation form). During the transition between the two locations of the sign, i.e. during the downward movement, the dominant hand changes its shape producing the typical -handshape of pointing signs, thus realizing the fused form SHOP-THERE.

3.1.3 Movement reduction and extension

Movement reduction and extension are phonological processes resulting in signs with smaller or larger movements than the movement of the citation form. Notice that the dimension concerned here is not the temporal one. As a side effect of the modification, sign duration may be shorter or longer, although this is not necessary.

There are two ways in which such movement modification may happen: either the reduction/extension is produced at the same joint where movement is produced in the citation form, or the movement is produced at a different joint, resulting in distalization and proximalization. More generally, movement modifications of both types are commonly found in the whispering/shouting mode [Phonology – Section 3.4.2]. In some case, reduction and extension may be morphologically induced.

3.1.3.1 Without joint shift

One case of movement reduction that does not necessarily involve a switch of the articulatory joint is found in plural reduplication morphology in LIS. The sign CITY contains a relatively long path vertical movement realized at the elbow. In the plural form, the movement is still realized at the elbow joint but it is shorter than in the citation form (note that this phonological process is morphologically conditioned).

 2_3.1.3.1_1a_LIS_city

CITY

 2_3.1.3.1_1b_LIS_city++

CITY++ ('cities') (LIS)

One case of movement extension is found in pointing signs when the space is iconically used. Pointing toward specific loci carries additional meaning about the locations of the various participants in an event. In this environment, the standard length of a pointing sign may be extended to reach locations at the periphery of the signing space. The conditioning factor of this process is ultimately to be found in the semantic/pragmatic domain.

3.1.3.2 With joint shift

Signs whose movement is executed by the elbow, wrist, or finger joint in the citation form may exhibit a shift in the selected joint resulting in a more proximal or distal execution of the movement. A shift towards a joint that is further away (i.e. more distal) from the body is referred to as distalization; a shift towards a joint that is closer (i.e. more proximal) to the torso as proximalization. Distal versions result in reduced movements, while proximal versions involve extended movements.

One example of distalization from LIS is provided by the sign VOLLEYBALL. In the citation form, VOLLEYBALL is produced with a repeated movement realized at the elbow joint. However, distalization produces an allophonic version with movement features specified at the wrist joint, as shown in the examples below.

 2_3.1.3.2_1a_LIS_volleyball

VOLLEYBALL (citation form)

 2_3.1.3.2_1b_LIS_volleyball(distal)

VOLLEYBALL (distal form) (LIS)

An example of proximalization from LSF is provided by the sign AGREEMENT. In the citation form, AGREEMENT is produced with a single movement realized at the wrist joint (left video below). However, proximalization produces an allophonic version with movement features specified at the elbow joint (right video) (note that proximalization is also commonly observed in first language acquisition; cf. Meier et al. 2008).

 2_3.1.3.2_2a_LSF_AGREEMENT (citation)

 2_3.1.3.2_2b_LSF_ AGREEMENT(proximal)

AGREEMENT (citation form) AGREEMENT (proximal form) (LSF)

3.1.4 Weak hand drop

Two-handed signs may show articulatory reduction and be produced with the dominant hand only; this process of phonological deletion is referred to as Weak Hand Drop, or just Weak Drop (Battison 1974; van der Kooij 2001). An example from LSF is the sign AGREEMENT. In the citation form, the sign is two handed, while in the reduced form it is one-handed.

 2_3.1.4_1a_LSF_AGREEMENT (citation)

 2_3.1.4_1b_LSF_ AGREEMENT(weak-drop)

AGREEMENT (citation form) AGREEMENT (Weak Drop) (LSF)

Normally, this process is phonologically (and possibly lexically) constrained by the type of two-handed sign. Typically, two-handed signs with a symmetrical non-alternating movement allow weak hand drop more easily than signs with alternating movement. In addition, a feature like [contact] may have an influence. Generally, weak hand drop appears to be more constrained in unbalanced signs, that is, in two-handed signs in which only one hand moves, in particular, in cases in which both hands have different handshapes. Finally, it has been observed for NGT that not only phonological factors are at play, but also lexical (semantic) factors: even in fully symmetrical signs weak hand drop may be ruled out if use of the two hands is iconically or metaphorically motivated, as, for instance, in the NGT signs MEET and SAME (van der Kooij 2001). The grammar writer should describe all these constraints.

3.1.5 Handshape drop

In signs with handshape change, it is often the case that one of the two handshapes is the closed or open variant of the other. As the result of a morphological process, phonological readjustments may lead to drop one of the two handshapes. The handshape which is not dropped is considered as the most prominent. An example of this process is found in ASL. Signs like HATE and ASK both involve handshape change. When affixed with the [multiple] morpheme [Morphology – Section 3.1.2.2], the two signs behave differently: HATE retains the first handshape, while ASK retains the second one. The handshape retained in this environment is the most prominent of the two handshapes appearing in the citation form of the sign.

3.1.6 Nativization

When a phoneme of a borrowed sign does not belong to the phonemic inventory of the target language, adaptation processes may change the original shape of the sign in order to meet well-formedness requirements.

A case of adaptation in LIS is the sign WORKSHOP, which is borrowed from ASL. In the source language the sign is articulated with a -handshape (left video below), which is not part of the handshape inventory in LIS. In order to make the sign compatible with LIS phonology, signers produce the sign WORKSHOP with the native -handshape (right video). Interestingly, in this adaptation, the initialization that is observed in the ASL sign (the -handshape representing the letter 'W') is lost.

 2_3.1.6_1_ASL_workshop

WORKSHOP (ASL)

 2_3.1.6_2_LIS_workshop

WORKSHOP (LIS)

Another case of nativization quite common in sign languages is that of "letter dropping" and movement interpolation during fingerspelling [Lexicon – Section 2.2.2] / fingerspelling in the process of local lexicalization. An example is provided by the fingerspelling of the word *syntax* in ASL (Brentari 1998: 231). After nativization, the sign loses two handshapes (i.e. two letters) and includes a movement between the second and the third handshape, as shown in the examples below (the Ø symbol indicates movement interpolation):

a. S-Y-N-T-A-X (fully fingerspelled form)
b. S-Y-Ø-T-X (nativized form)

3.1.7 Metathesis

Metathesis is a process that alters the order of phonemes in a word/sign. In sign languages, the process may affect signs involving a change of location as a result of movement (e.g. signs with a repeated movement perpendicular to the body contrasting the high vs. low part of the torso, or the ipsilateral vs. contralateral part of the torso).

A clear example of metathesis is the case of DEAF in ASL (Lucas et al. 2001). In its citation form, the sign is articulated with a -handshape which first makes contact with the ear and then with the lateral part of the mouth. In the metathesized form, the order of the two contact points is reversed, that is, the index finger first touches the lateral part of the mouth and then the ear.

 2_3.1.7_1_ASL_deaf metathesis

DEAF (after metathesis) (ASL)

3.2 Processes affecting the syllable

3.2.1 Epenthesis

Epenthesis is the insertion of phonemic material in order to repair ill-formed syllabic structures. For example, a consonant cluster formed by /s/ followed by a stop is not allowed in Spanish. An epenthetic mid-vowel /e/ is inserted in word-initial position to repair ill-formed words. This process is visible in the standard lexicon (e.g. *escuela* ('school') derived from the Latin *scola*) but also in loans (e.g. /estrɛs:/ imported from English 'stress'). In sign language, epenthesis can affect any of the parameters (movement, handshape, location, and orientation). We first present a typical case of movement epenthesis, then a less typical case of movement epenthesis, namely movement interpolation.

An example of typical movement epenthesis is that of the sign HEAD in LIS (Geraci 2009). In its underlying form, the sign does not contain any movement component (image below). However, due to sonority requirements on well-formed syllables in LIS, an epenthetic repeated short movement is introduced, as shown in the video below.

HEAD (underlying form) (LIS)

2_3.2.1_1b_LIS_head surface

HEAD (surface form) (LIS)

Epenthesis is blocked when the sonority requirement is otherwise satisfied. In LIS, this is the case in compound forms where the second member of the compound provides the movement for the entire sign (thus satisfying the sonority requirement).

Thus, movement epenthesis is not required when the sign HEAD appears as first part of the compound HEAD^POUND ('smart').


2_3.2.1_2_LIS_smart

HEAD^POUND ('smart') (LIS)

A *sui generis* movement epenthesis is represented by the transition between signs. It basically consists in the interpolation of a straight movement which is needed to displace the hand from the final location of a sign to the initial location of the following sign. During this interpolation movement, the hand normally changes handshape and orientation into that of the to-be-articulated sign.

3.2.2 Syllable reduction

Signs with a repeated movement which count as disyllabic may lose one syllable (i.e. loose one movement) in compounds [Morphology – Chapter 1]. This process is normally conditioned by articulation speed. The faster the signing, the more syllable reduction is likely to appear.

An example from LIS is provided by the verb WORK, which in its citation form contains a repeated short movement perpendicular to the horizontal plane (left video below). When compounded with the aspectual marker DONE, it may lose one movement (right video below).


2_3.2.2_1a_LIS_work done unred


2_3.2.2_1b_LIS_work done reduced

WORK^DONE (unreduced form) WORK^DONE (reduced form) (LIS)

Since the number of syllables is defined as the number of sequential movements in a sign, the reduced compound form has one syllable less than the unreduced one (for more examples, see the section on prosodic characteristics of compounds [Morphology – Section 1.4.2]).

3.2.3 Syllable reanalysis

Disyllabic signs with two movements and a transitional location change interspersed between the two movements may reanalyze the transitional movement as the only movement of the sign.

An example is provided by the LIS sign INSTITUTE. In the citation form, this sign has a short movement with contact with the torso in two different locations (high and low – see left video below). This location change may be reanalyzed as the only

movement of the sign. The consequence of this process is that the disyllabic citation form is reduced (interpolation is not considered as part of the sign) to a monosyllabic form (interpolation is the only movement of the sign and it is fully part of it – see right video below).

 2_3.2.3_1a_LIS_institute_LATERAL-VIEW

 2_3.2.3_1b_LIS_institute reanalyzed LATERAL VIEW

INSTITUTE (citation form) INSTITUTE (reanalyzed form) (LIS)

3.3 Processes affecting the prosodic word

The phonological processes that are known to affect the prosodic word are processes that go hand in hand with morphological (reduplication and compounding) and syntactic-prosodic (cliticization) processes. Consequently, there is a clear relation between the following subsections and other sections in the Blueprint. The grammar writer may therefore decide to be fairly brief about these processes in the present subsection and to refer the reader to the relevant grammar sections where these phenomena are discussed in more detail.

3.3.1 Reduplication

Reduplication is a morphological process with the main phonological consequence that some or all the components of a sign are copied into the reduplicate morpheme, providing phonological content to the morpheme itself. Thus, reduplication is a case of morphologically induced repetition (note that, by itself, the term "repetition" is usually reserved for lexical, inherent, repetition and prosodically induced repetition). An example of reduplication is provided by plural morphology in many sign languages. The LIS sign CITY, for instance, is a monosyllabic two-handed sign (see left video below) which gets reduplicated in the plural form (see right video; for another process related to reduplication see the section on Movement reduction and extension [Phonology – Section 3.1.3]).

 2_3.3.1_1a_LIS_city

 2_3.3.1_1b_LIS_city++

CITY CITY++ ('cities') (LIS)

Given its morphological nature, reduplication will also make an appearance in various subsections within the Morphology Part of the Blueprint (e.g. the sections on Aspect [Morphology – Section 3.3] and on Number [Morphology – Section 3.1.2]). In the present section, the grammar writer should focus on the phonological change(s) induced by reduplication.

3.3.2 Phonological effects of cliticization and compounding

Compounding [Morphology – Chapter 1] / compounding combines two stems in the lexicon, while cliticization combines two (or more) words in a syntactic string. Both types of processes may affect the prosodic word. For instance, cliticization may result in coalescence [Phonology – Section 3.1.2] / coalescence. Several phonological processes may be induced by compounding. The most common processes are provided in the list below, which may be used as a checklist.

a. Reduction or deletion of phonological material (Liddell & Johnson 1986).
b. Duration is shorter than that of equivalent phrases (Klima & Bellugi 1979: 213).
c. The transitional movement between the two signs is more fluid.
d. The transitional movement is reanalyzed as the sole movement of the compound (Sandler 1999b; Geraci 2009).

Reanalysis of transitional movement is typically found in stable compounds. A relevant example is the LIS compound meaning 'parents', which results from merging the signs for MOTHER and FATHER, as illustrated in the three videos below.

2_3.3.2_1a_LIS_mother

MOTHER

2_3.3.2_1b_LIS_father

FATHER (LIS)

2_3.3.2_1c_LIS_parents

FATHER^MOTHER ('parents') (LIS)

The citation form of both signs has a repeated path movement which disappears in the compound, where the more distal handshape change () is found. The resulting sign meets all criteria of a well-formed lexical sign of LIS and its phonological shape is much "lighter" than that of the original signs. Indeed, PARENTS is a monosyllabic sign while each of its members, taken in isolation, would count as a disyllabic sign in its citation form. Given that compounds will be discussed in more detail in the Morphology Part, the grammar writer may decide to briefly summarize the most important changes here and to refer the reader to the section on phonological and prosodic characteristics of compounds [Morphology – Section 1.4.2].

3.4 Processes affecting higher prosodic units

3.4.1 Organization of the signing space

Depending on the quantity of signed material to be used in discourse, the dimension of the signing space may vary from utterance to utterance.

For instance, the dimension of the signing space normally employed to articulate simple declarative sentences is different from that needed to articulate more complex sentences involving subordination and coordination. In the example (a) below, the square indicates the signing space needed to produce a simple declarative sentence, while the square in (b) indicates the signing space used to produce the same sentence embedded under a verb of saying.

a. PIERO CONTRACT SIGN (LIS)

b. GIANNI SAY PIERO CONTRACT SIGN (LIS)

Another process imposing a marked organization of the signing space can be contrastive focus, where items are contrasted by putting them in separated and distant spatial locations.

3.4.2 Differences in "loudness": Whispering and shouting mode

Whispering mode may be realized in sign language by a general reduction of all parameters and a consequent reduction in the use of the signing space (Crasborn 2001). Conversely, increasing the "loudness" of the message (for instance, in order

to sign over a distance) may be realized by increasing the size of individual signs and the signing space. As whispering has the intent of hiding a message from someone else, whispering will only be used if the signer is in fact in the visual field of the audience that is not supposed to perceive the message. Only if there are language- or culture-specific constraints on the use or form of such functional and gradient phonetic changes, a separate section in the grammar would be merited. Alternatively, including a separate section on phonetic variability is also an option.

Elicitation materials

We are not aware of elicitation materials that would specifically address phonological processes. As in other domains, important information may be extracted from corpus data.

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