

EXPLORING THE EFFECTS OF PHRASE-FINAL LENGTHENING IN ITALIAN SIGN LANGUAGE (LIS) NOUN PHRASES

EXPLORANDO OS EFEITOS DO ALONGAMENTO EM FINAL EM SINTAGMAS NOMINAIS DA LÍNGUA DE SINAIS ITALIANA (LIS)

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ABSTRACT

Phrase-final lengthening is a quite common prosodic phenomenon, previously accounted for in several spoken and signed languages. This study aims at investigating the prosodic cues produced in correspondence with the final boundary of noun phrases in Italian Sign Language (LIS), analyzing corpus data from both quantitative and qualitative perspectives. The quantitative analysis confirms that noun phrases in LIS are affected by phrase-final lengthening (i.e. in noun phrases including one nominal modifier, on average, postnominal modifiers are longer than prenominal ones) and reveals that the various modifier classes show different degrees of sensitivity to this phenomenon. Building on these results, the qualitative analysis explores in detail those modifier classes that show lengthening effects in the corpus: the main consequences in the phonological makeup of signs are insertion of movement repetition, prolonged path movement, final hold accompanied by head nod, and weak prop. The study also offers possible explanations for the fact that quantifiers, ordinals, and determiner-like pointing signs are less sensitive to lengthening effects in the phrase-final boundary, suggesting that particular morpho-syntactic factors may come into play.

KEYWORDS: Italian Sign Language, noun phrases, phrase-final lengthening, prosodic markers

RESUMO

O alongamento final é um fenômeno prosódico comum, que já foi observado em diversas línguas orais e de sinais. Este estudo tem por objetivo investigar as pistas prosódicas produzidas em correspondência com os limites do sintagma nominal na língua de sinais italiana (LIS), analisando dados quantitativos e qualitativos oriundos de corpus. A análise quantitativa confirma que os sintagmas nominais em LIS são afetados pelo alongamento final (ex: em sintagmas nominais que incluem um modificador nominal, em média, modificadores pós-nominais são mais longos em comparação com os pré-nominais) e revela que as várias classes de modificadores exibem diferentes graus de sensibilidade a este fenômeno. A partir dos resultados, a análise qualitativa explora em detalhes as classes de modificadores que demonstram os efeitos do alongamento no corpus: as principais consequências para a constituição fonológica dos sinais são a adição de uma repetição do movimento, um prolongamento da trajetória do movimento, suspensão final acompanhada por um aceno de cabeça e a sustentação fraca do sinal. O estudo traz também possíveis explicações para o fato de que os sinais quantificadores, ordinais e as apontações com função de determinante são menos sensíveis aos efeitos de alongamento nos limites fronteiros entre os sintagmas, sugerindo que alguns fatores específicos de ordem morfossintática possam estar também em jogo.

PALAVRAS-CHAVE: Língua de sinais italiana, Sintagma Nominal, Alongamento final de sintagmas, marcadores prosódicos

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1. Introduction²

Prosodic studies focus on suprasegmental phenomena in language, such as pitch, length changes, intensity or loudness, timbre, and rhythm. In linguistics, prosody typically falls under the domain of phonology, but it often interacts with other linguistic domains, in particular syntax and pragmatics.

Prosodic cues play a crucial role in human language since they fulfill a variety of functions. They help distinguish alternative meanings of syntactically ambiguous sentences, such as “Tap the frog with the flower” (readings: tap the frog by using the flower, tap the frog that has the flower; SNEDEKER; TRUESWELL, 2003, p. 105). They can also reveal speaker’s attitude, for example signaling the presence of verbal irony (see ATTARDO, 2000 and references therein). Moreover, specific prosodic cues guide early language acquisition, helping infants detect the boundaries between phrases and words, and thus segment the linguistic stream into smaller units (GOSWAMI, 2008; MORGAN; MEIER; NEWPORT, 1987). Overall, prosodic information provides important cues that support language processing and comprehension (CUTLER; DAHAN; VAN DONSELAAR, 1997; MORGAN, 1996). Prosodic cues may also have a non-linguistic status, in that they can be used to convey the emotional state of the speaker, e.g. whether s/he is angry, sad, or surprised (MAJID, 2012; MURRAY; ARNOTT, 1993).

The description of prosodic phenomena may apply to different types of prosodic constituents. These units are not unrelated, rather they are hierarchically organized, with larger prosodic constituents dominating the smaller ones. Since the seminal work by Nespor; Vogel (1986), it is generally assumed that the prosodic architecture is organized according to the following hierarchy (from the smallest to the largest prosodic constituent): syllable < foot < prosodic word < clitic group < phonological phrase < intonational phrase < phonological utterance. Syllable and foot are domains pertaining to the lexical level, whereas the others are above the lexical level. Each prosodic constituent may be the domain to which a specific phonological phenomenon applies. For example, the foot is the domain of primary and secondary stress, and the phonological phrase is where *Raddoppiamento Sintattico*³ can be observed (NESPOR; VOGEL, 1986).

The prosodic hierarchy is claimed to apply not only across languages, but also across modalities.

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3 *Raddoppiamento sintattico*, or word-initial gemination, is a sandhi phenomenon found in many varieties of Central and Southern Italian (for more details, see NESPOR; VOGEL, 1986)

A number of studies on sign languages demonstrated that this theoretical model can be effectively applied also to the prosody expressed in the visual-manual modality (a.o. BRENTARI, 1998; NESPOR; SANDLER, 1999; SANDLER; LILLO-MARTIN, 2006). On the one hand, it has been shown that the abstract prosodic structure is comparable in spoken and signed languages, regardless of modality. On the other hand, modality plays an important role in shaping the markers used to convey prosodic information. Prosody in sign languages relies on: i) non-manual suprasegmentals, e.g. torso leans, head nods, eye blinks, eyebrows, mouth patterns; ii) manual features, e.g. modulations of the movement component (lengthening, hold, tension), transitions and pauses in the sign stream, non-dominant hand spread, dominance shift from the dominant to the non-dominant hand, and iii) positional factors, e.g. reduplication and insertion of phonological material in prosodically strategic positions (for an overview, see BRENTARI; CROSSLEY, 2002; FENLON; CORMIER; BRENTARI, 2018). Another important modality-related difference is the temporal distribution of prosodic markers. Although in both spoken and signed languages prosodic markers simultaneously co-occur with phonetic segments, the two language types differ in how different prosodic markers can be arranged. Since intonation in spoken languages is produced by one single articulator (i.e. vocal cords), each tone must be articulated independently in a linear sequence. On the contrary, sign language prosody can resort to several manual and non-manual articulators: because of this, different prosodic cues can occur simultaneously, thus resulting in layering combinations (WILBUR, 2000).

Sign language prosody is considered a new field in research and so far prosodic studies in the visual modality have been limited to a small number of sign languages. Although some key properties are expected to be found across different sign languages because of the common linguistic modality, it would be desirable to further extend the empirical base of this research domain, exploring prosodic differences across sign languages.⁴ In this endeavor, the current study proposes an investigation of prosodic cues marking the boundaries of phonological phrases in Italian Sign Language (LIS). Prosodic studies on this particular sign language are only at the beginning. Mantovan (2017) showed that nominal modifiers in the right periphery of nominal expressions in LIS are more likely to show a longer duration than those in the left periphery and proposed this as evidence of a phrase-final lengthening (for more details, see section 3). However, there are still many open questions concerning this prosodic phenomenon, such as: i) is this a generalized pattern affecting all types of nominal modifiers? ii) what are the implications of phrase-final lengthening on the phonological structure of LIS signs? and more generally, iii) what are the linguistic aspects interacting with lengthening

4 An attempt to approach cross-linguistic variation in prosody is the study by Tang; Brentari; González; Sze (2010), in which different sign languages are compared with respect to the production of eye blinks used as a prosodic cue.

effects? The aim of this paper is to shed light on these research questions by further exploring LIS corpus data both quantitatively and qualitatively.

The paper is organized as follows. Section 2 presents a brief overview of what has been documented so far about prosodic phenomena in LIS, an under-investigated domain in LIS research. Section 3 specifically deals with the phenomenon of phrase-final lengthening, reporting findings from corpus data on the duration of nominal modifiers occurring in noun phrases. Section 4 further explores LIS corpus data, investigating duration patterns in noun phrases with one modifier only, also according to different modifier classes. Section 5 analyzes corpus data from a qualitative perspective with the purpose to identify the effects of phrase-final lengthening on the phonological makeup of signs. The findings reported in Sections 4 and 5 and their implications to the understanding of phrase-final lengthening in LIS are discussed in depth in Section 6. Section 7 concludes the paper.

2. Previous studies on LIS prosody

Although research on LIS is about half a century old and a considerable body of scientific literature on different research topics has been produced over the years, prosody remains an under-investigated domain in the description of LIS grammar. This section provides some background information on the studies that mention prosodic phenomena in LIS in passing.

Cecchetto; Geraci; Zucchi (2009) discussed some syntactic constructions in LIS, including *wh*-questions and negative sentences, and observed that they are prosodically marked by specific non-manual markers, as illustrated in (1) and (2).

furrowed-brows

(1) GIANNI t_{WHO} KISS WHO

‘Who did Gianni kiss?’ (adapted from CECCHETTO; GERACI; ZUCCHI, 2009, p. 298)

headshake

(2) GIANNI NOBODY HELP

‘Gianni did not help anybody.’ (adapted from CECCHETTO; GERACI; ZUCCHI, 2009, p. 299)

One of the main claims proposed in this study is that these non-manual markers have not only a prosodic status, but they also bear a strong connection with the syntactic structure. According to the authors, they mark syntactic dependencies: specifically, furrowed brows occurring in content interrogatives mark the dependency between the base position of the *wh*-sign and the matrix clause

complementizer in the right periphery, as in (1), while the headshake co-occurring with negative quantifiers (i.e. NOBODY and NOTHING) marks the dependency between the argument position of the negative quantifier and the head of the Neg phrase in the right periphery it is associated to, as in (2).

In another study on LIS content interrogatives, Branchini; Cecchetto; Cardinaletti; Donati; Geraci (2013) analyzed corpus data and found a reduplication pattern: as exemplified in (3), some *wh*-questions may feature the presence of two lexically identical *wh*-signs, with one occurring at the beginning and the other at the end of the interrogative sentence.

wh

(3) **WHERE** PLACE ACCIDENT **WHERE**

‘Where did the accident take place?’ (adapted from BRANCHINI; CECCHETTO; CARDINALETTI; DONATI; GERACI, 2013, p. 168)

Interestingly, their quantitative analysis revealed that the two *wh*-signs differ in terms of duration, with the one occurring in sentence-final position lasting longer than the other. The authors also showed that a similar pattern is found with the aspectual marker DONE, which typically occurs in postverbal sentence-final position, as in (4)a, although it can also be found in clause-internal position, as in (4)b.

(4) a. THREE FOUR TIME GIANNI CALL **DONE**

b. GIANNI CALL **DONE** THREE FOUR TIME

‘Gianni called three or four times.’ (BRANCHINI; CECCHETTO; CARDINALETTI; DONATI; GERACI, 2013, p. 171)

As similarly observed with *wh*-signs, the sign DONE is significantly longer in final position than in non-final position. The authors accounted for this difference in duration proposing a generalized sentence-final lengthening effect. In this respect, the longer duration of DONE in final position acts like a prosodic boundary marker signaling the end of the sentence.

Prosodic markers in LIS have been shown to interact with some pragmatic phenomena as well. For example, focus may be signaled by both manual and non-manual prosodic markers: according to Calderone (2020), focalized elements are usually articulated quickly and with a larger amplitude and are accompanied by raised brows, wide-open eyes, and forward head lean.

In a recent study on the expression of irony in LIS, Mantovan; Giustolisi; Panzeri (2019)

showed that ironic remarks can be distinguished from literal ones by the presence of specific prosodic cues. From the manual point of view, ironic remarks are characterized by a significantly longer duration than their literal counterparts, and the lexical sign expressing evaluation (e.g. BEAUTIFUL, WORTHLESS) is frequently articulated broadening the movement in an exaggerated way. Non-manually, ironic remarks may be accompanied by wide-open eyes, raised eyebrows, multiple head-nods, sentence-initial open mouth, and sentence-final headshakes. Another finding discussed by the authors concerns mouth patterns: in both ironic and literal remarks, mouth-corners up convey compliment, whereas mouth-corners down convey criticism. With this respect, the position of the mouth is a prosodic marker signaling signer's attitude (compliment vs. criticism).

The brief overview presented in this section showed examples of interaction between prosodic markers and other linguistic components, such as syntax and pragmatics. The next sections explore the production of prosodic markers in the domain of phonological phrases, specifically those associated with noun phrases.

3. Phrase-final lengthening in LIS corpus data

According to the prosodic hierarchy introduced in Section 1 (NESPOR; VOGEL, 1986), phonological phrases can be regarded as an intermediate prosodic constituent between prosodic words and intonational phrases. Although prosodic and syntactic structures are not always overlapping (for a discussion, see SELKIRK, 1981), phonological phrases generally revolve around a lexical head (e.g. a noun, a verb) and often correspond to syntactic constituents, such as noun and verb phrases.

One of the main prosodic phenomena investigated at this prosodic level both in spoken and signed languages is final lengthening. Focusing on phonological phrases in the visual modality, in Israeli Sign Language the last sign is frequently reduplicated or hold in its location (NESPOR; SANDLER, 1999), in American Sign Language lengthening systematically occurs at the end and is considered a cue for the final boundary of the phrase (WILBUR, 1999; BRENTARI; CROSSLEY, 2002), and in Hong Kong Sign Language the final signs on average are about one and one-half times that of non-final forms (TANG; BRENTARI; GONZÁLEZ; SZE, 2010).

To examine if the boundaries of phonological phrases in LIS are signaled by specific prosodic markers, corpus data may allow fruitful quantitative investigations on a large scale. Mantovan (2017) conducted a corpus study to investigate the syntactic structure of nominal expressions in LIS. The empirical base of this study comprised data coming from the LIS Corpus Project (CARDINALETTI;

CECCHETTO; DONATI, 2011; GERACI; BATTAGLIA; CARDINALETTI; CECCHETTO; DONATI; GIUDICE; MEREGHETTI, 2011), specifically from the spontaneous narratives of 162 native or near-native LIS signers. Participants were balanced with respect to various social factors, including geographical provenance.⁵ The analysis of these naturalistic data examined the distribution of different types of nominal modifiers (e.g. adjectives, cardinal numerals, determiners) and their duration. To do this, all the data were annotated with the software ELAN (Eudico Linguistic Annotator).⁶ In particular, to analyze sign duration, each nominal modifier has been segmented, with particular attention being paid to the beginning and ending point. This procedure allowed to automatically extract the exact duration in ms (milliseconds) of each sign. Interestingly, this study revealed that the duration of modifiers is sensitive to their position within the noun phrase: in particular, modifiers occurring after the noun are significantly longer than those occurring in prenominal position ($t=7.35$).⁷ According to the author, this result can be accounted for in terms of phrase-final lengthening. The longer duration of these elements may act like a prosodic cue signaling the end of the constituent. This explanation does not appear surprising as it is in line with what was previously proposed for *wh*-signs and the aspectual marker *DONE* (cf. Section 2), even if at sentence level. According to Mantovan (2017), other factors exerting an influence on the duration of nominal modifiers are: i) the part of speech nominal modifiers belong to (cardinal numerals and determiner pointing signs are significantly shorter than other modifier types), ii) signers' family (signers born to Deaf parents are faster than the others), iii) signer's geographical provenance (signers from Turin, Brescia, and Salerno sign significantly faster than those coming from other cities), and iv) gender (women are slower signers than men).

Going back to the effects of the position of modifiers within the noun phrase, an objection could be raised: the quantitative analysis conducted in Mantovan (2017) took into consideration nominal expressions of different complexity, i.e. including a variable number of modifiers (one, two, three or more). Although this allowed to capture general duration patterns occurring before and after the nominal head, in the case of noun phrases with multiple modifiers the distinction between internal and peripheral position was not accounted for. To illustrate, consider a nominal expression including two postnominal modifiers, e.g. CAT BLACK BEAUTIFUL ('beautiful black cats'). In the duration study described above, both modifiers were considered alike in terms of distribution *vis-à-vis* the noun (both

5 The signers who participated in the LIS corpus were recruited in ten Italian cities, selected for their geographical position and the presence of institutes for the deaf.

6 ELAN is a multimedia annotation software developed at the Max Planck Institute for Psycholinguistics Nijmegen, the Netherlands (CRASBORN; SLOETJES, 2008). For more details, see <https://archive.mpi.nl/tla/elan>.

7 An important result that emerged from Mantovan (2017) is that the nominal domain in LIS is not rigid in terms of sign order. It is actually characterized by a high degree of variation, with several categories of nominal modifiers appearing in both prenominal and postnominal position.

of them appear in postnominal position), although one appears in the middle of the phrase, whereas the other is in a peripheral position, close to the phrase-final boundary. In principle, the duration of internal pre- and post-nominal modifiers would not give us a direct insight into boundary phenomena. To overcome this issue, the next section presents a refined analysis of the same corpus data, as well as further quantitative considerations on modifier duration in the nominal domain.

4. Further quantitative explorations of LIS corpus data

As previously mentioned, the corpus data analyzed in Mantovan (2017) focused on LIS nominal expressions of variable size, for a total of 1,908 data points. To exclude the presence of internal modifiers, which could obscure prosodic boundary phenomena, the refined analysis presented in this section considers only those noun phrases containing one modifier, either in pre- or post-nominal position (e.g., THREE CAT, ‘three cats’ or CAT BLACK, ‘black cats’). This reduction results in a dataset containing 1,290 data points.

To ensure that the duration of modifiers is still sensitive to their position in the noun phrase, a statistical analysis is conducted comparing the mean duration in ms of the nominal modifiers across the variable Position.

Table 1: Mean duration in ms of pre- and post-nominal modifiers and standard deviation.

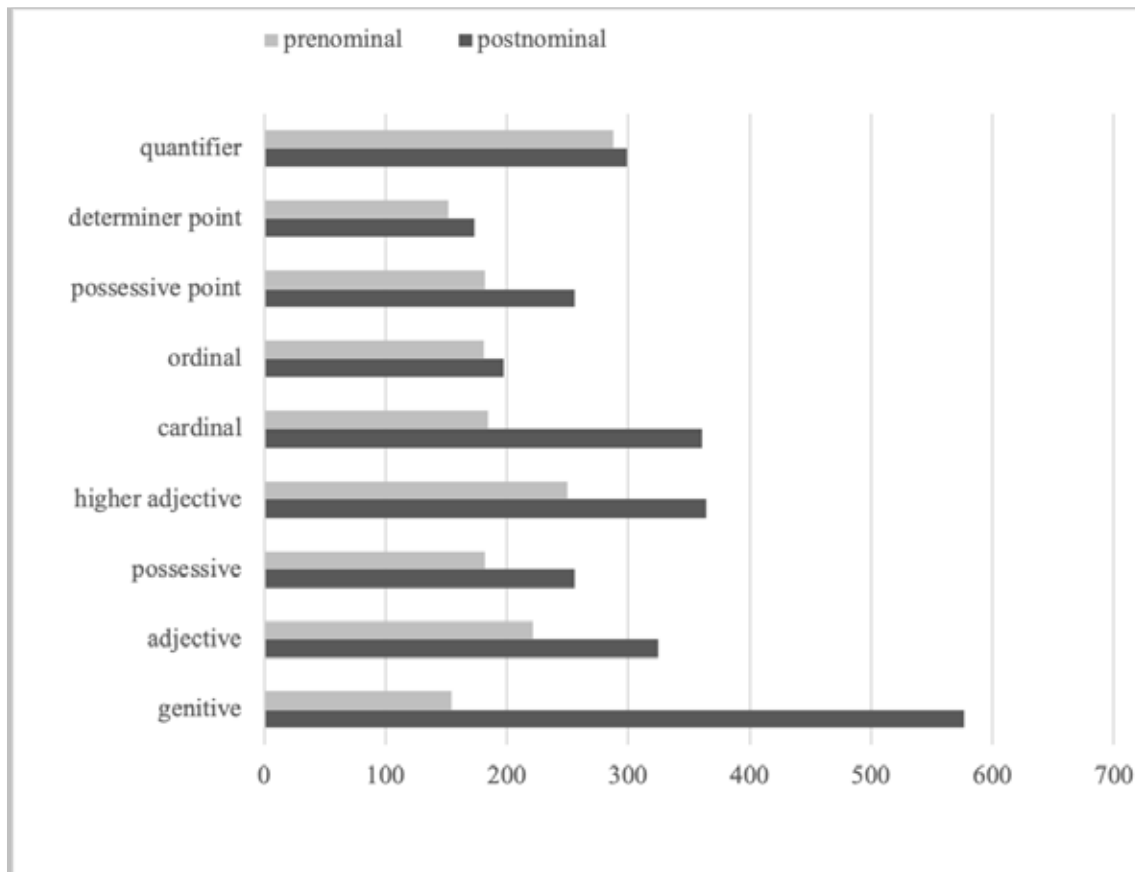
	Duration (ms)	Std Dev
Position prenominal [modifier + noun] tot. 493 tokens	186,67	(151,09)
postnominal [noun + modifier] tot. 797 tokens	283,09	(209,01)

As we can observe in Table 1, the duration of prenominal modifiers is on average about one-third less than that of postnominal modifiers. The analysis conducted on the reduced dataset reveals that this difference is statistically significant, $t=9.6$, $p<.001$: the duration of a nominal modifier is very likely to increase if it appears in postnominal position. Overall, the results that emerged from the refined analysis confirm what was previously hypothesized in Mantovan (2017): in LIS nominal expressions, a lengthening effect occurs in correspondence with the phrase-final boundary.

An interesting issue to address is whether this phrase-final lengthening affects all types of nominal modifiers without distinction, or whether any particular pattern occurs across different modifier categories. This quantitative analysis takes into consideration only those modifier classes that allow for both pre- and post-nominal distribution, i.e. quantifiers, determiner-like and possessive pointing signs, ordinary possessives, ordinal and cardinal numerals, higher adjectives (such as OTHER,

SAME, PREVIOUS), ordinary adjectives, and genitives.⁸ The new dataset includes a total amount of 1,196 data points. Below, Figure 1 shows the mean duration in ms of the different modifier classes when they precede the noun (in light gray bars) and when they follow it (in dark gray bars). The order of the modifiers from top to bottom in the bar plot reflects their position in the syntactic hierarchy (for a discussion, see MANTOVAN, 2017).

Figure 1: Duration mean of different classes of pre- and post-nominal modifiers.



The duration patterns of these nine modifier classes confirm the general trend of the data: postnominal modifiers are longer than prenominal ones. Interestingly, the comparison between light and dark gray bars shows that the different modifier classes do not behave in exactly the same way. While most classes seem to align with the general pattern, others show a more balanced distribution. Specifically, two different groups of modifiers emerge from the data: i) group 1 (quantifiers, determiner-like pointing signs, and ordinal numerals) showing less variation in duration and ii) group 2 (possessive pointing signs, cardinal numerals, higher adjectives, possessives, ordinary adjectives, and genitives) showing much more variation in duration across the variable Position. To evaluate if this categorization is statistically supported, the mean difference between the duration of postnominal

⁸ One of the main findings reported in Mantovan (2017) is that there is a considerable degree of sign order variation in the distribution of modifiers in nominal expressions in LIS, so it is not unlikely that the same modifier can occur either before or after the noun. Differences between pre- and post-nominal position in terms of meaning or linguistic function are not explored here, as they are out of the scope of the current study.

and pronominal modifiers is compared across the two groups through an independent-samples t-test. The analysis shows that there is a significant difference in the scores for group 1 ($M=17.51$) and group 2 ($M=123.90$); $t=56.06$, $p < 2.2e-16$.

5. Qualitative observations on the modifiers more sensitive to final lengthening

Capitalizing on the results emerged from the refined quantitative analysis (Section 4), a further step toward a better understanding of phrase-final lengthening in LIS would be examining the changes imposed by this phenomenon on the phonological structure of signs.

In this section, the analysis is still based on LIS corpus data, but follows a more qualitative path, focusing in particular on those modifier classes that are considerably affected by phrase-final lengthening (Figure 1 above), in particular cardinal numerals (Section 5.1), adjectives (Section 5.2), possessives and possessive pointing signs (Section 5.3).⁹ The main aim of this analysis is to compare pairs of signs produced in pre- and post-nominal position and detect possible phonological changes due to phrase-final lengthening.

Following Tang; Brentari; González; Sze (2010, p. 539), two criteria are applied: i) lengthening is evaluated comparing identical signs or at least signs featuring the same syllable structure and ii) lengthening is examined comparing signs produced by the same signer¹⁰ and in the same discourse context. A further criterion that is adopted here is that noun phrases are considered if they do not occur in sentence-final position: this allows us to examine only boundary markers characterizing phonological phrases, without the possible interference of markers specifically signaling the end of the larger constituent, the intonational phrase.

5.1 Comparing pre- and post-nominal cardinal numerals

Starting from cardinal numerals, it is important to draw a distinction between digits from 0 to 10, which are not endowed with a movement component (GERACI, 2009) and the other cardinals, which require some sort of movement (MANTOVAN; GERACI; CARDINALETTI, 2019).

As for digits, we compare below cardinals THREE (5) and SIX (6). The former is in pronominal position and lasts 480 ms, while the latter is in postnominal position and lasts 960 ms.

⁹ Genitives are not included in the qualitative analysis because they represent only a marginal minority in the dataset (11 out of 1,196 tokens, 0.09%).

¹⁰ Each example in this section is accompanied by a label identifying the signer who produced it (e.g. RO_M_2). The label is structured as follows: abbreviation for the signer's geographical provenance (e.g. 'RO' stands for Rome), abbreviation for the signer's age group (i.e. 'Y' for young, 'M' for middle-aged, and 'O' for old), number in the recording order (e.g. '2' means second signer in the list).

(5) a. IX₁ PAST CHILD [THREE YEAR] BECOME DEAF

‘When I was a child, I was three years old, I became deaf.’ [RA_M_4]

b.



THREE

(6) a. THEN [YEAR SIX] INSIDE INSTITUTE DEAF RAGUSA IX(loc) INSIDE

‘Then, at age six, I was taken to the institute for the deaf in Ragusa.’ [RA_M_4]

b.



SIX

As we can observe in the screenshots in (5)b and (6)b, prenominal **THREE** appears as a static sign, produced in an unmarked area in the neutral space, whereas postnominal **SIX** is articulated with a path movement in the shape of a forward arch.¹¹

Turning to cardinals requiring a movement in their citation form, we focus here on tens: in LIS, these signs combine handshapes from 2 to 9 with repeated finger bending (MANTOVAN; GERACI; CARDINALETTI, 2019; ROMEO, 2004). In the examples from the corpus reported below, we can

¹¹ In LIS, when cardinal numerals enter some linguistic forms, they receive an epenthetic movement to conform to the phonological constraints of the language (GERACI, 2009). For example, if a cardinal is used to indicate a specific time (e.g. AT-FOUR), the corresponding handshape is combined with a repeated downward movement. However, the addition of a forward arched movement to postnominal cardinals does not look like a case of epenthesis because the meaning of the sign does not change. Rather, it is a lengthening effect caused by prosody.

compare cardinals TWENTY (7) and SEVENTY (8). The former is in prenominal position and lasts 195 ms, while the latter is in postnominal position and lasts 880 ms.

(7) a. TEACH ALREADY [TWENTY YEAR] SO_FAR STILL

‘I’ve been teaching for the past twenty years (and I’m still doing it).’ [RO_O_4]

b.



TWENTY

(8) a. TODAY ALREADY [CHILD++ SEVENTY] ALREADY HEARING DEAF TOGETHER

‘Now we already have seventy kids, both hearing and deaf.’ [RO_O_4]

b.



SEVENTY

Comparing the screenshots in (7)b and (8)b above, we can observe that finger bending occurs once in prenominal TWENTY and thrice in postnominal SEVENTY. Interestingly, the number of hand movements in these two examples correlates with the number of syllables reproduced in the mouthing component: TWENTY is produced with partial mouthing (/ven/, from Italian *venti*, ‘twenty’), while SEVENTY is produced with full mouthing (/set-tan-ta/, from Italian *settanta*, ‘seventy’).

5.2 Comparing pre- and post-nominal adjectives

As expected, the internal structure of adjectives is variable: these signs could be either monosyllabic or disyllabic, they could involve path movement, handshape change, orientation change, or a combination of different movement types. Adjectives in LIS generally occur in postnominal position, except for some particular classes, namely value and size adjectives, which sometimes can

occur before the noun as well (MANTOVAN, 2017). In the corpus data under analysis, it is worth considering the case of a signer producing the same size adjective (BIG) in both positions, as we can see in (9) and (10) below. When BIG appears before the noun, it lasts 280 ms, while when it comes after the noun, it lasts 960 ms.

(9) a. IX₁ SIGN IX₃ (sign) [SURPRISE **BIG**] IX₁

‘My way of signing came as a big surprise to me.’ [FI_M_4]

b.



BIG

(10) a. IX(LOC) [**BIG** FESTIVAL] ONE CL(V): ‘person_on_stage’ DEAF SIGN

‘There was a big festival, a deaf guy went on stage and performed signing in a self-confident way.’ [FI_M_4]

b.



BIG

The adjective **BIG** in LIS is a two-handed symmetrical sign requiring an outward path movement. As the screenshots above show, in the two instances of **BIG** the starting and end points do not seem to change significantly, meaning that the extension of the path movement is more or less the same. However, what changes determining the difference in duration between the two signs is the time taken

by the hands to follow the trajectory of the path movement.¹²

5.3 Comparing pre- and post-nominal possessives and possessive pointing signs

As for possessives, LIS signers usually produce an index finger handshape combined with wrist rotation from radial to ulnar toward the location of the possessor (MANTOVAN, 2017). In the case of first-person possessives, the wrist rotation is not realized and the radial part of the extended index finger moves directly toward the signer's chest. In their citation forms, all kinds of possessives involve movement repetition (ROMEO, 2004). In the corpus examples below, we compare a prenominal first-person possessive (11), which lasts 200 ms, and a postnominal first-person possessive (12), which lasts 320 ms.

(11) a. BUT [POSS₁ PASSION] THERE_IS_NOT

‘However, I didn’t have the passion.’ [BO_M_5]

b.



POSS₁

(12) a. OPEN [PASSWORD POSS₁] OPEN CLICK OPEN

‘I entered my password, then I clicked and opened it’ [BO_M_5]

b.



POSS₁

12 In this case, the prolonged articulation of the movement component does not correlate with any morphological modification (e.g. comparative degree), as a native signer judgment confirmed. To express comparative degree, movement extension and special non-manuals would be necessary.

The screenshots above show that while the prenominal possessive is realized with a single movement toward the signer's chest (11)b, its postnominal counterpart performs a repeated path movement and comes into contact with the chest twice (12)b.

In LIS, possessive meaning can also be conveyed by pointing signs. In this case, the tip of the extended index finger moves toward the location associated with the possessor, without wrist rotation (MANTOVAN, 2017). The sentence reported in (13) includes two first-person possessive pointing signs (here glossed as IX(poss)₁): the first one is in postnominal position and lasts 480 ms, while the second one occurs before the noun and lasts 70 ms.

(13) a. THEN [MOTHER IX(poss)₁] FAMILY WELL BUT [IX(poss)₁ BROTHER] DEAD REASON ACCIDENT WORK

‘My mother and my family are all fine, except my brother who died in a workplace accident.’ [SA_M_4]



IX(POSS)₁ (POSTNOMINAL)



IX(POSS)₁ (PRENOMINAL)

As shown in the screenshots above, the length of the path movement is very similar in the two instances of IX(poss)₁, i.e. the starting and end points of the trajectory are more or less the same. What changes, though, is: i) the time taken by the hand(s) to follow the trajectory (shorter in (13)c and longer in (13)b), ii) the active presence of the non-dominant hand, copying the dominant hand, in (13) b, iii) a final hold only at the end of (13)b right after the hands reach the signer's chest, and iv) a final head nod only at the end of (13)b.

6. General discussion on the effects of phrase-final lengthening in LIS

To reach a better understanding of the phonological implications and functioning of phrase-final lengthening in LIS, corpus data were analyzed from both quantitative and qualitative perspectives. The refined quantitative analysis presented in Section 4 has confirmed that, in noun phrases with one modifier only, the duration of the modifier is longer if it appears at the end of the phrase: on average, the duration of prenominal modifiers is about one-third less than that of postnominal modifiers. Interestingly, the analysis also showed that different modifier classes in LIS behave differently when it comes to phrase-final lengthening. While most modifiers align to the general pattern (i.e. postnominal modifiers are longer than prenominal ones), the duration of three modifier classes, namely quantifiers, determiner-like pointing signs, and ordinal numerals, seem to be less sensitive to the position within the noun phrase.

This section aims at further discussing the relationship between phrase-final lengthening and the different modifier classes. In particular, it discusses the phonological changes detected in those modifier classes more sensitive to phrase-final lengthening (Section 6.1) and offers possible explanations for the fact that quantifiers, ordinals, and determiner-like pointing signs are less sensitive to lengthening effects in the phrase-final boundary (Section 6.2).

6.1 Modifier classes more sensitive to phrase-final lengthening

Section 5 presented a qualitative analysis of those modifier classes that in LIS show more sensitivity to phrase-final lengthening. According to the results of this analysis, when these signs occur in final position, some changes may affect their phonological makeup, especially the movement component (as found in other sign languages). If the sign lacks movement, as in the case of cardinal numerals from 0 to 10 (see *SIX* in Section 5.1), a path movement may be added. If the sign is produced with a repeated movement in its citation form, there seem to be two options: either the two movements are maintained (see *POSS₁* in Section 5.3) or a further repetition is added (see *SEVENTY* in Section 5.1). This seems to hold both for path movement and handshape change.

As a side effect, the number of movement repetitions may correlate with the number of syllables visible in the mouthing component. This phenomenon could be seen as a case of “echo phonology” (WOLL, 2001): a particular mouth pattern reflects (or echoes) certain articulatory features of the manual sign.

Another phonological effect that emerged from the analysis is prolonged articulation (see *BIG*

in Section 5.2 and IX(poss)₁ in Section 5.3), which extends the time needed for the hand(s) to go from the starting to the end point of the path movement. Prolongation may also occur after the trajectory is concluded, realizing a final hold at the end of the manual segment. In the case of IX(poss)₁, such a final hold is accompanied by a downward head nod.

The qualitative analysis of IX(poss)₁ also suggests that, in addition to lengthening effects, phrase-final boundary may determine changes in other phonological features of signs, for example in the number of hands involved. In particular, a phrase-final one-handed sign may turn into a two-handed sign, with the non-dominant hand realizing a symmetric copy of the dominant one. Such a phonological process, well known as “weak prop” (BATTISON, 1974; PADDEN; PERLMUTTER, 1987), may occur to increase the phonological weight at the end of the phrase, thus making the prosodic boundary more visible. Contrary to weak drop (i.e. one-handed realization of two-handed signs), which is mainly driven by phonological constraints (BRENTARI, 1998; VAN DER KOOIJ, 2002), weak prop seems to be triggered by other factors: in this, discourse and prosody may play a relevant role. Further investigation is needed to shed light on this research topic.

All these phonological modifications seem to act as boundary markers that signal the end of the prosodic constituent. They may be considered language-specific cues that help the interlocutor segment the linguistic stream and hence process linguistic information, as was similarly proposed for other languages, both spoken and signed (a.o. CUTLER; DAHAN; VAN DONSELAAR, 1997; NESPOR; SANDLER, 1999; MILLOTTE; WALES; CHRISTOPHE, 2007; TANG; BRENTARI; GONZÁLEZ; SZE, 2010). As clearly shown in the case of postnominal IX(poss)₁, these suprasegmental cues are not mutually exclusive since they can combine in a layering distribution. Simultaneous combination of different markers is not a novelty in the literature (for more details, see NESPOR; SANDLER, 1999; WILBUR, 2000).

On the other side, the analysis reveals another interesting finding: some phonological changes also occur to nominal modifiers in prenominal position. Besides the fact that these signs are generally shorter and do not show prolongation in their articulation, it is worth noting that some of the analyzed prenominal modifiers do not appear exactly as in their citation form. In particular, cardinal TWENTY (Section 5.1) and possessive POSS₁ (Section 5.3) underwent phonological reduction: one of their two syllables disappeared, resulting in a single movement. If compared to what was previously observed in postnominal modifiers (maintenance of the citation form or movement insertion), this phenomenon goes in the opposite direction: it suggests that phrase-final lengthening could gradually increase its intensity over more than one sign, reaching its peak at the end of the phrase. Clearly, this claim needs

to be confirmed by further studies.

6.2 Modifier classes less sensitive to phrase-final lengthening

According to the results of the refined quantitative analysis presented in Section 4, quantifiers, determiner-like pointing signs, and ordinal numerals seem to behave exceptionally when compared to other modifier classes, in that their duration is less susceptible to phrase-final lengthening. However, this result seems less surprising if we take a closer look at this particular set of LIS signs. What is proposed in this section is that these signs may be characterized by some morpho-syntactic factors that block (or limit) the effects of phrase-final lengthening.

Ordinal numerals represent a defective class in LIS since they are limited to ten items, from FIRST to TENTH (MANTOVAN; GERACI; CARDINALETTI, 2019, p. 804). Phonologically, their handshape and location are the same as their cardinal counterparts. However, while cardinals from 0 to 10 lack movement (GERACI, 2009, p. 34), ordinals in their citation form require a secondary (or hand-internal) movement realized as orientation change. What is generally observed in these signs is that the wrist rotates producing a change in palm orientation, from prone to supine, as illustrated below.



Given these phonological properties, we can assume that ordinal numerals in LIS are linguistic forms derived from their cardinal counterparts. Note that this is a quite common process in the languages of the world, as documented in WALS.¹³ For example, ordinals in Hunzib, a Northeast Caucasian language, are morphologically derived from cardinals by adding the suffix *-s(ə)*, as illustrated in (15) (VAN DEN BERG, 1995, p. 69-70).

13 <https://wals.info/chapter/53> (Accessed on August 10, 2020).

(15) a. q'an.u

'two'

b. q'an.u.s

'second'

However, contrary to Hunzib, LIS does not derive ordinals from cardinals via suffixation, rather through a simultaneous morphological process. As frequently happens in sign languages, the derived form is realized through a stem-internal modification (ARONOFF; MEIR; SANDLER, 2005) specifically, in this case, ordinals are obtained simultaneously combining the cardinal stem with a derivational simulfix realized by wrist rotation. This analysis suggests that orientation change in ordinals is not just a phonological component of these signs, but functions as a derivational morpheme. The fact that this movement has a morphological status might explain why it is less prone to prosodic modifications.

Pointing signs are very common in sign languages and usually cover a wide range of linguistic functions (for an overview, see PFAU, 2011). In this study, determiner-like pointing signs are considered an umbrella category including articles and demonstratives. In LIS, these two modifier classes are both realized by directing the extended index finger toward the location associated with the relevant referent (MANTOVAN, 2017). Something that helps signers distinguish articles and demonstratives is movement: articles are usually articulated with a quick and subtle path movement and are not maintained in space, whereas demonstratives typically feature the presence of a longer path movement directed toward a specific point in space (BERTONE, 2011; BRANCHINI; MANTOVAN, 2020). These articulatory differences highlight the crucial role of movement in differentiating articles from demonstratives, which would be otherwise phonologically ambiguous. It is important to note that in the data considered for the refined quantitative analysis, demonstratives represent only a tiny minority of the total amount of determiner-like pointing signs (8 out of 180, corresponding to 4.4%). As a consequence, the marginal presence of demonstratives in the data indicates that the quantitative results reported in Section 4 mainly apply to articles. What can be proposed here is that articles in LIS are less prone to lengthening effects because if they underwent movement extension and/or final hold in phrase-final position, that could trigger an unwanted morphological change from article to demonstrative, or would at least determine an ambiguity between the two different linguistic functions. If this line of reasoning is on the right track, then it might provide additional indirect evidence for treating possessive pointing signs and determiner-like pointing signs as distinct categories, despite their similar phonological shape. Contrary to determiner-like pointing signs, pointing signs with a possessive meaning do not resist phrase-final lengthening probably because its effects do not yield any morphological ambiguity.

Quantifiers, similarly to adjectives, constitute a heterogeneous class including signs with a variety of phonological characteristics (BRANCHINI; MANTOVAN, 2020.). For example, the sign ALL requires a single arched path movement, MANY is articulated with repeated handshape change combined with a horizontal path movement, and FEW has a handshape change only. Given this diversity, contrary to what happens in determiner-like pointing signs, it is unlikely that a specific phonological feature of quantifiers triggers resistance to phrase-final lengthening. Although it seems difficult to account for the particular behavior of quantifiers, we could speculate that, in this case, syntax plays a role. According to several syntactic accounts on the noun phrase extended projection (see CARDINALETTI; GIUSTI, 2006; CINQUE; RIZZI, 2012 and references therein), quantifiers are merged on top of the nominal hierarchy. Previous studies on the syntax of nominal expressions in LIS (MANTOVAN, 2017; MANTOVAN; GERACI, 2017) showed that quantifiers frequently occupy a peripheral position also in the linear ordering of signs. The fact that a quantifier is almost always produced close to the phrase boundary could at least partially explain why, in a noun phrase containing a quantifier, prosody does not need to overtly mark phrase boundaries.

Conclusions

Prosodic lengthening in phonological phrases is a phenomenon that has been previously described for several languages in the spoken and signed modality. In this study on LIS prosody, this issue has been investigated analyzing spontaneous corpus data with the purpose to capture general trends in the sign community. Phonological phrases corresponding to nominal expressions with one modifier feature a significant lengthening close to the final boundary. A deeper quantitative analysis revealed that such lengthening does not affect all nominal modifiers to the same extent. Cardinals, higher and ordinary adjectives, genitives, possessives, and pointing signs with possessive meaning show more sensitivity to phrase-final lengthening. The internal structure of these LIS signs may undergo a variety of phonological modifications, such as movement insertion, repetition or elongation, final hold (with or without head nod), weak prop, and realization of full mouthing. On the other hand, quantifiers, determiner-like pointing signs, and ordinal numerals show less sensitivity to final lengthening. This particular behavior may be attributed to some morpho-syntactic factors (e.g. movement with morphological status and peripheral syntactic position), which block (or limit) the intervention of prosodic modifications. Overall, these findings seem to confirm that prosody constitutes a complex interface: it interacts with other linguistic domains, it may act as an indicator of structural configurations, it may be influenced by specific linguistic factors and, in turn, may show effects on others.

REFERENCES

- ARONOFF, Mark, Irit Meir, Wendy Sandler. The paradox of sign language morphology. *Language*, vol. 81, n. 2, pp. 301-344, 2005.
- ATTARDO, Salvatore. Irony markers and functions: towards a goal-oriented theory of irony and its processing. *Rask*, v. 12, n. 1, pp. 3-20, 2000.
- BATTISON, Robbin. Phonological deletion in American Sign Language. *Sign Language Studies*, vol. 5, pp. 5-19, 1974.
- BERTONE, Carmela. *Fondamenti di grammatica della lingua dei segni italiana*. Milano: Franco Angeli, 2011.
- BRANCHINI, Chiara, Carlo Cecchetto, Anna Cardinaletti, Caterina Donati, Carlo Geraci. Wh-duplication in Italian Sign Language (LIS). *Sign Language & Linguistics*, vol. 16, n. 2, pp. 157-188, 2013.
- BRANCHINI, Chiara, Lara Mantovan. *A Grammar of Italian Sign Language (LIS)*. Venice: Edizioni Ca' Foscari, 2020.
- BRENTARI, Diane. *A prosodic model of sign language phonology*. Cambridge, MA: MIT Press, 1998.
- BRENTARI, Diane, Laurinda Crossley. Prosody on the hands and face: Evidence from American Sign Language. *Sign Language & Linguistics*, vol. 5, pp. 105-130, 2002.
- CALDERONE, Chiara. Can you retrieve it? Pragmatic, morpho-syntactic and prosodic features in sentence topic types in Italian Sign Language (LIS). 2020. PhD dissertation, Ca' Foscari University, Department of Linguistics and Comparative Cultural Studies, Venice, 2020.
- CARDINALETTI, Anna, Giuliana Giusti. The syntax of quantified phrases and quantitative clitics. In: EVERAERT, Martin, Henk van Riemsdijk (eds.), *The Blackwell companion to syntax*, vol. V, Oxford: Blackwell, 2006. pp.23-93.
- CARDINALETTI, Anna, Carlo Cecchetto, Caterina Donati. *Grammatica, lessico e dimensioni di variazione nella LIS*. Milano: Franco Angeli, 2011.
- CECCHETTO, Carlo, Geraci Carlo, Zucchi Sandro. Another way to mark syntactic dependencies:

- The case for right-peripheral specifiers in sign languages. *Language*, vol. 85, n.2, pp. 278–320, 2009.
- CINQUE, Guglielmo, Luigi Rizzi. The Cartography of Syntactic Structures. *CISCL Working Papers on Language and Cognition*, vol. 2, pp. 43-59, 2012.
- CRASBORN, Onno, Han Sloetjes. Enhanced ELAN functionality for sign language corpora. In: Proceedings of LREC 2008, Sixth International Conference on Language Resources and Evaluation, 2008.
- CUTLER, Anne, Delphine Dahan, Wilma van Donselaar. Prosody in the comprehension of spoken language: a literature review. *Language and Speech*, vol. 40, n. 2, pp. 141-201, 1997.
- FENLON, Jordan, Kearsy Cormier, Diane Brentari. The phonology of sign languages. In: HANNAHS, Stephen J., Anna R. K. Bosch (eds.). *The Routledge Handbook of Phonological Theory*. London, New York: Routledge, 2018. pp. 453-475.
- GERACI, Carlo. Epenthesis in Italian Sign Language. *Sign Language & Linguistics*, vol. 12, n.1, pp. 3-51, 2009.
- GERACI, Carlo, Katia Battaglia, Anna Cardinaletti, Carlo Cecchetto, Caterina Donati, Serena Giudice, Emiliano Mereghetti. The LIS corpus project: A discussion of sociolinguistic variation in the lexicon. *Sign Language Studies*, vol. 11, n.4, p. 528-574, 2011.
- GOSWAMI, Usha. *Cognitive Development: The Learning Brain*. Hove: Psychology Press, 2008.
- MAJID, Asifa. Current Emotion Research in the Language Sciences. *Emotion Review*, vol. 4, n. 4, pp. 432-443, 2012.
- MANTOVAN, Lara. Nominal modification in Italian Sign Language (LIS). Berlin: De Gruyter Mouton, 2017.
- MANTOVAN, Lara, Carlo Geraci. The syntax of nominal modification in Italian Sign Language (LIS). *Sign language & Linguistics*, vol. 20, n. 2, pp. 183-220, 2017.
- MANTOVAN, Lara, Beatrice Giustolisi, Francesca Panzeri. Signing something while meaning its opposite: the expression of irony in Italian Sign Language (LIS). *Journal of Pragmatics*, vol. 142, pp. 47-61, 2019.
- MANTOVAN, Lara, Carlo Geraci, Anna Cardinaletti. On the cardinal system in Italian Sign Language

(LIS). *Journal of Linguistics*, vol. 55, n. 4, pp. 795-829, 2019.

MILLOTTE, Séverine, Roger Wales, Anne Christophe. Phrasal prosody disambiguates syntax. *Language and Cognitive Processes*, vol. 22, n. 6, pp. 898-909, 2007.

MORGAN, James L. Prosody and the roots of parsing. *Language and Cognitive Processes*, vol. 11, pp. 69–106, 1996.

MORGAN, James L., Richard P. Meier, Elissa L. Newport. Structural packaging in the input to language learning: Contributions of prosodic and morphological marking of phrases to the acquisition of language. *Cognitive Psychology*, vol. 19, pp. 498–550, 1987.

MURRAY, Iain R., John L. Arnott. Toward the simulation of emotion in synthetic speech: A review of the literature on human vocal emotion. *The Journal of the Acoustical Society of America*, vol. 93, n. 2, pp. 1097-1108, 1993.

NESPOR, Marina, Irene Vogel. *Prosodic phonology*. Dordrecht: Foris Publications, 1986.

NESPOR, Marina, Wendy Sandler. Prosody in Israeli Sign Language. *Language and Speech*, vol. 42, n. 2-3, pp. 143-176, 1999.

PADDEN, Carol, David M. Perlmutter. American Sign Language and the architecture of phonological theory. *Natural Language and Linguistic Theory*, vol. 5, pp. 335-375, 1987.

PFAU, Roland. A point well taken: On the typology and diachrony of pointing. In: Napoli, Donna Jo, Gaurav Mathur (eds.). *Deaf around the world. The impact of language*. Oxford: Oxford University Press, 2011. pp. 144-163.

ROMEO, Orazio. *Il dizionario tematico dei segni*. Bologna: Zanichelli, 2004.

SANDLER, Wendy, Diane Lillo-Martin. *Sign language and linguistic universals*. Cambridge: Cambridge University Press, 2006.

SELKIRK, Elisabeth O. On prosodic structure and its relation to syntactic structure. In: FRETHEIM, Thorstein (ed.). *Nordic prosody II*. Trondheim: TAPIR, 1981. pp. 111-140.

SNEDEKER, Jesse, John Trueswell. Using prosody to avoid ambiguity: effects of speaker awareness and referential context. *Journal of Memory and Language*, vol. 48, pp. 103-130, 2003.

TANG, Gladys, Diane Brentari, Carolina González, Felix Sze. Crosslinguistic variation in the use of prosodic cues: the case of blinks. In: BRENTARI, Diane (ed.). *Sign languages: A Cambridge language survey*. Cambridge: Cambridge University Press, 2010. pp. 519-542.

VAN DEN BERG, Helma. *A Grammar of Hunzib* (Lincom Studies in Caucasian Linguistics, 1). München: Lincom Europa, 1995.

VAN DER KOOIJ, Els. Phonological Categories in Sign Language of the Netherlands. The Role of Phonetic Implementation and Iconicity. Leiden: Universiteit Leiden, PhD Thesis, 2002.

WILBUR, Ronnie B. Stress in ASL: Empirical evidence and linguistic issues. *Language and Speech*, vol. 42, n. 2–3, pp. 229-250, 1999.

WILBUR, Ronnie B. Phonological and prosodic layering of nonmanuals in American Sign Language. In: EMMOREY, Karen, Harlan Lane (eds.). *The signs of language revisited: An anthology to honor Ursula Bellugi and Edward Klima*. Mahwah, N.J.: Lawrence Erlbaum Associates Publishers, 2000. pp. 215–244.

WOLL, Bencie. The Sign that Dares to Speak its Name: Echo Phonology in British Sign Language (BSL). In: BOYES-BRAEM, Penny, Rachel Sutton-Spence (eds.). *The hands are the head of the mouth. The mouth as articulator in sign languages*. Hamburg: Signum, 2001. pp. 87–98.