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# The syntax of nominal modification in Italian Sign Language (LIS)

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Abstract

In this paper we investigate structural aspects of nominal modification in a language with a relatively flexible word order like Italian Sign Language (LIS). In order to tackle the issue, this study combines different approaches, namely generalizations emerging from typological universals on word order, their formal counterparts, and a variationist approach to language facts. Data come from the largest corpus of LIS currently available. Despite the absence of categorical rules, our mixed approach shows that LIS data are consistent with the general tenets of nominal modification. Results from the statistical analysis indicate that the attested language-internal variability is constrained both by linguistic and social factors. Specifically, a fine-grained structure of nominal modification is able to capture the internal variability of LIS. Processing effects, age, gender, and early exposure to the language also play a relevant role in determining order preferences.

Keywords

Nominal modification, word order variation, Italian Sign Language, Universal 20

# 1. Introduction

Word order phenomena have been the object of a substantial body of research within typological and formal linguistics for many years. In this work, we conduct a corpus-based study on nominal modification in Italian Sign Language (LIS),[1] showing how word order variation depends on both linguistics and sociolinguistic factors. Despite previous literature indicates the order in (1) as the base order of nominal modifiers in LIS (Bertone 2007, Branchini 2007, and Brunelli 2011), we found a rather different pattern. The most frequent order we observed in the corpus data is illustrated in (2).

(1) N > Adj > Num > Dem

(2) Num > N > Adj > Dem

However, this word order is far from categorical and other combinations are also widely attested. This fact is in line with other studies on nominal modification in other sign languages (SLs), a.o. Tang and Sze (2002) for Hong Kong Sign Language (HKSL), Zhang (2007) for Taiwan Sign Language (TSL), MacLaughlin (1997) and Neidle and Nash (2012) for American Sign Language (ASL), and Rutkowski, Czajkowska-Kisil, Łacheta, and Kuder (2014) for Polish Sign Language (PJM). In this study, we will show that word order variation in LIS is influenced by linear and hierarchical syntactic factors, signers' age, gender, and early exposure to the language. We interpret our findings in light of fine-grained structural constrains (Cinque 2005, 2010), processing requirements (Hawkins 2004, Martin and Romani 1994), sociolinguistic trends (Labov 2001), and LIS specific sociolinguistic situation.

In addition to provide a solid empirical account of word order variation in the nominal domain of LIS, this paper also contributes to the theoretical discussion about

typological word order universals and formal approaches to grammar. The Universal 20 (U20, i.e. a generalization on word order among demonstratives, numerals, and adjectives), which has been the center of a longstanding theoretical debate between typologists and generativists, has been recently extended to account for a larger set of nominal modifiers (Dixon and Aikhenvald 2004, and Cinque 2010, 2012). Our study offers a completely new perspective on word order facts that challenges the traditional view of language universals and establishes a clear connection between cross-linguistic variation and language-internal variation.

Finally, our work also provides a significant contribution to a recent methodological problem connected to the sample size of language universals (Piantadosi and Gibson 2013). In this respect, we argue that those languages, which are often reported as being flexible in terms of word order relations, provide an additional valuable and independent testing ground.

To give the reader a concrete idea, the examples below illustrate the sort of variability found in LIS corpus data (the relevant modifiers are boldfaced).

(3) a. **Demonstrative** > N (Florence)

[**IX-3_DEM** CHILD] IX-3_POSS FATHER^MOTHER DEAF

'The parents of this kid were Deaf'

b. N > **Demonstrative** (Lamezia)

[GROUP **IX-3_DEM**] NEED GROW-UP

'(Deaf people) need this community to grow up'

(4) a. **Numeral** > N (Milan)

(IX-1) TAKE [**ONE** GOLD], [**TWO** SILVER], [**THREE** BRONZE]

'I won one gold, two silver, and three bronze (medals)'

b. N > **Numeral** (Bologna)

IX-1 [PASSION **TWO**] SNOWBOARD TRAVEL

'I have two passions: snowboarding and traveling'

(5) a. **Adjective** > N (Florence)

[**BIG** FESTIVAL] SOMEONE GO-ON-STAGE

'At this big festival, someone appeared onstage'

b. N > **Adjective** (Ragusa)

WAIT-FOR [PRESIDENT **NEW**]

'We are looking forward to our new president'

The rest of the paper is organized as follows. Section 2 sets the methodological and theoretical background upon which our study is based. Section 3 presents an overview of previous works on the DP in LIS. Section 4 introduces our case study by illustrating the methodology of data collection and annotation. Results are presented in Section 5 and discussed in Section 6. Section 7 concludes the paper.

## 2. Background on Nominal Modification

Crosslinguistic studies of the syntax of human language showed that the variety of orders attested does not equally distribute across all logical possibilities, indeed languages tend to cluster more on some orders than others both at the clausal and nominal level (Cheng & Sybesma 1999, Cinque 1994, Dixon and Aikhenvald 2004, Dryer 2007, Givon 2001, Greenberg 1963, Hawkins 1983, Kayne 1994). Several

generalizations have been proposed; some of them are claimed to be universal, namely valid across languages or language families. However, it has been recently questioned that the empirical basis of these studies is insufficient to provide statistically reliable results (Piantadosi and Gibson 2013). Furthermore, the empirical ground over which these generalizations are claimed to hold is biased by the fact that the languages considered are all spoken.

In this section, we illustrate the theoretical framework on nominal modification, focusing on the aspects that are relevant to this study (Section 2.1). Then, we briefly discuss the methodological issues connected to language universals, illustrating how the study of language-internal variation provides a solution to the problem (Section 2.2). Finally, we summarize major findings on nominal modification in SLs (Section 2.3), showing how these languages are particularly suited to address universals by looking at language-internal variation.

## 2.1 Theoretical framework

When it comes to the distribution of nominal modifiers vis-à-vis the head noun, cross-linguistic differences are widely attested. The typological pattern that classifies word order variation with respect to the distribution of demonstrative, numeral, and adjective is U20. First proposed in Greenberg's (1963) work,[2] its current formulation is due to Hawkins (1983).

(6) *Universal 20 current formulation* [Hawkins 1983:119-120]

When any or all of the modifiers (demonstrative, numeral, and descriptive adjective) precede the noun, they (i.e., those that do precede) are always found

in that order. For those that follow, no predictions are made, though the most frequent order is the mirror-image of the order for preceding modifiers. In no case does the adjective precede the head when the demonstrative or numeral follow.

A great effort has been made by both typologists and formal linguists to expand the generalization in (6). This was done in two main ways. On the one hand, a more explanatory account of U20 was offered (Cinque 2003, 2005, Abels and Neeleman 2009, 2012); on the other hand, the descriptive adequacy was improved by proposing finer-grained classifications (e.g. by splitting the adjectival category into more classes as in Cinque 2010, 2012, and Dixon and Aikhenvald 2004). Most of the empirical findings of our work address this second aspect. However, there are also some implications with respect to formal accounts of U20, which we discuss in the appendix.

In the typological tradition, Dryer (2011) points out that different classes of nominal modifiers may be realized in different ways across languages. For example, numerals may be realized as a distinct word class, as a subclass of adjectives, or as verbs included in relative clauses. Dryer claims that the specific morphological categories that crosslinguistically encompass adjectives, numerals, and demonstratives are not crucial to capture word order relations. Indeed, principles referring to general tendencies rather than absolute categorical rules are better suited to capture crosslinguistic variation. Working on a sample of 341 languages, he proposes the principles in (7) (Dryer 2011:6; see also Cysouw 2010 for a similar proposal).

(7) a. Symmetry Principle I: “the Adj and the Num tend to occur closer to the N than the Dem when they (the Adj and the Dem and/or the Num and the Dem) occur on the same side of the noun.”

b. Symmetry Principle II: “the Adj tends to occur closer to the N than the Num when they occur on the same side of the N.”

c. Asymmetry principle: “the Symmetry Principles apply more strongly to prenominal modifiers than they do to postnominal modifiers; exceptions to the Symmetry Principles will occur only with postnominal modifiers.”

d. Greenberg's Universal 18: “when the Adj precedes the N, the Dem and the Num, with overwhelmingly more than chance frequency, do likewise.”

e. Intracategorial Harmony: “the Dem, Num, and Adj tend to all occur on the same side of the N.”

While functional definitions of nominal modifiers have the advantage of capturing the macroscopic picture, they also have the disadvantage of blurring genuine syntactic constraints on the architecture of language, or at least of diminishing the relevance of categorical behavior displayed in the syntax of specific languages. One interesting issue connected to the principles in (7) is whether they are still valid once looking at language-internal variation. Specifically, principles (7)a and (7)b predict an interaction between the categories of nominal modifiers and the linear distance from the head noun in a DP. Principle (7)c is an ad hoc stipulation (Dryer 2011:8) to capture the fact that the syntactic structure of human language is antisymmetric (Kayne 1994). Finally, principles (7)d and (7)e predict an effect of morphosyntactic category on the order of nominal modifiers with respect to the head noun. In Sections

4, 5, and 6, we will test whether these principles account for language-internal variation by looking at LIS data.

In the formal tradition, Cinque (2005, 2010, 2012) proposed a fine-grained categorization of the structure of nominal expressions. In particular, he proposes the hierarchy in (8) in which several categories of modifiers are treated as independent projections in a universal hierarchy of nominal modifiers.

(8) *Partial map of the extended functional projection of the NP* (Cinque 2012)

Non-restrictive RelC > Universal QP > DemP (Det°) > Distributional QP > Restrictive RelC > OrdinalP > CardinalP > Reduced RelC > AP value > AP size > AP shape > AP color > AP nationality > NP

This hierarchical structure exploits at the highest levels the original insight of U20 and somehow incorporates Dryer's claim that languages may categorize nominal modifiers in different ways. This is so because the morphosyntactic status of the modifiers in the various structural projections can be lexicalized in different ways (e.g. as adjectives, bound morphemes, classifiers, or particles). However, Cinque's works also introduce non-trivial issues concerning the relative order between the nominal head and its modifiers. One possibility is that the modifiers are independently linearized with respect to the nominal head. Another possibility is that they are organized in larger syntactic units and that within these units they are linearized either to the left or the right of the nominal head as a group. This latter option is based on the assumption that there are "areas" in the hierarchy of syntactic projections. Although prima facie this seems to be highly speculative, there are some hints that something along this line is on the right track. One should think about areas in the

nominal structure as similar to the vP, IP, and CP layers at the sentential level. Each of these structural domains further splits in several projections (VP, AspP, TenseP, TopicP, FocusP, etc.). Some languages are organized in such a way that the vP area is head final, while the IP and the CP areas are head initial (this is the case of some verb-second languages, for instance); other languages are organized in such a way that most XPs are head initial while some others are head final (this could be the case of the Complementizer Phrase in ASL, Neidle, Kegl, MacLaughlin, Bahan, and Lee 2000) and vice versa (like in Basque, where the orientation of the NegP is claimed to be different from that of the other projections, Laka 1990). A similar variation is also found at the level of specifiers, for example LIS has right-branching specifiers in the CP and NegP, while all the others are left-branching (Cecchetto, Geraci, and Zucchi 2009). In Section 5, we show that something along these lines also happens for the nominal domain in LIS. More specifically, we assume that the original categories identified by the U20 (demonstrative, numeral, and adjective) are actually the markers of larger portions of the nominal structure, like vP, IP, and CP are at the sentential level. Crosslinguistic variation is then in principle expected on the size of the areas with both syntactic and semantic factors determining the relevant cut-off points; while processing factors may be responsible for some aspects of the variability in languages with no fixed order. In Sections 5 and 6 we will see some empirical motivations for these areas in LIS and we will also discuss some processing effects on the organization of stacked nominal modifiers.

## 2.2 Language Universals and the sample problem

Piantadosi and Gibson (2013) convincingly argue that the empirical base (i.e. the set of currently known languages) of (absolute) typological universals is not sufficiently large to extract reliable inferences on universal properties of the language faculty. Specifically, they claim that the likelihood of accidental gaps is too high; hence it is impossible to determine whether certain word orders are unattested because they are ruled out by the architecture of language or because the number of unrelated languages is too small to conclude anything. They illustrate this problem with the case of U20. The number of possible order permutations between a noun, adjective, demonstrative, and numeral (4! = 24) is already too big to be effectively tested against the number of unrelated languages currently available and the presence of gap in attested word orders could be totally accidental. To obviate to this limitation, Piantadosi and Gibson (2013:4) argue that "other sources of evidence such as learning experiments are necessary" (see also Tily and Jaeger 2011).

In this paper, we propose that language-internal variation should be considered as a valid and independent alternative in addition to learning experiments. The idea is that there is a strict correlation between crosslinguistic and language-internal variation. This is so, because if the syntax of human language obeys constraints imposed by universal rules, then even for those languages in which word order parameters are not categorically set, orders that are predicted to be impossible are still expected to be impossible or at least unattested. Under this view, languages displaying word order variation are the source of crucial information about the structure of human language, rather than representing exotic exceptions to an

otherwise well-behaved pattern.

The fine-grained hierarchy reported in (8) above magnifies the sample problem illustrated by Piantadosi and Giboson (2013). The logically possible permutations are precisely 14! = 87178291200, a number of combinations hardly testable. However, our proposal that nominal modifiers are organized in syntactic areas sensibly reduces the number of possible combinations. Specifically, in Section 5.1, we propose that LIS nominal modifiers cluster in three macro areas, which cross-cut the traditional categories of determiner, numeral, or adjective. Without anticipating too much and despite the considerable attested variation, three syntactic areas corresponding to the low, middle, and high portions of Cinque's hierarchy in (8) will emerge. Modifiers in low and high projections tend to be postnominal, whereas modifiers in the central part tend to be more variable. At least at the macroscopic level, this move will reduce the number of syntactic projections to a size that is comparable to that of U20[3] (and thus suffer of the same sample problem identified by Piantadosi and Gibson 2013). However, these syntactic areas of nominal structure are not defined upon traditional morphological categories but in purely syntactic terms. In a certain sense this proposal shares with Dryer (2011) and Cinque (2005) the need to go beyond traditionally defined categories in order to capture the syntactic distribution of nominal modifiers.

## 2.3 Sign language, Language Universals, and Nominal modification

SLs are generally ignored or marginally considered in typological studies, although in some cases the relevant linguistic level (i.e. sign/word order) is sufficiently abstract to

allow for a fruitful comparison (see Zeshan 2006, Zeshan and Perniss 2008, and Zeshan 2013 for typological works on SLs). For instance, if we consider the relation between the head and its complement, the so-called head-directionality parameter, spoken and signed languages display the same syntactic diversity. Instances of mainly head-initial languages are English and ASL (Neidle et al. 2000),[4] while instances of head-final languages are Japanese (Fukui 1993) and LIS (Cecchetto, Geraci, and Zucchi 2006).[5] To what extent the typological universals proposed for spoken languages are also valid for SLs is still an open issue, and whether the flexibility of SLs conforms to universal patterns is still a matter of empirical research. The fact that the world's languages consistently aggregate to certain word order patterns and not to others can be viewed, all things being equal, as the byproduct of the language universal computational mechanism in the sense of Chomsky (1995). In this respect, SLs should not be exceptional.

A few works on nominal modification in SLs seem to confirm this. Despite a considerable degree of order flexibility, Zhang (2007) reports that in TSL, when the noun is found with one modifier, be it a demonstrative, a numeral, or an adjective, both modifier > noun and noun > modifier are possible orders. She points out that different combinations do not yield any difference in interpretation; hence a unique basic order does not emerge. Crucially, even if TSL shows a considerable degree of language-internal variation, all the attested combinations in which more than one modifier is considered are derivable within Cinque's (2005) model. Although based on a completely different methodology, our study takes a similar approach to language-internal variation, showing that this variation is still within the limits of

what the Universal Grammar makes available.

More recently, other works also showed that nominal modification in SLs is a good testing ground for language universals. Neidle and Nash (2012) report that the canonical order for ASL is Dem > Num > Adj > N. Rutkowski et al. (2014) report that in PJM the canonical order is Dem > Num > N > Adj.

## 3. The structure of DP in LIS: early studies

The structure of the DP in LIS is discussed in Branchini (2007), Bertone (2007, 2009), and Brunelli (2011). The empirical base of the three studies consists of elicited data. Since the three authors are in substantial agreement, the core part of this section is based on the most extensive analysis of the DP in LIS, namely that of Bertone (2007, 2009). Additional data from Branchini (2007) and Brunelli (2011) are provided to complement the picture. Bertone (2007, 2009) reports that nominal modifiers in LIS usually occur in postnominal position. The unmarked order is represented in (9)a and exemplified in (9)b (the straight line above the glosses indicates the presence of a specific prosodic contour mainly due to grammatical facial expressions).[6]

(9) a. N > Adj > Num > Dem

b. BOOK NEW TWO DEM$_i$ MINE [Bertone 2009:22]

'These two new books are mine'

The order in (9)a, which contains the nominal modifiers considered under Greenberg's U20 (adjective, numeral, and demonstrative), is enriched in Branchini

(2007) and Brunelli (2011) by including order information for other nominal modifiers. Specifically, they claim that: i) possessives usually appear between the noun and the adjective, and ii) quantifiers tend to appear after all DP modifiers. The revisited ordering schema is illustrated in (10).

(10) N > Poss > Adj > Num > Dem > Quant (after Branchini 2007, Brunelli 2011)

Besides the unmarked order presented in (9), Bertone reports that other orders are also attested, as shown in (11). These orders are claimed to be infrequent and require additional prosodic marking (mainly tensed cheeks and raising eyebrows).[7]

(11) a. N > Num > Adj > Dem [Bertone 2009:22-23]

BOOK TWO NEW $DEM_i$, MINE

b. Dem > N > Adj > Num > index

$DEM_I$ BOOK NEW TWO $IX_i$, MINE

c. Dem > N > Num > Adj > index

$DEM_I$ BOOK TWO NEW $IX_i$, MINE

'These two new books are mine'

Branchini (2007) points out that although nominal modifiers are mainly postnominal, as shown in (12), some cases of prenominal modifiers are also attested, as in (13). Another case of prenominal modifiers discussed in Branchini (2007) is that of heavy NP complements[8] shown in (14).

(12) $CHILDREN_i$ $DEM_i$ SOCCER PLAY [Branchini 2007:48]

'These children play soccer'

(13) DEM$_i$ CHILDREN$_i$ SOCCER PLAY [Branchini 2007:49]

'These/those children play soccer'

(14) a. [[[FRIEND$_K$ POSS] SISTER POSS$_K$] THREE] MARRY DONE

[Branchini 2007:51]

b. ?? [THREE [[FRIEND$_K$ POSS] SISTER POSS$_K$]] MARRY DONE

'Three of my friend's sisters are married'

The order of LIS modifiers shown in (9)a is the mirror image of the universal (and underlying) order of merge proposed in Cinque (2005). Bertone (2007, 2009) and Brunelli (2011) adopted Cinque's framework to account for these data.

In the next sections, we will see how corpus data call into question the claim that modifiers are systematically postnominal. Indeed, we will show that prenominal modifiers are consistently attested and their distribution is highly constrained.

## 4. Nominal modification in LIS: A corpus-based approach

As a minority language, LIS shows the influence of several social factors like the lack of formal recognition by Italian authorities, the paucity of bilingual programs for deaf pupils at school, the absence of a written form, the constant pressure from the dominant spoken language, etc. Given this sociolinguistic context, it is not surprising that there is no standard, although dialectal variation does not undermine mutual comprehension among signers. Indeed, variation in LIS has been documented in several linguistic domains including the lexicon, syntax, and prosody (Branchini, Cardinaletti, Cecchetto, Donati, and Geraci 2013, Cardinaletti, Cecchetto, and Donati

2011, Conte, Santoro, Geraci, and Cardinaletti 2010, Geraci, Battaglia, Cardinaletti, Cecchetto, Donati, Giudice, and Mereghetti 2011, Geraci, Bayley, Cardinaletti, Cecchetto, and Donati 2015).

Therefore, even though elicited data show a relatively stable order in the DP structure, we decided to look at corpus data to have a clearer picture of the dimensions of variation in this domain. Like previous corpus works on LIS (Conte et al. 2010, Geraci et al. 2011, Geraci et al. 2015), our research is based on the Labovian sociolinguistic approach to language variation (Labov 2001), and its empirical base is the largest corpus of LIS currently available (Geraci, Bayley, Branchini, Cardinaletti, Cecchetto, Donati, Giudice, Mereghetti, Poletti, Santoro, and Zucchi 2010).

## 4.1 The LIS Corpus

The LIS Corpus is composed of video recordings from 165 signers from 10 different Italian cities. Each participant took part in four linguistic tasks: individual narration, free conversation among three people, a question-answer elicitation task, and a picture-naming task. At the end of the session, metadata were collected though a questionnaire. In addition to standard sociolinguistic information about age (signers are divided into three groups: 18-30, 31-54, and over 55; see Geraci et al. 2011 for the motivation of this tripartition), gender, etc., information specific to the Deaf world was also collected, such as the presence of Deaf members in the family (Deaf parents, Deaf relatives, hearing family), the involvement in the Deaf community, and whether they watched the LIS version of the TV news.

In this study, we focus on individual narrations analyzing data from 162

signers out of 165 (three signers did not participate in this specific task). We decided to focus on narration (rather than conversation) because this linguistic task triggers detailed description of situations, events, participants, etc. and it is the ideal place to look for both simple and complex DPs. As part of the procedure of data collection, participants were encouraged to produce narratives in front of a signer of the same local variety of LIS. This was done to minimize potential interference from non-local varieties of LIS and to avoid the unpleasant situation of a signer placed alone in front of a camera.

## 4.2 Data annotation

For each signer, we annotated with ELAN (Crasborn and Sloetjes 2008) about 15 DPs containing at least the nominal head and one nominal modifier. For each narration, we skipped the first couple of minutes before starting our annotation. In order to exclude modifiers that are not part of the same nominal expression, only sequences with no clear prosodic break have been considered for annotation. We also excluded clear cases in which non-manual markers were breaking a DP into smaller parts.

The DPs were coded for the following properties: i) the position of nominal modifiers with respect to the head noun, ii) whether the modifier is adjacent or not to the head noun, iii) the number of modifiers within the DP, iv) the clause type in which the DP is found, and v) the modifier type according to Cinque's (2012) hierarchy. The tier *Position* coded for the syntactic distribution of the dependent variable of our study. Four options were in principle expected: i) the modifier appears

before the head noun, ii) the modifier appears after the head noun, iii) the modifier is repeated before and after the head noun, and iv) the head noun is repeated before and after the modifier. An example for each of these options is reported in (15), while the coding for the independent linguistic variables is listed in Table 1, Section 5.

(15) a. modifier > N (Bari)

FIRST STEP [$_{DP}$ **BEAUTIFUL** EXPERIENCE], GO-AHEAD

'After the first step you'll see it's a beautiful experience and you'll go ahead with it!'

b. N > modifier (Milano)

LEAVE PARIS GO-TO [$_{DP}$ EXPERIENCE **BEAUTIFUL**]

'I left and went to Paris, it was a beautiful experience'

c. modifier > N > modifier (Brescia)

[…] GO-BACK THERE NO, MUST [$_{DP}$ **ANOTHER** JOB **ANOTHER**]

'[…] I didn't go back there, I had to find another job'

d. N > modifier > N (Bari)

[$_{DP}$ PRIEST **ALL** PRIEST] BEAT

'All the priests used to use physical violence'

The annotation was performed by one of the authors of the paper, an Italian-LIS professional interpreter and checked by the other author, a hearing native signer of LIS. Unclear cases were double-checked by two Deaf native signers, teachers of LIS at the Ca' Foscari University of Venice, who had already collaborated in other corpus projects. The final dataset of annotated DPs contains 2023 nominal modifiers.

## 5. Results and Analysis

The overall distribution of modifiers with respect to the head noun is illustrated in Figure 1. The most frequent order is noun > modifier (1216 tokens, 60%). The second most frequent option is modifier > noun (692 tokens, 34%). Repetition cases are not frequent in the corpus: 4% for the duplication of the modifier (88 tokens) and 2% for the duplication of the head noun (27 tokens).

--- Insert Figure 1 here ---

Although interesting and never described in the literature of LIS before, these cases of repetition are too few to conduct a systematic quantitative analysis and are therefore excluded from the dataset. The new dataset containing only the two most frequent order options has a total of 1908 tokens. It includes 1216 postnominal modifiers (64%) and 692 prenominal modifiers (36%). This dataset provided the empirical basis for the statistical analysis.

A preliminary observation that can be drawn is that the percentage of prenominal modifiers is too large to be considered as epiphenomenal or a marginal aspect of LIS. Rather, it calls for a more accurate investigation. The position of modifiers with respect to the head noun is analyzed employing mixed-effects models (Baayen, Davidson, and Bates 2008). Since the dependent variable is binomial (noun > modifier vs. modifier > noun order) a logistic model was applied. A step-up and step-down procedure with *Participant* and *Item* as random factors was conducted considering linguistic and social factors as potential predictors of the position of modifiers.[9] The complete list of predictors and their levels is provided in Table 1.[10]

--- Insert Table 1 here ---

The step-up and step-down procedure converged on the same model, which consisted of two linguistic fixed effects (*Modifier type* and *Linear distance*) and three social ones (*Age*, *Family*, and *Register*). A significant interaction was found between *Modifier type* and *Gender*. The parameters estimated by the final model are listed in *Table 2*.[11] The reference level of the dependent variable is the order modifier > noun.

--- Insert *Table 2* here ---

The analysis of the linguistic and social factors exerting a statistically significant influence on the distribution of LIS nominal modifiers as well as the significant interaction are reported in Sections 5.1, 5.2, and 5.3, respectively.

## 5.1 Linguistic factors

The *Modifier Type* factor encodes information about the syntactic status of the modifier according to Cinque's hierarchy. A close inspection of order distribution of the modifiers and their nominal head reveals an interesting pattern (see Figure 2, where dark gray bars indicate postnominal modifiers and light gray bars indicate the prenominal ones). Modifiers occurring to the left are hierarchically higher than those coming to the right (the modifier types are ordered top-down and left-to-right following Cinque's hierarchy). What clearly emerges is that modifiers occurring in the lowest and highest positions of Cinque's hierarchy tend to occur in postnominal position, while modifiers occurring in the central part of Cinque's hierarchy are more balanced.

--- Insert Figure 2 here ---

In our study, we also included some nominal modifiers not considered in Cinque's work, namely genitives (i.e. lexical possessors, à la Alexiadou, Haegeman, and Stavrou 2007), higher adjectives (e.g. other, next, same), relational modifiers (e.g. technical, international, political), and possessive modifiers. These latter have been assigned two separate projections. This is so because in our corpus we found three types of possessive modifiers: one pointing sign and two non-pointing signs. These three forms are illustrated and exemplified in *Table* 3.

--- Insert *Table* 3 here ---

As far as we know, the pointing option co-exists with the other possessive forms in the same varieties of LIS (as also attested in other SLs, Zeshan and Perniss 2008). However, their syntactic distribution suggests splitting the group of possessives into two categories, namely pointing possessives and non-pointing possessives. Pointing possessive modifiers are found both before (51%) and after (49%) the head noun without any strong preference. Non-pointing possessives preferably follow the noun (around 80%).[12]

The distribution of modifiers with respect to the nominal head is in line with the hypothesis put forward in Section 2.2 that nominal modifiers tend to cluster in areas with similar syntactic behavior. In order to test this hypothesis, the different modifier types illustrated in Figure 2 have been collapsed into three groups corresponding to three sections of the hierarchical structure: i) modifiers in the higher portion of the structure showing a preference for the postnominal position, ii) modifiers in the intermediate portion of the structure showing a slight preference for the prenominal position, and iii) modifiers in the lower portion of the structure

showing a preference for the postnominal position. As illustrated in (16), the predictor *Modifier type* is thus a variable containing three levels: high, middle, and low modifiers.[13] Cut-off points are determined by the projections where the frequency of modifier > head/head > modifier order is reversed.

(16) a. High modifiers: relative clauses,[14] quantifiers, determiner-like pointing signs.[15]

b. Middle modifiers: possessive pointing signs, genitives, cardinal numerals, ordinal numerals, higher adjectives.

c. Low modifiers: (non-pointing) possessives, adjectives, relational modifiers.

This factor turned out significant (see *Table 2* above). The direction of the effect of *Modifier type* indicates that modifiers sitting in the higher and lower portion of Cinque's (2012) hierarchy are more likely to occur in postnominal position (*Figure* 3a). For each of the three groups of modifiers, an example is provided below.

(17) High modifiers: N > Quantifier (Salerno)

[HEARING **ALL**] COMPLAIN

'All the hearing people were complaining (about that)'

(18) Middle modifiers: Ordinal > N (Florence)

[**SECOND** HUSBAND] CHILD THREE

'I had three children with my second husband'

(19) Low modifiers: N > Relational modifier (Trani)

SOON INSIDE TYPE VOLUNTARY-WORK, [SERVICE **CIVIL**]

'Soon I began with some sort of voluntary work, in the civil service'

The effect of *Linear distance* indicates that there is a significant difference between modifiers that are adjacent and those that are not adjacent to the head noun. The latter are more likely to occur in postnominal position (*Figure* 3b). To illustrate this general trend, consider quantifiers. Their distribution with respect to the noun is represented in the table below.

--- Insert *Table* 4 here ---

We already saw that quantifiers usually occur in postnominal position (cf. Figure 2). Their distribution shows that this pattern is even stronger when there is an intervening sign between the quantifier and the noun. An example of this structural configuration is illustrated in (20).

(20) N > X > Q (Salerno)

MATE DEAF ALL INSTITUTE WANT IX-1 PLAY

'I wanted to play with all my Deaf mates in the institute'

Qualitative investigation of the internal distribution of nominal expressions with two modifiers reveals that in 68% of the cases they occur adjacent to the noun, indicating that modifier stacking is highly marked. An example of this marked order is (20).

## 5.2 Sociolinguistic factors

As for the social factors, the continuous variable *Age* shows a significant effect on the position of modifiers. The signers born before 1945 and those born after 1965 are more likely to produce postnominal modifiers (*Figure* 3c). Some examples are given below.

(21) N > modifier (from Ragusa, born before 1945)

[FATHER **IX-1_POSS**] ASK IX-2 FUTURE GET-MARRIED WHEN

'My father asked me when I would get married'

(22) modifier > N (from Milan, born between 1945 and 1965)

LATER **IX-3_DET** COMPANY CRISIS

'Later on, the company fell on hard times'

(23) N > modifier (from Brescia, born after 1965)

TEACHER **ALL_THREE** SIGN QUALITY NEG

'All three of the teachers were not good signers'

Another social variable that exerts an influence on the dependent variable is *Family*. Signers with Deaf parents show a significantly different behavior with respect to signers from hearing families. Specifically, they are less likely to produce postnominal modifiers. Signers with at least one Deaf relative are somehow in between the other two categories (*Figure* 3d).

--- Insert *Figure* 3 here ---

Some examples are given below.

(24) modifier > N (from Rome with Deaf parents)

STREET THERE-IS **TWO** DIRECTION

'It is a two-way street'

(25) N > modifier (from Turin with hearing parents)

IX-1 PROBLEM **BIG**

'(In my life) I had big problems'

### 5.3 Interaction: *Modifier type * Gender*

A significant interaction is found between *Modifier type* and *Gender* (*Figure* 4). Women show a more extreme pattern than men because they are more likely to produce modifiers belonging to the central part of Cinque's hierarchy in prenominal position and modifiers sitting in the peripheral projections in postnominal position.

--- Insert *Figure* 4 here ---

Some examples including ordinal numerals (i.e. middle modifiers, which are typically found in prenominal position) are provided below.

(26) modifier > N (female signer from Brescia)

IX-1 FOLLOW **FIRST** ROW

' I followed (my teacher) from the front row'

(27) N > modifier (male signer from Bologna)

COACH **SECOND** NAME SIGNNAME-DAVIDE

'The vice coach's name was Davide'

## 6. Discussion

The position of modifiers in LIS show that variation in their distribution is much higher than previously noted. At the macroscopic level, modifiers can be: i) prenominal, ii) postnominal, iii) repeated both before and after the noun, or iv) sandwiched between repetitions of the head noun. The two latter options are only marginally present in the corpus (around 6%). The statistical analysis revealed two linguistic effects (*Modifier type* and *Linear distance*), two sociolinguistic ones (*Age*

and *Family*), and one interaction (*Modifier type* * *Gender*). We first discuss the linguistic predictors (Section 6.1), then the social predictors (Section 6.2) and the interaction (Section 6.3). We conclude the section with some general observations about the methodology used in this study and the relevance of language-internal variation to the debate about language universals (Section 6.4).

## 6.1 Making sense of the Linguistic factors

The main effect of *Modifier type* indicates the presence of a hierarchical constraint. Indeed, the factor itself is derived by Cinque's proposal of a fine-grained hierarchical structure of the DP layers. The fact that the partition into three areas turned out statistically significant confirms our hypothesis that different areas of the syntactic structure cluster in terms of order with respect to the nominal head. Two further considerations are needed: the first one concerns how it is technically possible to derive such ordering options; the second one concerns how to manage possessive markers in the fine-grained structure since they were not considered in Cinque's original proposal.

As for the first consideration, the most frequent orders between the nominal head and each modifier are: i) N > Dem, ii) Num > N, and iii) N > Adj. In principle, these patterns can be captured by two different orders, either Num > N > Dem > Adj or Num > N > Adj > Dem.[16] A close inspection of the relative order between determiner-like pointing signs and adjectives is required to establish which typological configuration reflects the most frequent pattern in LIS. In the corpus, when two or more than two modifiers are used, the pattern N > Adj > Dem is more

frequent (18 occurrences) than N > Dem > Adj (4 occurrences). Upon closer scrutiny, the four cases of N > Dem > Adj reveal a predicative usage of the adjective, which is probably contained in a reduced relative clause.[17] Thus, these are cases of indirect modification (see Cinque 2010). Notice that if they were genuine cases of direct modification, they would be underivable under current formal theories (Cinque 2005, Abels and Neeleman 2009, see also the Appendix for a more detailed formal proposal). To further investigate this possibility, we elicited both configurations (i.e. N > Adj > Dem and N > Dem > Adj) in a clear context of non-predicative use of the adjective, as illustrated in (28). The result shows that the order N > Dem > Adj is not acceptable. This fact confirms that in cases of non-predicative adjective the typological order of LIS is N > Adj > Dem.

(28) a. SEA BLUE IX-DEM GIVE QUIET

b. * SEA IX-DEM BLUE GIVE QUIET

'this blue sea is relaxing'

Although no categorical rule forces a specific order between a nominal head and its modifiers, our data suggest that the macrotypological order characterizing the nominal domain is Num > N > Adj > Dem. This order is also documented in Basque, Celtic, Easter Island, Hebrew, Hmong, Indonesian, Jacaltec, Rapanui, Wolof, Watjarri, some Mon-Khmer languages, and a number of creoles (e.g. Haitian Créole, Papiamentu, Angolar, Le Tayo, St. Lucian Creole, Louisiana Creole, see Haddican 2002).[18] Interestingly, the order identified in this study is different from the one observed in Bertone (2007, 2009), Branchini (2007), and Brunelli (2011), namely N >

Adj > Num > Dem. We suspect that the informants involved in those studies are signers of a stricter variety of LIS in which modifiers are all postnominal.[19]

As for the second consideration, Cinque's hierarchy has been implemented by adding two separate projections hosting the two lexically different types of possessives: pointing and non-pointing possessives, in line with Longobardi (2000) Alexiadou et al.'s (2007) analyses. The reason to treat the two types of possessive markers differently is not just that of introducing redundant taxonomy into an already dense DP cartography, rather it is motivated by their different syntactic distribution in LIS.[20] Pointing possessives behave like modifiers sitting in the central part of the hierarchy, while the other possessives behave like modifiers sitting at the edge of the hierarchy. Their position in the extended projection of the DP can be addressed by placing pointing possessives at the junction between the higher and central portion of the hierarchy and non-pointing possessives at the junction between the central part and lower edge of the hierarchy. Under this assumption, possessives are thus in crucial positions in LIS signaling the three different areas of the hierarchy: the two peripheries and the central area (see Figure 2).[21]

The direction of the effect of *Linear distance* reveals that non-adjacent modifiers are more likely to be postnominal than adjacent ones. The tendency to place stacked modifiers in LIS in postnominal rather than in prenominal position may reflect the influence of underlying processing mechanisms. Martin and Romani (1994:509) working on English showed that stacked adjectives occurring in prenominal position, as in (29)a, are more challenging than stacked adjectives (inside a relative clause) appearing in postnominal position, as in (29)b.

(29) a. She bought the soft, large pillows at the department store.

b. She bought the pillows that were soft and large at the department store.

Prenominal adjectives cannot be integrated in sentence structure until the noun is processed and therefore imply a higher memory load (i.e. prenominal modifiers cannot be attached to the relevant head until the head itself is processed). On the contrary, postnominal modifiers are not so demanding for working memory because the head noun has already been processed and they can be immediately integrated (i.e. postnominal modifiers can be immediately attached to the relevant head because the head itself has already been processed). This is supported by the finding that patients with short-term memory impairments perform better with stacked postnominal adjectives rather than stacked prenominal adjectives (Martin and Romani 1994). Turning to LIS, Geraci, Gozzi, Papagno, and Cecchetto (2008) show a short-term memory difference between signs and words (a fact already known for other SLs as well, see Wilson and Emmorey 2006). Specifically, LIS signs are particularly challenging for short-term memory. Given this limited capacity, it is at least conceivable that signers avoid those configurations leading to a short-term memory overload. Indeed, stacked nominal modifiers are preferably produced in postnominal position so that they can be immediately attached to the nominal head with lower processing costs. Furthermore, the most frequent option for nominal expressions containing two modifiers is that they are both adjacent to the head (68% of the cases). This configuration is obtained by placing one modifier before and one modifier after the head noun (i.e. modifier > noun > modifier). As before, this tendency may be explained by processing considerations. Hawkins (2004) claims that there is a

correlation between variation and how grammatical conventions are established (Performance-Grammar Correspondence Hypothesis). More specifically, preferences in performance influence the way categorical rules are built in a linguistic system. The fact that nominal expressions containing two different modifiers are frequently arranged according to the modifier > noun > modifier order can be seen as an attempt of LIS to maximize the syntactic difference among modifiers. The presence of the nominal head between two modifiers signals that the two modifiers belong to separate and independent syntactic projections, thus helping the process of mapping modifiers into morphosyntactic independent categories.[22] The most frequent configuration emerging when two modifiers co-occur within the same nominal expression, namely modifier > noun > modifier, represents a violation of Dryer's (2011:6) principle of Intracategorial Harmony ("the Dem, Num, and Adj tend to all occur on the same side of the N"). As for the other principles proposed by Dryer (2011), we did not find an interaction between *Modifier type* and *Linear distance*, indicating that both Principles of Symmetry regulating order between Adj, Num, and Dem in nominal expressions are also violated in LIS (see (7)a-b above). We take these facts as evidence that those general typological principles are not able to capture language-internal variation. This is not a particularly striking observation, since those principles were designed to capture crosslinguistic variation rather than language-internal variation. What is interesting, though, is the fact that once fine-grained distinctions across distinct morphosyntactic categories are available, they are a better predictor than generalizations based on functional definitions.

## 6.2 Making sense of the sociolinguistic factors

Turning now to the significant social predictors, the effect of *Age* reveals a threefold partition: i) signers born before 1945 showing a slight preference for postnominal modifiers, ii) signers born between 1945 and 1965 producing modifiers preferably in prenominal position, and iii) signers born after 1965 showing a significant preference for postnominal modifiers (cf. *Figure* 3c). The fact that the generation of signers born between 1945 and 1965 behaves differently than the other two groups may be due to historical circumstances. During the Second World War and right afterwards, some Institutes for Deaf students temporarily shut down. Since most Institutes were located in urban areas they had to face the threat of bomb blasts. In some cases, students were sent home for precaution or because of structural damage (Luca Des Dorides, P.C.). For instance, in 1942 Prinotti Institute in Turin was damaged by firebombs. In 1943, the State Institute for Deaf students in Milan was destroyed by a bomb attack. In 1943, Smaldone Institute in Bari was severely damaged by the explosion of a ship in the harbor (Zatini 2014). Overall, the devastating effects of the Second World War had a potentially unique impact on LIS due to the crucial role of Deaf schools in language transmission and acquisition. Structural damages to some of the buildings devoted to the education of Deaf students probably led to a disaggregating effect on the Deaf community undermining the socialization process among signers. We speculate here that this disaggregating effect induced a sort of process of recreolization of the language. The linguistic implication of such historical circumstances is that the signers who grew up in the postwar period were exposed to LIS under different conditions with respect to the other generations. As already discussed, the main

tendency in this population is to produce modifiers in prenominal position. It is worth noting that this configuration is widely considered to be the unmarked pattern for U20 (Greenberg 1963, Cinque 2005, and Abels and Neeleman 2009). This is compatible with the idea that the language underwent a process of semi-pidginization (at least in the nominal domain). After 1965, a more stable socioeconomic environment (Nardozzi 2003) encouraged the Deaf community to reaggregate, activating a process of recreolization. We speculate that, during the postwar period, two different substrata corresponding to two different generations of signers converged so that a pattern of postnominal modifiers emerged (similarly to the prewar period). One possible explanation that we can only tentatively sketch here is that some form of sociolinguistic pressure was at play. Older signers could have been implicitly perceived as carrier of a more genuine form of LIS, hence imposing a model of LIS where postnominal modifiers were more frequent. A similar process has been documented in younger speakers of Sipakapense (i.e. a Mayan language), who avoid SVO order because it is perceived as a direct influence from Spanish, and hence a non-genuine pattern (Barrett 2008). Whether this recreolization process represents the intermediate stage between pidgin and creole or simply consists in the original LIS variety used by older signers and re-emerged after particular historical events is left as an open issue to be addressed in future.[23]

The effect of *Family* can be interpreted in terms of different degrees of acquisition. Signers with Deaf parents are slightly more variable, probably showing more competence in managing the syntactic repertoire, as typical of native signers/speakers of a language. This would imply that different semantic nuances are

associated with different order options. Further research is needed in order to get a more precise picture. Signers from hearing families are more regular in preferring postnominal modifiers. These signers behave like advanced learners of a second language, who have mastered the basic rules of the language without being completely acquainted with the exceptions (see Littlewood 1984:ch.3). Their preference for postnominal modifiers is therefore an overgeneralization of the general tendency. This preference is not due to the possible interference from spoken Italian at home or in the domestic environment because nominal modifiers in Italian are almost always prenominal, with the exception of relative clauses and some adjectives (see Cinque 2010). Signers from families with at least one Deaf relative show an intermediate behavior, thus reinforcing the idea that the effect of *Family* correlates with the different degrees of language acquisition.

## 6.3 Making sense of the of *Modifier type* * *Gender* interaction

Finally, the interaction between *Modifier type* and *Gender* shows an interesting pattern displayed by women. They follow the most frequent option depending on the structural position of the modifier. Namely, women are more likely to produce postnominal modifiers if they are at the peripheries of the hierarchy, while they are more likely to produce prenominal modifiers if they are in the central portion of the hierarchy. This behavior of the female population (i.e. following the most frequent option) is also found in the literature of spoken languages (Labov 2001). Labov (2001:266) reports the preference for women to less stigmatized and more prestigious variants. Information about prestigious variants of LIS is not available, however, the

most frequent options can be considered as the less stigmatized in a sociolinguistic environment where there is no standard form, no written form, and no official recognition of the language.

## 6.4 The big picture

Before concluding this section, we would like to point out one potential positive outcome of our method of inquiry. Piantadosi and Gibson (2013) noticed a sample problem in absolute typological universals: the number of languages upon which these universals are based is not sufficiently large to extract statistically reliable inferences. Unattested forms may be the result of accidental gaps rather than of constraints on the architecture of language. Following Tily and Jaeger (2011), Piantadosi and Gibson (2013) propose learning experiments as an alternative source to test what the faculty of language allows as part of its system of rules.

Under the plausible assumption that the same mechanisms underlying the grammar of "stable" languages are also operative in shaping the grammar of languages with a considerable amount of internal variation, our method of investigation provides additional and independent testing ground for language universals. In the case of word order universals, for instance, if certain orders still remain unattested despite internal variation, the probability that these are due to chance or gaps in the sample drastically decreases. However, as it is shown by the case of nominal modification in LIS, these universals must refer to categories that are active in the specific language and not to broad concepts that might or might not apply to the specific case.

## 7. Conclusions

Our corpus study shows that, even in languages with a considerable variation like LIS, the distribution of the various word orders is affected by hierarchical constraints. This finding is of particular relevance both at empirical and theoretical levels.

At the empirical level, we addressed a classic typological research question from a different perspective, namely by looking at variation within a single language rather than by looking at crosslinguistic variation. This approach, fruitfully used in the investigation of U20 in TSL with elicited data (Zhang 2007), has been replicated in LIS using corpus data and extended also to nominal modifiers not originally included in the formulation of Universal 20. Our method has proven useful because we found the same regularities as predicted by classic typological studies. While LIS would have been classified among languages without a specific order under gross macroscopic classifications, our work shows that its behavior is consistent with U20, namely that of a mixed language (LIS most frequent option is Num > N > Adj > Dem). However, LIS regularities do not have the form of rigid categorical rules, rather they have the form of tendencies. These tendencies are determined by the significant factors identified in our model. This is an expected result if we consider that LIS has no standard form and no official status in Italy. Our work reveals that a process of stabilization is put forward by younger generations of signers; while native and native-like signers are still preserving a larger repertoire of syntactic constructions. Women also show a distinct behavior in selecting the most frequent

options. The significant linguistic factors also provide a key contribution to the empirical import of our findings. Specifically, *Modifier type* shows the effects of a highly structured syntax of the DP in shaping the variability of LIS, while *Linear distance* shows processing effects, which are compatible with the idea that processing factors contribute to the final shape of grammatical rules.

At the theoretical level, our study shows that the generalizations on order restrictions and their formal derivations are not just adequate descriptions of crosslinguistic observations. Rather, they tap into the deep cognitive mechanisms which are behind abstract language structures and provide an adequate explanation to linguistic facts. Therefore, they constitute a valuable and independent source of evidence for testing the universals of language. This conclusion is further strengthened by our particular choice of studying a signed language. Indeed, our results show that the abstract syntactic mechanisms underlying the derivation of the structure of nominal modifiers do not depend on the specific modality of transmission.

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# Appendix

In the paper, we provided corpus evidence that the order between a nominal head and its modifiers in LIS is in part determined by the way nominal modifiers are distributed along a rigid hierarchical structure (implemented after Cinque 2012). This was the main effect of the *Modifier Type* factor. We also showed that order preferences across various types of modifiers cluster into two groups: modifiers following the nominal head and modifiers that are almost equally likely to occur either before or after the nominal head. The former characterize the situation of projections in the high and low part of the hierarchy, the latter those in the middle.

In this appendix, we provide the full derivation of the most frequent pattern (Num > N > Adj > Dem) observed in LIS under both Cinque's (2005) and Abels and Neeleman's (2009) models. Then, we will spell out more clearly what are the additional assumptions that are needed to capture (at least part of) the variability observed in the data. The preliminary assumptions needed are the following:

I. The hierarchy of nominal modification in (8) describes the underlying syntax of nominal modifiers (this is qualitatively equivalent to the assumption that Dem > Num > Adj > N is the underlying order under U20, but see endnote 3);

II. Movement inside the DP must contain at least the nominal head;

III. Movement always targets c-commanding positions;

IV. The source of antisymmetry in syntax is due to: (i) the effect of the Linear Correspondence Axiom (LCA), for Cinque's model but not for Abels and Neeleman’s, and (ii) the fact that moved phrases are always linearized first (i.e. movement is always to the left), while base-generated specifiers can be

linearized last (i.e. right-branching specifiers are allowed when base-generated), for Abels and Neeleman's model only.

Under Cinque's model, the order Num > N > Adj > Dem is derived through a simple NP-movement displacing the NP to a position higher than the Adjectival Phrase and a pied-piping movement which rolls up the projections hosting Num, N, and Adj to the left of Dem, as illustrated in *Figure* 5a. In addition to allowing for the same derivation as in Cinque's model, Abels and Neeleman also allow the same order to be base generated, as illustrated in *Figure* 5b.

--- Insert *Figure* 5here –-

The other attested orders are also derivable along similar lines. However, in order to derive the observed variability further stipulations are needed. This is particularly true for the case of modifiers in the central part of the structure, where there is no strong preference for being linearized before or after the nominal head, except for numerals which are mostly prenominal. While this is only possible by stipulating truly optional movements in Cinque's model, at least two options are available in Abels and Neeleman's model. One option is to say that the order of linearization of base-generated specifiers is fixed and determined by language-specific (post-spell-out) rules. Variation should then be captured by stipulating that for some cases a certain degree of optionality is possible. This stipulation is basically equivalent to the one needed for Cinque's model. Interestingly, though, there is also another possibility, namely that base-generated specifiers do not have any fixed order specification. Under this approach, the order between a head and its specifier is not predetermined once for all in the language. Rather, it is negotiated at the perceptual-articulatory

interface at each derivation, with processing needs possibly having a major role. In this case, language-internal variability is naturally accounted for. Categorical behavior (i.e. languages with small or no variation) may still be achieved by introducing some Bayesian mechanism reducing over time the likelihood of true optionality, thus paving the way for a rigid categorical rule. The fact that we also observed a diachronic effect in our LIS data is compatible with the possibility that such a rule is currently not operating in LIS.

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# Endnotes

1 LIS is the language used in everyday exchanges by the Italian Deaf community. We adopt the standard convention of using capitalized "Deaf" to indicate deaf people who identify themselves as members of the signing community.

2 Greenberg's original formulation of U20 is: "When any or all of the items (demonstrative, numeral, and descriptive adjective) precede the noun, they are always found in that order. If they follow, the order is either the same or its exact opposite" [Greenberg 1963:87].

3 The order and the number of the various projections in each cluster is an empirical question. In this paper, we simply assume Cinque's hierarchy. This assumption is qualitatively similar to the assumption about the underlying order in the case of U20 (Dem > Num > Adj > N), although quantitatively different because of the higher number of projections involved.

4 The only exception is the head of C which is claimed to be phrase final (Neidle et al. 2000).

5 Laudanna and Volterra (1991) claim that the basic order is SVO for simple declarative sentences, although they found a consistent use of SOV order, as well. In a more recent corpus study, Branchini and Geraci (2011) confirmed that LIS allows for a considerable amount of variability in the position of the object with respect to the main verb.

6 As a methodological note, Bertone (2007, 2009), Branchini (2007), and Brunelli (2011) notice how difficult it is to observe the co-occurrence of all nominal modifiers in one and the same sentence. To bypass this issue and collect evidence about the relative order among nominal modifiers, partial combinations of these elements were elicited until the total order was derived by transitivity.

7 Bertone (2007) does not distinguish semantic nuances for the options in (11). Although an instance of prenominal demonstrative appears in the examples (11)b and (11)c, as Bertone (2009:23) suggests, it seems to be included in a doubling construction (i.e. it is not a genuine prenominal modifier).

8 We think that this construction is similar to the English genitive construction. Unfortunately, as Branchini (2007) does not provide further data, this claim cannot be verified.

9 The step-up analysis started with a model containing random factors only, which was then enriched by adding all fixed effects one at a time. Only those factors that provided a significant contribution to the model overall goodness of fit were retained. If more than one factor was below the significance threshold ($p = 0.05$), the one associated with the best loglikelihood was retained at that step of the analysis. A check was made at each step to ensure that the additional parameter positively affects the goodness of fit of the model. The level of collinearity of the new parameter was also evaluated by inspecting the contingency tables between the new parameter and each of the parameters already present in the model. We followed Guy (1988) and Tagliamonte (2006) in considering a 90 percent of overlapping as tolerable and a 95 percent as the absolute limit. Due to a high level of collinearity the factors *Linear distance* and *Number of modifiers* could not be retained in the same model (DPs with one modifier are also adjacent to the head noun). Since the effect of *Linear distance* was stronger than that of *Number of modifiers,* we decided to retain the former. The step-down analysis started with a full factorial model, which was then simplified by removing all fixed effects that did not make an overall contribution to the goodness of fit of the model. If more than one factor was above the significance threshold, the factor producing the worst loglikelihood was removed. A check was made at each step to ensure that the removal of the parameter did not significantly affect the goodness of fit of the model.

10 The variable *Register* encodes preliminary and gross information about the register repertoire of the signers. They are considered having a high-register repertoire if they covered any directional position in the administration of the Deaf association (which presumably requires the ability of signing in public for instance during official events and internal electoral campaigns) and if they watched the LIS version of the TV news (assuming that the LIS used in television broadcasts by high-level interpreters is a high-register variant).

11 Several potential predictors considered in the study did not turn out significant. These are: *Number of modifiers*, *Clause type*, *Gender*, *Age group*, *Geographical provenance*, *Residence*, *Job*, and *Education*. In the final model, we kept *Gender* as main factor because of its interaction with *Modifier type* (Baayen 2008).

12 Following Alexiadou et al. (2007), the two types of non-pointing possessives are analyzed as strong possessives occurring in a low structural position, whereas pointing possessives are analyzed as "deficient possessives" occupying a higher structural position (corresponding to either weak or clitic possessives).

13 From a statistical perspective, the variable could be collapsed into two levels (peripheral vs. central modifiers). However, we have strong theoretical motivations to maintain at least a three-way distinction (i.e. it reflects Cinque's hierarchy). The procedure in which similar levels are not combined into one single level is discussed in Tagliamonte (2006:150).

14 Although the distribution of full relative clauses has been coded and gauged, we decided not to investigate this issue in this study. As a matter of fact, there is at present no general consensus on the status and structure of relative clauses in LIS (for further discussion the reader is referred to Cecchetto, Geraci, and Zucchi 2006, Branchini and Donati 2009).

15 The pointing signs included in the corpus have been classified according to two categories, namely determiner-like and possessive pointing signs.

16 Notice that these categories now include larger portions of the DP structure since they reflect the collapsed levels of *Modifier type*. Deriving basic word order from partial orders is only possible on the assumption that transitivity holds across partial orders (see also endnote 6). We are aware of possible conflicts with restrictions on order that might depend on semantic reasons (e.g. scope). Unfortunately, the evaluation of semantic effects is hard to test with corpus data of this kind.

17 The four examples of N>Adj>Dem order found in the corpus are the following: 1) ONE DEAF IX OLD, 'One deaf person (who is) old, 2) IX Pointing_Poss FRIEND IX DEAF, 'The friend of mine (who is) deaf', 3) IX HORSE IX SMALL, 'The horse (that is) small', and 4) SPORT IX VARIOUS, 'Sports (that are) of several kinds'. As reflected by the English translation, these adjectives (OLD, DEAF, SMALL, and VARIOUS) yield an implicit relative clause reading.

18 The fact that LIS patterns with several "young languages" is reminiscent of the debate of whether SLs undergo a recreolization process (see Kegl, Senghas, and Coppola 1999, Newport 1999). The original claim that even well-established SLs undergo constant recreolization has been argued to

be too strong, although some aspects of creolization may remain (Kegl 2008). If the syntax of nominal modifiers is a relevant aspect of the recreolization process, then the question arises as to why the underlying order (Dem > Num > Adj > N) does not emerge as the default in LIS (and possibly other creole languages). Although we cannot provide a conclusive answer to this question here, the discussion of the diachronic change in the text will show that the underlying order does in fact emerge among those signers whose LIS most likely underwent a creolization process.

19 We also had the chance to work with the main informant of Bertone (2007) and Brunelli (2011), who indeed uses strictly postnominal modifiers. This informant belongs to the generation of younger signers, hence his preference for postnominal modifiers is in line with our general findings.

20 The pointing and non-pointing possessives may be distinguished not only by the different syntactic distribution, but also by different semantic properties, such as the kind of possessive relations allowed, the quantificational interpretation of the possessive DP, and different ways to mark alienable vs. inalienable and inherent vs. non-inherent possession. Semantic differences between the two types of LIS possessives deserve further investigation.

21 Pointing and non-pointing possessives in ASL are also given a different account. Abner (2012) analyzes ASL possessives as verb-like predicative entities rather than nominal modifiers. She claims that possessives are accommodated in the DP structure via reduced relative clause formation. As for non-pointing possessives, Abner argues that they are pronominal instances of juxtaposed possession (i.e. low possessives).

22 The least frequent orders (noun > modifier > modifier and modifier > modifier > noun) bear a resemblance to clausal center embedding since in both cases a linearly closer modifier intervenes between a more external one and the modified element. Similarly to center embedding (see Cecchetto, Geraci, and Zucchi 2006, Geraci, Cecchetto, and Zucchi 2008), it can be argued that the configuration including stacked modifiers at the nominal level is disfavored because of its high processing cost. A fortiori, this means that orders in which all modifiers are stacked either before or after the noun should be highly infrequent. All things being equals, this language-specific (or

possibly modality-specific) situation runs against the two crosslinguistically most frequent orders namely, Dem > Num > Adj > N and N > Adj > Num > Dem.

23 In the group of predictors that has been considered for the analysis, there was another factor associated with signers' age, namely *Age group*. This factor has been conceived as a predictor reflecting the special education policies that have been adopted in Italy in the last decades (i.e. residential schools for old signers, transition period for middle-aged signers, and mainstream education for young signers). Most importantly, the step-up and step-down procedures maintained *Age* in the model but excluded *Age group* as non-significant predictor. This reveals that signers' age has an effect on the distribution of modifiers only if the subdivision into age groups is based on historical circumstances. On the contrary, different education policies did not affect the syntactic distribution of modifiers.

# Tables

*Table 1:* List of predictors and levels for the study on the distribution of modifiers.

| **Linguistic predictors** | **Levels** | **Levels after collapsing** |
|---|---|---|
| *Modifier type* | quantifier, determiner pointing, possessive pointing, ordinal numeral, cardinal numeral, possessive, genitive, higher adjective, adjective, relational modifier, relative clause | high (rel_clause, quant, det_point), middle (poss_point, genitive, ord, card, higher_adj), low (poss, adj, relational_mod) |
| *Linear distance* | 0, 1, 2+ | adjacent (0), non-adjacent (1, 2+) |
| *Number of modifiers* | 1, 2, 3+ | single modifier (1), more than one modifier (2, 3+) |
| *Clause level* | main, argument, adjunct clause | - |
| **Social predictors** | **Levels** | **Levels after collapsing** |
| *Gender* | female, male | - |
| *Age* | range 18-81 | |
| *Age group* | young, middle-aged, older | - |
| *Geographical provenance* | Turin, Milan, Brescia, Bologna, Florence, Rome, Salerno, Trani, Lamezia, Ragusa | - |
| *Residence* | urban, rural | - |
| *Family* | hearing, Deaf parents, Deaf relatives | hearing, Deaf |
| *Job* | white collar, blue collar, professional, student, unemployed | working (white and blue collar, prof.), non-working (student, unemployed) |
| *Education* | primary, middle, high | - |
| *Register* | low, medium, high | low (low, medium), high |

*Table 2:* Mixed-Effect Analysis. Parameters Estimated by the Final Model and their Statistical Significance Analysis. Model's goodness of fit values: AIC 1785, BIC 1835 and logLik -879.9. Reference level of the dependent variable: noun > modifier. Outliers are cut at 2 points with respect to standard deviation. Following this procedure, 74 data points have been excluded.

| **Fixed factors** | **Estimate** | **Std. Error** | **Z value** | **Pr(>\|z\|)** |
|---|---|---|---|---|
| Intercept | 1.483 | 0.601 | 2.470 | 0.0135 * |
| Mod.type: high | 2.297 | 0.365 | 6.292 | 3.13e-10 *** |
| Mod.type: low | 3.055 | 0.305 | 10.030 | < 2e-16 *** |
| Linear distance: adjacent | -0.934 | 0.228 | -4.105 | 4.03e-05 *** |
| Age: age | -0.029 | 0.013 | -2.180 | 0.0293 * |
| Age: age' | 0.025 | 0.013 | 1.816 | 0.0693 . |
| Gender: male | 0.367 | 0.215 | 1.712 | 0.0868 . |
| Register: low | -0.168 | 0.174 | -0.963 | 0.335 |
| Family: Deaf parents | -0.429 | 0.183 | -2.341 | 0.0192 * |
| Family: Deaf relatives | -0.298 | 0.18 | -1.658 | 0.0972 . |
| Mod.type * Gender (high*m) | -0.575 | 0.319 | -1.801 | 0.0717 . |
| Mod.type * Gender (low*m) | -0.841 | 0.355 | -2.369 | 0.0178 * |

*Table* 3: Possessive forms found in the corpus data.

| **Possessive sign** | **Still** | **Example** (the relevant possessive forms are boldfaced) |
|---|---|---|
| pointing possessive |  | WH<br>PASSION **IX-1_POSS** WHICH<br>'What is my passion?' |

| | | |
|---|---|---|
| non-pointing possessive with wrist rotation |  | MUM **POSS-1_WRIST** NAME S-I-L-V-I-A<br>'My mum's name is Silvia' |
| non-pointing possessive with open handshape |  | PROBLEM FAMILY **POSS-1_OPEN** OBLIGE MOVE IX_LOC ITALY IX_LOC<br>'Because of my family's problems, I had to move here (to Italy)' |

*Table* 4: Distribution of quantifiers according to *Linear distance.*

| | Quantifier > N | | N > Quantifier | |
|---|---|---|---|---|
| Adjacent | 48 | 35% | 88 | 65% |
| Non-adjacent | 3 | 17% | 15 | 83% |

# Figures

*Figure 1*: [MAN1.tiff] General distribution of nominal modifiers.

*Figure 2*: [MAN2.tiff] Distribution of nominal modifiers according to *Modifier type*.

*Figure* 3: Probability for modifiers to occur in postnominal position according to: a) *Modifier type,* b) *Linear distance,* c) *Age,* d) *Family*.

a) *Modifier type* [MAN3.tiff] b) *Linear distance* [MAN4.tiff]

c) *Age* [MAN5.tiff] d) *Family* [MAN6.tiff]

*Figure* 4: [MAN7.tiff] Probability for modifiers to occur in postnominal position according to the interaction between *Modifier type* and *Gender*.

*Figure* 5: Derivation of Num > N > Adj > Dem according to: a) Cinque (2005), b) Abels and Neeleman (2009).

a) [MAN8.tiff] Num > N > Adj > Dem derived via movement

b) [MAN9.tiff] Base-generated Num > N > Adj > Dem