

# A Study on Qualification/Naming Structures in Sign Languages

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## Abstract

In the prospect of animating virtual signers, this article addresses the issue of representing Sign, in particular on levels not restricted to the language lexicon. In order to choose and design a suitable model, we illustrate the main steps of our corpus-based methodology for linguistic structure identification and formal description with the example of a specific structure we have named “qualification/naming”. We also discuss its similarity and difference with other Sign properties described in the literature such as compound signs. Consequently we explain our choice for a description model that does not separate lexicon and grammar in two disjoint levels for virtual signer input.

**Keywords:** Sign Language animation; grammar modelling; weak hand persistence; compound signs; corpus analysis

## 1. Introduction

With the purpose of formally representing Sign Language (SL) elements and rules to generate animations and automatically produce SL utterances via a virtual signer, we have worked on the DictaSign corpus to identify various grammatical rules. This paper presents our methodology and the result of what is the first cross-SL study of the project. In terms of SL processing, the outcome of such research will benefit Sign synthesis by specifying what should be performed from a grammatical rule. Also, we believe that it can assist grammatical annotation tasks by specifying surface cues to be caught by image processing software.

Among other linguistic structures, we have identified one that we called the “qualification/naming structure”, which constitutes the main focus of this report. It has the interest to be a structure which surface form can also be found in compound lexical units.

First, we describe the methodology used for the cross-language corpus observation, then, we discuss the constraints that must be represented by our formalism, and we conclude on how to refine the current results.

## 2. Methodology

Two approaches are possible to determine a systematic rule between a semantic structure or relation and a surface (phonetic) production: start from either the semantic function or the surface form. The structure presented here was discovered using the latter, as follows.

We have selected gestural units composed of one-handed signs performed by the strong hand while the weak hand is kept activated immediately after the end of a two-handed sign. More precisely, we consider structures containing what Liddell named “fragment buoys”. A fragment buoy is the final handshape of a sign that has just been performed which is then held in the signing space while other signing activity continues on the other hand (Liddell, 2003). In a fragment buoy, the signer uses the

fragment or handshape of a previous sign S0 as a buoy because S0 is referred to by other signs interacting with it (Johnston, 2011).

Figure 1 shows an example in LSF. The two-handed sign S0 is the sign LINE. It is followed by three one-handed signs YELLOW, U and THREE. The intent is to specify a subway line, the line Yellow with the name U3. The sign LINE is clearly held up by the weak hand and remains tense throughout the following three one-handed signs.



Figure 1: LSF example: LINE YELLOW U THREE.

To annotate our corpus, we used labels close to those proposed in the Auslan annotation guidelines (Johnston, 2011). A fragment buoy is labelled FBUOY, followed by a colon and the IDgloss of the two-handed sign S0. In our example, that is FBUOY: LIGNE (for LINE).

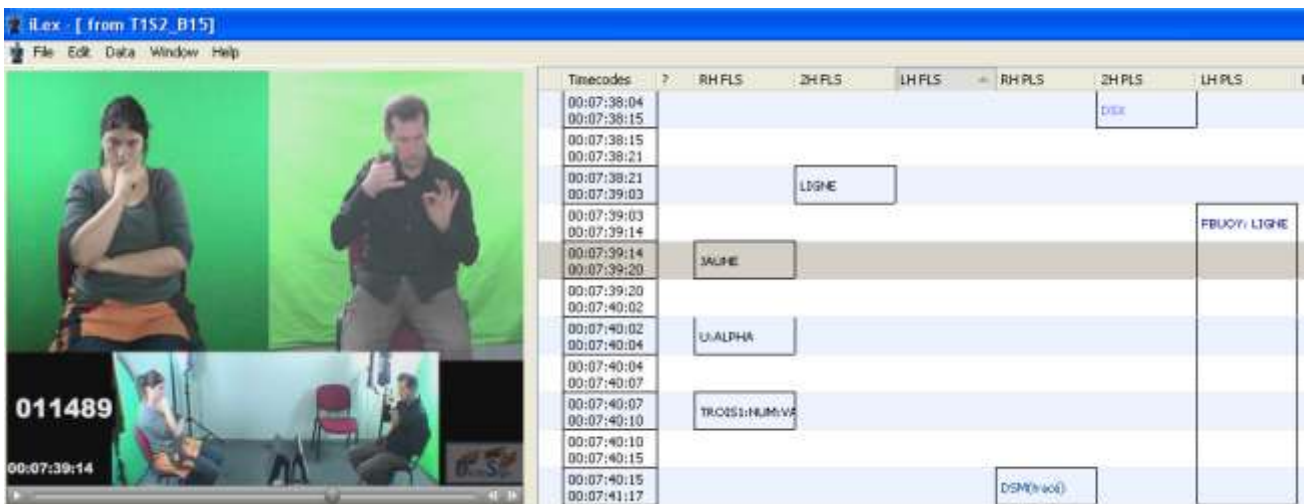


Figure 2: Annotation of our LSF example in iLex using FBUOY label.

Figure 2 shows a snapshot of the corresponding annotation in iLex (Hanke 2002; Hanke & Storz 2008). Time flows from the downwards. We use three tiers for the fully lexical signs (RH FLS, LH FLS and 2H FLS, for the activity of respectively the right hand, the left hand and the two hands), three tiers for the *partly lexical signs* (RH PLS, LH PLS and 2H PLS), and other tiers not detailed here. All the terminology is explained in (Johnston, 2011). Fully-lexical signs are what is often called conventionalised signs or standard signs and are identified with a ID-gloss that is the identifier of the entry in the sign lexicon database. Partly lexical signs include pointing signs, depicting signs, and buoys. See (Johnston, 2011) for a detailed explanation on how to identify and annotate these signs.

In Figure 2, the tier 2H FLS contains the ID-gloss LIGNE (for LINE), and while the LH PLS segment is labelled with FBUOY: LIGNE, the RH FLS tier contains successive segments with the ID-gloss JAUNE, U and THREE (for YELLOW, U and THREE).

T. Johnston suggests that if the activity on the weak hand is not meaningful, for example if it seems only to be the continuation of part of the previously articulated sign and to slowly relax to a neutral handshape or rest position, one must only annotate information for the strong hand. But in our annotation, we did consider the cases excluded by Johnston were there was no topological relationship between S0 and the following one-handed signs (thereby excluding things like classifier predicates, more semantically loaded and based on a lot more than a mere sequence).

Using our annotated part of the corpus (5 hrs of LSF dialogue), we have collected more than 500 occurrences of FBUOY segments and applied the following process.

(a) Choice of target occurrences to collect from the corpus

From these FBUOY segments, we had first noticed a large number of occurrences where the weak hand was held while the strong hand continued on without the two being linked by any geometric or topological reason (like pointing to the weak hand, or depicting a path holding the weak hand as a locative). This led us to define the “unrelated weak hand persistence” criterion as follows: *A two-handed sign S0 is performed followed by one or more one-handed gestures while the final posture of the weak hand is held in place.*

Strong hand:  S0  1-handed signs   
 Weak hand:  S0  held from S0

(b) From form to function in LSF

We collected a minimum of 150 clear occurrences of the surface form described in (a), and found that all fitted either of the two categories below:

1. Qualification/naming: The one-handed utterance on the strong hand qualifies S0 like an adjective, or names it with a name-sign or finger-spells something to identify it. It can be a combination of those.
2. Conservation of activation: S0 is held because it is needed again after the one-handed sequence (S0 usually repeated then). This can be seen as a parenthesis in a discourse, during which S0 is to be kept “active”.

(c) From function to form in LSF, DGS and GSL

The next step of the process was to submit this finding to the Greek and German teams and begin a cross-language verification process based on the LSF, DGS and GSL parts of the Dicta-Sign corpus. All languages were searched for occurrences of the qualification/naming semantic function above (b1), and the corresponding forms observed. The SLs were observed by local experts

separately and their feedback allowed us to suggest the following statement:

*When S0 is a 2-handed sign followed by one or more qualifying or naming 1-handed signs, the weak hand tends to be held strongly in its last S0 posture while the other signs are performed with the strong hand.*

Figures 4 and 5 shows examples extracted from DGS and GSL.



Figure 3: DGS example with TICKET ‘rectangular object’.



Figure 4: GSL example with SALAD DELICIOUS.

This identified structure, to be animated in the hands of a virtual signer, must be formalised to enforce a temporary hand separation and synchronise them on a common timeline. The next section illustrates this process and raises a few linguistic questions.

### 3. Representation and discussion

Azalee is a representation model that allows specifying different parts of a signing activity independently, and that distributes them in time (Filhol, 2011; Filhol, 2012). It has two important properties, which makes it our choice to base our discussion to come:

1. Sign Language productions enrol several simultaneous parts, usually overlapping in time; Azalee defines 'time intervals' (TI), one for each separate part of the production, represented as a box in the diagrams below.
2. Sign Language productions are flexible in many ways, some of the variability is meaningless, some have an effect on the semantics; Azalee deals well with this aspect as it uses minimal sets of necessary constraints.

**Question 1:** Representation of the necessary and sufficient conditions

Fragment buoys are represented as follows (Figure 5), where “S0” is the eponymous TI for the initial two-handed sign, the qualifying/naming 1-handed sequence following S0 is composed of S1 and S2, and FBUOY represents the effect weak hand holding.

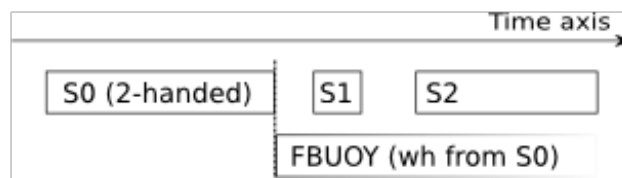


Figure 5: Time arrangement for weak hand persistence after S0

Pertaining to property no. 2 above: There is variability in the point where the FBUOY ends, but invariably signers hold it for a minimum of time. What is the necessary condition? Our model allows to constrain it to the longest commonly used time across signers, which does not force any animation to retract the hand past this boundary.

**Question 2:** Boundary between lexicon and syntactic structures

Another question appears when comparing this structure with compound signs. A compound sign is a lexical unit, whereas we deal with grammatical constructions not registrable as signs. We have noticed the presence of fragment buoy structures in the LSF lexicon database built during the Dicta-Sign project, where each entry corresponds to a given concept. The example shown in Figure 6 corresponds to the concept “relative”. It is expressed in LSF with a compound composed of the signs FAMILY and PERSON. The weak hand is held from the sign FAMILY while the strong hand signs PERSON.



Figure 6: LSL expression of the concept “relative”, which is signed FAMILY PERSON.

There is undoubtedly some similarity between the two constructions (phrase or lexical level). Though we would need quantitative measures on the start and end of the TIs to allow proper comparison of the dynamics and rhythm (they may differ by that only), this question already leads us to question the opacity and even the relevance of the boundary between lexicon and syntactic structures.

### Question 3: Weak hand anticipation

If we invert the diagram above, we end up with a new phenomenon, analogous to what Johnson calls “weak hand anticipation” (Liddell & Johnson, 1986). Again, this has to do with lexical compound signs, i.e. signs composed of several lexical signs and including progressive, or in this case regressive, assimilation.

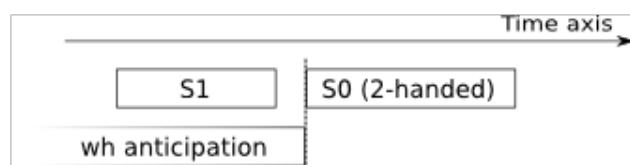


Figure 7: Time arrangement for weak hand anticipation after S0 (inverted fig. 5)

An interesting issue to raise at this point is to transpose question 2 on this inverted diagram. Indeed once again, weak hand anticipation is defined as a lexical property of compounds. But similarly to our observation in Q2, can we question this statement by finding any construction using wh-anticipation and still variable enough to be excluded from the lexicon?

In any case, we insist that Azalee be designed without assumption regarding these questions, both to ensure coverage of all structures and to provide Sign experts with a formalism to write down all possible approaches of a phenomenon. Indeed, only then can we efficiently debate over differences in representations and discover categories instead of having them assumed by the model. Given our observations above, this statement leads us strongly to advocate the use of a model with no immutable gap between lexicon and syntax.

### 4. Future work and conclusion

We have used more than 500 times the label FBUOY in our annotation, and we have not analysed all of them. A deeper and extensive analysis must now be conducted, in order to refine these first results on various aspects, and first of all, by verifying if there can be other semantic categories than the two presented in 2.b for this given surface form. We could use for example the same kind of approach that this used in (Nishio, 2009).

Then we must analyse other parts of the corpus that contain the qualification/naming semantic function that are not annotated with FBUOY. For example, we have to reply to the following questions:

- When another surface form is used (only one-handed signs, only two-handed signs, S0 being a one-handed sign and the following ones two-handed...), can we observe other frequent properties? We have hypothesised the following: “the shoulder line does not move during the sequence, and the time between S0 and the following signs is shorter than average”
- Is it possible that S0 is signed after the qualifying

signs, and in which case?

This paper has presented a Sign linguistic structure for qualifying and naming 2-handed concepts. We have mentioned the unclear lexical vs. syntactic status of the productions using this structure, and explained the need for a representational model that does not make any strong division between those two levels of language. Future work awaits ahead in the study of more linguistic structures, always with the aim of full coverage by the description models.

### 5. Acknowledgements

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