The noun-verb distinction in Catalan Sign Language: an exo-skeletal approach

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This paper investigates the morpho-phonological differences between the members of related noun-verb pairs in Catalan Sign Language. Like parallel investigations in other sign languages, our experimental work provides evidence that the major differentiating factors between related nouns and verbs materialize in the movement component of signs and non-manual markers, thus providing empirical support to the hypothesis that most of noun-verb pairs have different morpho-phonological properties. We distinguish different types of movements, which we categorize into four regular morphological subgroups. We also take into account a fifth group that shows no apparent movement distinction. Concerning non-manual markers, we provide empirical evidence that nouns are mostly produced simultaneously with mouthing, in contrast to verbs, which in a smaller proportion are produced mainly with mouth gestures. Crucially, the fifth group presents the largest ratio of mouthing for nouns and even for verbs. We address these findings within an exo-skeletal theoretical syntactic approach (Borer 2005a,b, 2013, 2014).

Keywords: noun-verb categorization; morpho-phonology of lexical categories; Catalan Sign Language

1 Introduction

This study provides evidence for systematic distinctions within related noun-verb pairs in Catalan Sign Language (LSC), as has been described in previous studies on American, British, Australian, Austrian, and Russian Sign Languages (Supalla & Newport 1978; Sutton-Spence & Woll 1999; Johnston 2001; Hunger 2006; and Kimmelman 2009, respectively, among others). According to these studies, the noun-verb (N-V) categorial distinction appears to be encoded in the movement and in the non-manual markers (NMMs) of the related signs. As for the former property, depending on the kind of movement, verbs take more time to be articulated than the related nouns, thus being identified by a longer duration.

Our main goal in this article is to address the following questions: (i) Are movement and duration relevant in the N-V distinction in LSC?; (ii) Are there any NMMs, such as mouthing and mouth gestures, that help to identify the N-V distinction in LSC?; and (iii) How can these properties be cast in a theoretical model that accounts for the connections between morpho-phonology and syntactic categorization? Our aim is thus to lay out the morpho-phonological differences within a selected set of form-related N-V pairs in LSC, and to analyze them from a

syntactic perspective. To reach this goal, a production experiment was designed in which N-V distinctions were elicited from LSC signers on the basis of a number of cartoons they had to describe. The outcome was that in LSC not all nouns and verbs have the same movement characterization, and that different morpho-phonological groups exist, as Kimmelman (2009) reported for Russian Sign Language (RSL). The data obtained were categorized into four morpho-phonological groups depending on the kind of movement used in the elicitation task. A fifth group was identified for which no obvious movement difference would distinguish N-V pairs. Following the theoretical syntactic approach proposed by Borer (2005a,b, 2013, 2014), we will assume that roots have neither syntactic properties, nor formal semantic properties of any kind. According to this syntax-driven approach, a root, which has phonological properties, is identified as being N-equivalent or V-equivalent, and as receiving different semantic interpretations, depending on the syntactic position where it merges. The account developed here postulates a V-equivalent function (i.e., a C-functor), to be spelled out as path movement, which turns uncategorized roots into a categorized domain.

Concerning NMMs, this paper shows that in most cases, nouns are co-articulated with a mouthing in a higher percentage than their related verbs. In contrast, verbs show a higher percentage of mouth gestures, but the likelihood of verbs to be accompanied by a mouth gesture is lower than that of nouns to be accompanied by a mouthing. Thus, not all verbs are co-articulated with a mouth gesture, and the majority of those co-articulations seem to be associated with verbs that refer to activities.[1] In particular, we will show that items belonging to one specific group of N-V pairs (our fifth group) have the highest percentage of mouthing in both members of the pair, which makes us postulate that the status of both mouthing and mouth gestures in LSC is that of adjuncts: they are segments of Extended Projections (ExP-segments). We take mouthing and mouth gestures to be range assignors and hence S-functors: their phonological realization is not only not unique, but it is also highly contingent on their immediate environment.

The paper is organized as follows. Section 2 presents the relevant background on previous research on the N-V distinction in sign languages. Section 3 describes the design and methodology of the experimental task pursued in our LSC study. Section 4 details the results of our experimental research. Finally, Section 5, after presenting a summary of the theoretical syntactic approach of Borer (2005a,b, 2013, 2014), discusses these results and assesses their consequences within this syntactic approach.

2 Studies on noun-verb pairs in sign languages

To our knowledge, one of the first studies that reported morphological differences within pairs of nouns and verbs in the visual-gestural modality is the one by Supalla & Newport (1978) on American Sign Language (ASL). This study established a relation between the movement of a sign and its lexical category, and compared nouns that refer to an instrument with the

[1] In terms of the event structure templates as defined in Rappaport-Hovav & Levin (1998) and subsequent work.

corresponding verbs that describe the actions performed by using these instruments. For example, the pair HAMMER$_N$/HAMMER$_V$ is morpho-phonologically different in the sense that HAMMER$_V$ is articulated with a larger movement or more amplitude than HAMMER$_N$ (Supalla & Newport 1978: 108). In contrast, HAMMER$_N$ is articulated with a repeated movement. The authors also reported that nouns are usually articulated with a restrained (i.e. tense) movement, while related verbs are not. The existence of a systematic distinction between each member of these related pairs led Supalla & Newport to defend the hypothesis that there is only one entry in the mental lexicon for the pair, an abstract form which is unspecified for manner of movement, and that both nouns and verbs are derived from this underlying general form. In our research, we defend a similar approach, but updated and adapted to the neo-constructionist framework of Borer (2005a,b, 2013).

It is worth mentioning that, after Supalla & Newport's (1978) research, several studies have been carried out on other sign languages that also aimed to identify morphological differences within related pairs of nouns and verbs (Moody (1983) on French Sign Language (LSF); Collins-Ahlgren (1990) on New Zealand Sign Language (NZSL); Pizzuto & Corazza (1996) on Italian Sign Language (LIS); Sutton-Spence & Woll (1999) on British Sign Language (BSL); Johnston (2001) on Australian Sign Language (Auslan); Voghel (2005) and Bouchard et al. (2005) on Quebec Sign Language (LSQ); Hunger (2006) on Austrian Sign Language (ÖGS); Schreurs (2006) on Sign Language of Netherlands (NGT); Schwager & Zeshan (2008) on German Sign Language (DGS) and Kata Kolok; Kimmelman (2009) on Russian Sign Language (RSL), among others). These studies reveal that – although no universal characterization can be provided for the N-V distinction in all sign languages – the sign languages investigated share some common properties:

1. Verbs take more time to be articulated than the corresponding nouns.
2. Longer articulations result from movement associated with the verbal form, but the kind of movement may be different for every language.
3. Nouns are often articulated with mouthing, while verbs are often realized with mouth gestures.
4. N-V distinctions affect, for the most part, pairs that relate a concrete or instrument noun with the corresponding activity verb, whereas pairs consisting of abstract noun-verb pairs show fewer differences.

According to the first and second factors, verbs take longer to be articulated than the related nouns, because of the movement properties associated with the verbal forms. Voghel (2005) compares different investigations and observes that in most sign languages, verbs usually have a simple movement while the related nouns reduplicate it. Still, verbs tend to be articulated with more amplitude and less tension than the corresponding nouns, which are articulated with a tensed and shorter movement.[2]

[2] Restrained movement consists in a lack of looseness in hands and arms, because the muscles are tightened, and movement is small, quick, and stiff (Supalla & Newport 1978).

Kimmelman (2009) describes a set of eight different movement types for verbs and nouns, some of which are also observed in our research in LSC. For example, he observes that some N-V pairs show some sort of opposition to one another, in the sense that the verb includes a path movement, while the noun does not, or one member of the pair involves contact, while the related member of the pair does not, or one introduces more amplitude in the movement than the other member, etc. Nevertheless, Kimmelman concludes that the most common difference is that verbs are usually articulated with increased movement amplitude, adding path, or changing location more often than the corresponding noun. Finally, although in some languages, like NGT, no systematic movement distinction has been found within the selected pairs (Schreurs 2006), most studies agree that verbs usually have a greater variety of morpho-phonological changes than the corresponding nouns.

With regard to the third aspect, mouthing and mouth gestures are factors that have been found to distinguish nouns from verbs. Mouthings are considered NMMs derived from the spoken language with which the sign language is in contact (Sutton-Spence & Boyes Braem 2001). They are instances of mostly silent articulations of (a part of) spoken words, borrowed from a spoken language, which are assumed to have the same basic meaning as the sign they co-occur with. In contrast, mouth gestures have their origin in the sign language itself (Sutton-Spence & Boyes Braem 2001). They consist in mouth movements that somehow reproduce characteristics of the action that the verb refers to (e.g., laughing, vibration of a motor, etc.). Sometimes mouth gestures add information about manner or degree, and in yet other cases, they are simply co-articulated with the sign without contributing any special meaning, even though they appear to be obligatory. Many studies have described mouthings and mouth gestures (Ebbinghaus & Hessmann (2001) for DGS; Rainò (2001) for Finnish Sign Language (FinSL); Sutton-Spence & Woll (1999) and Lewin & Schembri (2011) for BSL; Vogt-Svendsen (1983) for Norwegian Sign Language (NSL), Sutton-Spence & Boyes Braem (2001) and Crasborn et al. (2008) for BSL, NGT and Swedish Sign Language (SSL); and Bank et al. (2011) and Bank (2014) for NGT), and there is much debate in the field of sign language research on the linguistic status of mouthings, namely on the question whether they are part of the phonological specification of signs or should rather be considered a performance phenomenon due to language contact. In Section 5, we will propose that they assign a range to an open syntactic position (see Section 5).

For N-V pair differences, most studies reveal that nouns are more likely to be articulated with mouthing than verbs, which in turn show a higher percentage of mouth gestures. In some sign languages, like NGT, both nouns and verbs display mouthings, but still there exist significant differences between NMMs on nouns and on verbs, as the mouthing in noun-signs is often a full mouthing, while the mouthing in verb-signs often consists of a reduced word (Schreurs 2006: 23).[3]

Finally, let us note that most of the studies that deal with the distinction between nouns and verbs focus on concrete nouns and, within this group, a subgroup of instrument nouns; the corresponding verbs then reflect the action performed with a particular instrument. For

[3] For NGT and LSC, respectively, Crasborn & van der Kooij (2013) and Navarrete (2016) note that mouthings can also mark focus.

example, BROOM$_N$ is classified as an instrument noun, in contrast with CHAIR$_N$, which corresponds to a concrete noun identified as a location.[4] Two of the works referred above include abstract nouns: Hunger (2006), and Schreurs (2006).[5] For ÖGS, Hunger (2006) concludes that pairs with a concrete or instrument noun usually show clearer distinctions than those with abstract nouns, like INTEREST/TO-BE-INTERESTED-IN. On the other hand, Schreurs (2006), who included pairs like VERBAZING/VERBAZEN ('surprise/to be surprised'), BEGIN/BEGINNEN ('beginning/to begin'), and RESPECT/RESPECTEREN ('respect/to respect'), concludes that there are no morpho-phonological differences between these nouns and verbs.

Given the results from these studies, it is our aim to identify the morpho-phonological differences that distinguish N-V pairs in LSC.

3 Methodology

Concerning the study of N-V pairs in LSC, we had three main objectives. First, we aimed at collecting examples of related noun-verb pairs in appropriate discourse contexts. The underlying idea was to identify for each category the morpho-phonological differences that could possibly surface in those contexts. Second, we aimed at getting examples in an environment as natural as possible. As for this goal, it is known that using written stimuli in sign language research may cause distortion of the results because participants may reproduce the written language literally, instead of signing naturally. To avoid this problem, we used pictures, although we were aware of the fact that drawings may be interpreted in various ways and thus lead to different outputs, other than the target one. Third, we also aimed at collecting examples of the items in their citation form (without any linguistic context) or in a neutral syntactic context (without any inflection).

3.1 Participants

Our participants were four women aged between 35 and 50 years. Three of them are native signers of LSC, while the fourth one learned LSC at school, at the age of five. All of them were born and live in the province of Barcelona and attended school before the law of inclusive education came into effect.[6]

[4] BROOM$_N$ reflects the action of holding a broom, while CHAIR$_N$ reflects the movement of the body sitting in a chair.
[5] For further ditails in abstract and verbals nouns, see Abner (2017).
[6] In 1990, the Spanish Government introduced a new law for education (LOGSE, Organic Law 1/1990), which implemented the so-called *integrated education* or *mainstreaming*, according to which deaf children were expected to share the classroom with hearing ones. AS a consequence, the contact of deaf children with LSC would decrease. Before the application of this law, deaf children attended special schools for deaf children, where the education was fully oral, and deaf children only signed outside classrooms. This sociolinguistic situation explains why it is difficult to find native signers or early learners, who developed their full competence in LSC within the critical period for language acquisition. In Spain, only 9.6% of deaf signers are born into a deaf family, and only a small proportion of users of LSC or Spanish Sign Language (LSE) (depending on the area where they live) are native signers (Gras Ferrer 2006).

3.2 Materials

In order to reach these specific goals, we created a dataset that would provide us with the required material for investigation. We selected drawings and pictures, which were shown to our participants as stimuli. We asked our participants to describe the depicted object or action with a single sign, and after that, to provide examples of sentences with that particular sign.

In our sample, we included pictures that could trigger nouns belonging to different classes: concrete, instrument, and abstract nouns. In this way, we also hoped to find out whether the differences that had previously been described for different classes of nouns in other sign languages also existed in LSC (Supalla & Newport 1978; Johnston 2001; Hunger 2006; Schreurs 2006; Kimmelman 2009).

The list of N-V pairs included in our study, classified depending on the semantic status of the noun, is reproduced in Table 1.

Table 1. List of N-V pairs selected for the production experiment

CONCRETE NOUN-VERB	**INSTRUMENT NOUN-VERB**	**ABSTRACT NOUN-VERB**
1. BOAT$_N$/SAIL$_V$	12. BROOM$_N$/BROOM$_V$	21. DEATH$_N$/DIE$_V$
2. CAT$_N$/SCRATCH$_V$	13. CAR$_N$/DRIVE$_V$	22. DEBATE$_N$/DEBATE$_V$
3. CHAIR$_N$/SIT$_V$	14. COAT$_N$/PUT-ON-COAT$_V$	23. DIZZINESS$_N$/DIZZY$_V$
4. CLOTHES$_N$/DRESS$_V$	15. COMB$_N$/COMB$_V$	24. EXPENSE$_N$/SPEND$_V$
5. GAME$_N$/PLAY$_V$	16. DRAWING$_N$/DRAW$_V$	25. SURPRISE$_N$/SURPRISE$_V$
6. GRANDPARENT$_N$/AGE$_V$	17. KNOT$_N$/TIE$_V$	26. TRIUMPH$_N$/TRIUMPH$_V$
7. KITCHEN$_N$/CHEF$_N$/COOK$_V$	18. IRON$_N$/IRON$_V$	27. WISH$_N$/WISH$_V$
8. PLANE$_N$/FLY-(BY/A)-PLANE$_V$	19. FOOD$_N$/EAT$_V$	
9. SHOWER$_N$/SHOWER$_V$	20. SCISSORS$_N$/CUT$_V$	
10. STUDENT$_N$/STUDY$_V$		
11. WOUND$_N$/HURT$_V$		

It should be noted that we focused on the set of morpho-phonological criteria that distinguish concrete from instrument nouns, and their corresponding verbs. Those signs whose handshape shows the way the object is manipulated were categorized as 'instrument', while the remaining signs that referred to objects were categorized with the more generic label 'concrete'. Within the group of instruments, we included COAT$_N$/PUT-ON-COAT$_V$,[7] DRAWING$_N$/DRAW$_V$, and KNOT$_N$/TIE$_V$, because – despite, strictly speaking, not being instruments – the handshape still

[7] Note that in LSC DRESS must be distinct from PUT-ON-COAT in that the latter requires a path while the former involves reduplication.

reflects the way in which an object (a coat, a pencil, a rope) is manipulated. By contrast, the group 'concrete' included any other kind of objects.

Although visual stimuli facilitate natural responses and avoid literal translations from spoken language to sign language, the signs we got were not always the ones that we expected. Because of this, two pairs were removed (WOUND$_N$/HURT$_V$ and TRIUMPH$_N$/TRIUMPH$_V$), as they yielded less than four relevant tokens. In the case of other pairs, like KNOT$_N$/TIE$_V$, DEBATE$_N$/DEBATE$_V$, and DIZZINESS$_N$/DIZZY$_V$, we decided not to remove them, but considered their results preliminary, as we got only 5–6 tokens for the noun of each pair. On some occasions, informants used a certain sign, while others used a different one. It also happened that a drawing/picture was interpreted in a way different from what was expected, such as those intended to elicit abstract nouns like DEBATE$_N$ or DEATH$_N$. In those cases, we only counted the most frequent sign in the dataset, not variants or synonyms.

The overall dataset consisted of four and a half hours of recordings, divided into 145 files, corresponding to the individual elicitation activities. Concerning the specific comparison between nouns and verbs, 933 signs were selected (434 verbs and 499 nouns) and analyzed, of which 97 were isolated forms (42 verbs and 55 nouns). The remaining signs were produced in sentential contexts.

Finally, it should be noted that, for the signs produced in sentence contexts, the boundaries of the signs were identified based on handshape, location, and the start and end of the movement. In order to determine the starting point of the sign, it was important to observe the combination of handshape and the location of the sign, discarding the transitional movement from neutral position to the starting point of the sign and also the transitional handshape. The end of the sign was determined by final location and handshape with special attention to its relaxation.

3.3 Procedure

Every informant was interviewed individually. Each one of them was asked to look at the drawing/picture and to describe it, in the way that we reported in Section 3.2. Participants were filmed with a video camera. We analyzed and annotated the videos with ELAN, an annotation program developed at the Max-Planck-Institute for Psycholinguistics.[8] With this software tool, we processed the videos, segmented them, and got the exact duration of each token. The program also allowed us to analyze in detail the execution of signs, such as the kind of movement or the number of repetitions in those cases where the movement was reduplicated. Our video annotations included the gloss, the lexical category, the kind of movement, the mouthings or mouth gestures (together with other NMMs), the location, the morphological markings (agreement, aspect, manner, etc.), and the duration. We made a distinction between path movement and hand-internal movement. With the aim of unifying criteria, our analysis of movement was based in part on Brentari's (1998) and Sandler's (1989) phonological models.

[8] http://tla.mpi.nl/tools/tla-tools/elan/ (last accessed 07/09/2015).

In order to distinguish between path movements and hand-internal movements, we established that a path movement involves elbow or shoulder movement, causing movement of the hand across the signing space. By contrast, we established that hand-internal movement includes the remaining movement types, such as wiggling, hooking, flattening, squeezing, twisting, nodding, pivoting, circling, and swinging movements of the fingers or the wrist. Our categorization diverges from that of Brentari (1998) and Sandler (1989) in that we consider circular movements as hand-internal movements instead of path movements.[9] In this respect, our classification is closer to the one in van der Hulst (1993).

Referring strictly to the contrastive study between nouns and verbs in LSC, our main goal was to describe the data in accordance with the following criteria:[10]

1. Whether the signs had path movement or not. In case they showed path movement, we described the directionality, the manner, and the frequency of these movements, and identified whether there was any kind of hand-internal movement.
2. The duration of the sign.
3. Whether the signs were accompanied by a NMM, such as mouthing, mouth gesture, or movement of the body, the head or the shoulders.
4. Whether the signs showed any differences depending on the encyclopedic content of the root.

We first calculated the duration of every member of the pair of the dataset. After that, in order to calculate the relative duration in frames of V vs. duration in frames of N, we used Hunger's formula, stated in (1) (adapted from Hunger 2006: 81).

(1) Let N be the noun in a Noun/Verb Pair for a target pair, and V the verb of the target pair. Then: Q(V/N Pair) = duration in frames of V/duration in frames of N.

Following this study, the variable resulting from the formula is labelled *quotient of the noun-verb pair*, and it consists in a relative proportion of their duration value. If it is greater than 1, then the verb is longer, if it is not, the noun is longer.

To calculate the mean duration, we annotated all the data in a Microsoft Excel spreadsheet file. This allowed us to calculate the mean duration for nouns and verbs of each pair. Following this procedure, we could analyze the number of examples for every item, the number of variants, and the duration of the shorter vs. longer member of the pair.

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[9] Although we are aware that the label 'hand-internal' does not fit the definition of circular movement, we keep it in order to maintain into the same group movements classified as secondary movements in van der Hulst (1993).

[10] This contrastive study of N-V pairs was part of a broader research project on the category verb in LSC (Ribera-Llonc 2015). In this larger study, movement was described in terms of (i) directionality (i.e., whether the movement has only one direction –unidirectional–, or more than one –bidirectional–); (ii) the manner in which movement was performed (see Supalla & Newport (1978: 96) for the distinction among *continuous* –when the hands move across the signing space with no interruption–, *hold* –when the hands begin with a loose movement as in continuous manner, but end with an abrupt stop–, and *restrained* –when there is no looseness in the hands and arms, because the muscles are tightened–); and (iii) the frequency of the movement (i.e., the distinction between *simple movement* –just one movement– and *repeated*/*reduplicated* movement –when the frequency is multiple–).

At the same time, this procedure allowed us to determine the inherent properties of the root of each N-V pair and to identify general morpho-phonological patterns for the N category and for the V category. For some nouns, we observed that there existed two variants with different kinds of movement. The difference consisted in single movement in one variant vs. repeated movement in the other, or else, in lack of path movement in one variant vs. path movement in the other. We decided to categorize these nouns into two variants, labelled 'a' or 'b', depending on the kind of movement observed. Accordingly, four pairs of the dataset were divided and classified as N_a-V and N_b-V. These pairs shared the same verbal form because only the related noun was sub-classified. Crucially, those variants of nouns labelled 'b' had a small number of tokens (5–7).[11]

4 Results

As explained in the previous section, in our study of N-V pairs in LSC, we focused on four main properties: (i) differences related to movement, (ii) differences related to the duration of the articulation, (iii) differences related to the NMMs, and (iv) differences related to the encyclopedic content of the root. We present the results obtained per property in the following four subsections.[12]

4.1 Differences related to movement

One of the main results of our analysis is that several morpho-phonological differences can be observed on the basis of movement among N-V pairs, in the sense that depending on the root, a specific morpho-phonological form corresponds to the nominal form and a different one to the verbal one. We categorized these differences into four morpho-phonological groups. We also found some N-V pairs in which the members of the pair turned out not to show any movement, and we categorized them in a fifth morpho-phonological group, to be described below.

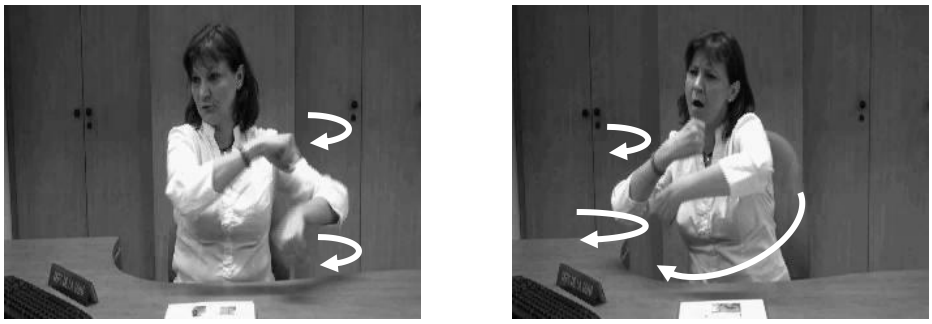
As we pointed out at the end of Section 3, 6 nouns showed two phonological variants. In these cases, we decided to code each variant of the noun as a different N-V pair, and we identified them with a different subscript ('a' or 'b'). One of these pairs was the triad KITCHEN/CHEF/COOK, which was coded as four different variants (KITCHEN_{Na}-KITCHEN_{Nb}, CHEF_{Na}-CHEF_{Nb}). On the other hand, in the case of two pairs (TRIUMPH_N/TRIUMPH_V and WOUND_N/HURT_V), we got few tokens (3 and 4, respectively), and we decided to remove them

[11] The number of tokens for each item is specified inside the parentheses, in Tables 2 to 6, and also in Tables A1 to A5 of the Appendix.
[12] See also the appendix with all the data.

from our study. Overall, we analyzed 33 pairs, instead of the initial 27 pairs (see Table 1 above).[13]

4.1.1 Group 1: roots without path movement

This first group includes pairs of items whose root involves no path movement, but only a hand-internal movement, which can be simple or repeated. Note that in these cases, the noun is articulated without path movement (but may involve hand-internal movement), while the verb adds path movement to the root, as we can see in Figure 1.



a. BROOM$_N$ b. BROOM$_V$

Figure 1. Example of the N-V pair BROOM$_N$/BROOM$_V$

The noun BROOM$_N$, shown in Figure 1a, is articulated with a repeated hand-internal movement executed at the wrist, represented in the picture by means of two white curved arrows. By contrast, in the verb BROOM$_V$, depicted in Figure 1b, the informant simultaneously combines the repeated hand-internal wrist movement with a path movement, represented in the picture by a longer white arrow. Notice also that the movement of the hands is accompanied with a turning movement of the torso.

Moreover, note that this difference of movement also affects the duration of the articulation, so that the verb takes a longer time to be articulated than the corresponding noun, as illustrated in Table 2, in which we apply Hunger's (2006) formula to our recordings.[14]

Table 2. V-N pairs whose root involves no path movement[15]

PAIR	**MEAN DURATION (in ms)**		**QUOTIENT VERB:NOUN** **Q (V/N pair)**
	VERB	**NOUN**	
SHOWER$_V$/SHOWER$_N$	497.69 (13)[16]	318.57 (14)	1.56:1

[13] From the initial 27 pairs, we removed 2 because we didn't have enough tokens. To the remaining 25 we added 6 pairs from double nouns (variant b), plus 2 more pairs from 1 triad. This makes a total of 33 pairs.
[14] Note that in all the tables that follow, we always present the duration of the verb first, and the duration of the noun second, because the duration of the verb is longer than that of the noun.
[15] For details, see Table A1 in the Appendix.
[16] The number inside the parentheses refers to the number of tokens. We use "SD" to refer to Standard Deviation, and "SE" to refer to Standard Error calculated by the formula: standard deviation/number of tokens.

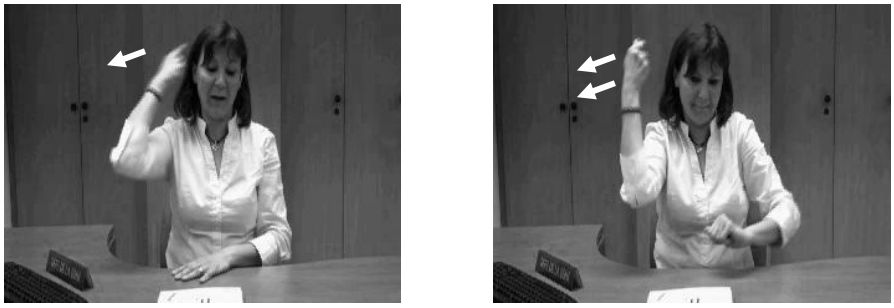
	SD:242.03 SE:18.62	SD:246.29 SE:17.59	
AGE$_V$/GRANDPARENT$_N$	918.33 (12) SD:344.71 SE:28.73	311.87 (16) SD:145.57 SE:9.09	2.83:1
BROOM$_V$/BROOM$_N$	742.22 (9) SD:221.01 SE:24.56	430 (13) 376.21 SE: 28.94	1.72:1
SAIL$_V$/BOAT$_{Na}$	765.33 (15) SD:322.45 SE:22.16	443.6 (25) SD:482.51 SE: 19.30	1.72:1
CUT$_V$/SCISSORS$_N$	715 (12) SD:428.63 SE:35.72	460.90 (11) SD:281.16 SE:25.56	1.55:1
MEAN QUOTIENT FOR THE GROUP			**1.87:1**

Table 2 shows that the smallest difference in duration is found in the pair CUT$_V$/SCISSORS$_N$ (1.55:1), but in general, length differences related to duration are clearly noticeable.

Note also that this group also includes the pair AGE$_V$/GRANDPARENT$_N$, which is special because it is body-anchored. This implies that the members of this pair involve contact with the body and that their phonological place of articulation (location) cannot be modified. The fingers grip the chin in both the noun and the verb, and signers are thus forced to realize the path movement with the trunk, which bends forward, thus assuming the posture of some old people in real life. The difference in duration between the verb and noun of this pair is striking (2.83:1).

4.1.2 Group 2: roots with a simple movement

The second group includes N-V pairs whose root is characterized by a simple movement, which can be either a path movement or a hand-internal movement. In these pairs, the noun shows simple movement, and the verb reduplicates it. Hence, the difference between the noun and the verb is the simple movement vs. reduplicated movement, as illustrated in Figure 2.



a. COMB$_N$ b. COMB$_V$

Figure 2. Example of the N-V pair COMB$_N$/COMB$_V$

As illustrated in these pictures, the noun COMB$_N$ is articulated with a simple path movement (represented by only one arrow), which is reduplicated in the verb COMB$_V$.

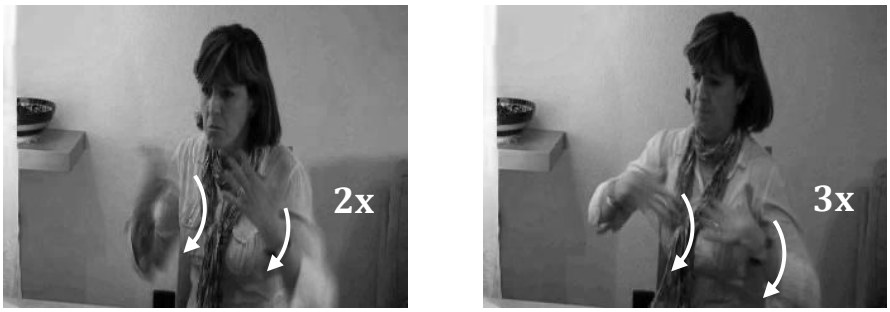
In this group, the average duration differences are quite noticeable, too, and, as in the case of Group 1, the verb takes more time to be articulated than the related noun. Consider Table 3, in which the pair DRIVE$_V$/CAR$_N$ is the one that shows the smallest difference in duration (1.58:1).

Table 3. V-N pairs whose root involves simple (path or hand-internal) movement.[17]

PAIR	**MEAN DURATION (in ms)**		**QUOTIENT VERB:NOUN** **Q (V/N pair)**
	VERB	**NOUN**	
$DRIVE_V/CAR_N$	461.25 (8) SD:147.11 SE:18.39	290.63 (47) SD:140.44 SE:2.99	1.58:1
$COOK_V/KITCHEN_{Na}$	620 (18) SD:335.35 SE:18.63	282.22 (8) SD:75.58 SE:9.45	2.19:1
$COOK_V/CHEF_{Na}$	620 (18) SD:335.35 SE:18.63	373.3 (10) SD:88.50 SE:8.85	1.66:1
$DRAW_V/DRAWING_N$	895.83 (9) SD: 592.28 SE:65.81	508.12 (17) SD: 257.57 SE:15.15	1.76:1
$SPEND_V/EXPENSE_N$	624 (15) SD: 235.40 SE: 15.69	335 (8) SD: 146.68 SE: 18.33	1.86:1
$EAT_V/FOOD_{Na}$	369.61 (26) SD: 266.92 SE: 10.27	200.9 (22) SD: 64.65 SE: 2.94	1.83:1
$COMB_V/COMB_{Na}$	868.33 (18) SD: 556.80 SE: 30.93	232 (11) SD: 73.11 SE: 6.65	3.17:1
$IRON_V/IRON_{Na}$	766.92 (13) SD: 685.27 SE: 52.71	390 (9) SD: 160.37 SE: 17.82	1.96:1
$DRESS_V/CLOTHES_{Na}$	524.14 (29) SD: 226.53 SE: 7.81	269.47 (19) SD: 84.03 SE: 4.42	1.94:1
MEAN QUOTIENT OF THE GROUP			**2.00:1**

4.1.3 Group 3: roots with repeated hand-internal movement

In the third group, both the noun and the verb of a pair show repeated hand-internal movement, but crucially, the verb increases the number of repetitions, as illustrated in Figure 3.



a. $CLOTHES_N$ b. $DRESS_V$

Figure 3. Example of the N-V pair $CLOTHES_N$ /$DRESS_V$

[17] For details, see Table A2 in the Appendix.

The two images in Figure 3 show the same movement for the noun and the verb, but the noun duplicates the movement, while the verb triplicates it. Many pairs of this third group are body-anchored, although not all of them are. As Table 4 illustrates, the mean quotient Verb:Noun of the members of this group is low and, therefore, it is less noticeable. This means that the difference is not always easily perceived, especially in a conversation, where the number of repetitions may change, depending on the context.

Table 4. V-N pairs whose root involves repeated hand-internal movement[18]

PAIR	**MEAN DURATION (in ms)**		**QUOTIENT VERB:NOUN** **Q(V/N pair)**
	VERB	**NOUN**	
$DRESS_V/CLOTHES_{Nb}$	524.14 (29) SD: 226.53 SE: 7.81	441.25 (16) SD: 168.36 SE: 10.52	1.18:1
$DEBATE_V/DEBATE_N$	982 (15) SD: 503.50 SE: 33.57	616.66 (6) SD: 242.71 SE: 40.45	1.59:1
$STUDY_V/STUDENT_N$	674.67 (14) SD: 432.09 SE: 30.86	367 (10) SD: 162.89 SE: 16.29	1.83:1
$EAT_V/FOOD_{Nb}$	369.61 (26) SD: 266.92 SE: 10.27	256.66 (18) SD: 105.94 SE: 5.89	1.44:1
$COMB_V/COMB_{Nb}$	868.33 (18) SD: 556.80 SE: 30.93	530 (7) SD: 342.30 SE: 48.90	1.63:1
$COOK_V/CHEF_{Nb}$	620 (18) SD:335.35 SE:18.63	914 (5) SD:238.60 SE:47.72	0.67:1
$COOK_V/KITCHEN_{Nb}$	620 (18) SD:335.35 SE:18.63	1174.28 (7) SD:683.57 SE:97.65	0.52:1
$IRON_V/IRON_{Nb}$	766.92 (13) SD: 685.27 SE: 52.71	1298 (5) SD: 530.63 SE: 106.13	0.59:1
MEAN QUOTIENT OF THE GROUP			**1.19:1**

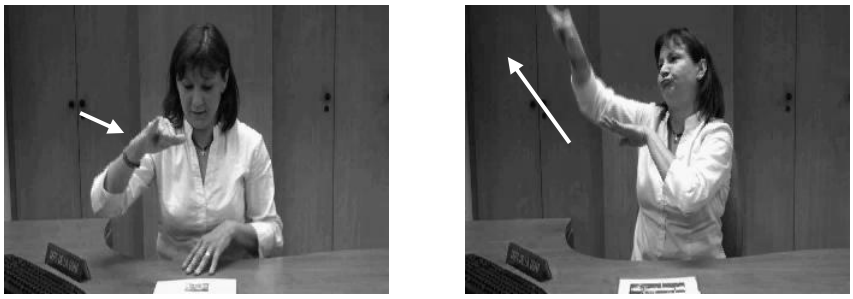
It should be further remarked that in this group, there are some pairs where the noun is even longer than the verb. This occurs in three "b" variants: $COOK_V/KITCHEN_{Nb}$, $COOK_V/CHEF_{Nb}$, and $IRON_V/IRON_{Nb}$. Likewise, in the case of the "b" variant $DRESS_V/CLOTHES_{Nb}$, the difference is also quite small (1.18:1).

4.1.4 Group 4: roots with path movement

In this group, both the nouns and verbs of a pair show simple path movement (or a hand-internal movement in combination with path movement), and therefore, the difference between the two members of each pair lies in the properties of this path movement: in the speed of articulation

[18] For details, see Table A3 in the Appendix.

or in the size of that path movement. In a verbal context, roots are usually signed more slowly or with longer path movement than in a nominal context, as illustrated in Figure 4.



a. PLANE$_N$ b. FLY- (BY/A)-PLANE$_V$

Figure 4. Example of the N-V pair PLANE$_N$/FLY-(BY/A)-PLANE$_V$

The noun PLANE$_N$ in Figure 4a has a short path movement and ends in a hold, while the verb FLY-(BY/A)-PLANE$_V$ in Figure 4b is articulated with a longer and continuous path movement.

The characteristic movement properties within this group make the difference between the average duration of the pair members less noticeable, although it is more pronounced than that of the third group, as shown in Table 5.

Table 5. V-N pairs whose root shows path movement[19]

PAIR	**MEAN DURATION (in ms)**		**QUOTIENT VERB:NOUN** **Q (V/N pair)**
	VERB	**NOUN**	
PUT-ON-COAT$_V$/COAT$_N$	605.55 (18) SD: 263.40 SE: 14.63	483.45 (26) SD: 168.90 SE: 6.50	1.25:1
FLY-(BY/A)-PLANE$_V$/PLANE$_N$	610 (17) SD: 357.49 SE: 21.03	298.69 (23) SD: 193.77 SE: 8.42	2.04:1
WISH$_V$/WISH$_N$	543.06 (26) SD: 380.05 SE: 14.62	353.33 (21) SD: 175.91 SE: 8.38	1.53:1
SCRATCH$_V$/CAT$_N$	376.66 (18) SD: 124.59 SE: 6.92	329.67 (31) SD: 162.98 SE: 5.26	1.14:1
TIE$_V$/KNOT$_N$	833.47 (23) SD: 465.68 SE: 20.25	518 (5) SD: 211 SE: 42.20	1.60:1
DIZZY$_V$/DIZZINESS$_N$	695.38 (13) SD: 383.22 SE: 29.48	291.66 (6) SD: 101.08 SE: 16.85	2.38:1
SAIL$_V$/BOAT$_{Nb}$	765.33 (15) SD:322.45 SE:22.16	299.09 (11) SD: 106.71 SE: 9.7	2.55:1
MEAN QUOTIENT OF THE GROUP			**1.78:1**

[19] For details, see Table A4 in the Appendix.

4.1.5 Group 5: pairs with no apparent distinction

As mentioned above, some pairs showed no movement distinction between the noun and the verb. Alternatively, the distinction was so small that it was difficult to detect, even after a careful and repeated study of the videos. Three out of four pairs belonging to this group are body- anchored. Consider the example in Figure 5.

GAME$_{N}$ / PLAY$_{V}$

Figure 5. Example of the N-V pair GAME$_{N}$ /PLAY$_{V}$

The signs GAME$_{N}$ and PLAY$_{V}$, which we illustrate in Figure 5, are apparently articulated in the same way, with a twisting movement executed at the wrists which are in contact with each other. The mean quotient between the verb and the noun is characteristically very low (as illustrated in Table 6), while the percentage of mouthings associated with the noun (and the verb in some pairs) is considerably high, as we will consider in Section 4.3.

Table 6. V-N pairs with no movement distinction.[20]

PAIR	**MEAN DURATION (in ms)**		**QUOTIENT VERB:NOUN** **Q (V/N pair)**
	VERB	**NOUN**	
PLAY$_{V}$/GAME$_{N}$	291 (19) SD: 144.29 SE: 7.59	250 (28) SD: 183.28 SE: 6.55	1.16:1
DIE$_{V}$/DEATH$_{N}$	440.52 (19) SD: 209.77 SE: 11.04	403.8 (8) SD: 164.49 SE: 20.56	1.09:1
SURPRISE$_{V}$/SURPRISE$_{N}$	355.83 (24) SD: 169.63 SE: 7.07	377.08 (24) SD: 148.33 SE: 6.18	0.94:1
SIT$_{V}$/CHAIR$_{N}$	365.38 (13) SD: 124.87 SE: 9.61	414.54 (12) SD: 201.74 SE: 16.81	0.88:1
MEAN QUOTIENT OF THE GROUP			**1.01:1**

According to the results presented so far, in most of the investigated pairs (i.e. 29 out of 33), the noun and the verb display some kind of movement distinction. However, there are also four

[20] For details, see Table A5 in the Appendix.

pairs, namely those classified as belonging to the fifth group, in which there is no noticeable movement distinction between the members of each pair.

4.2 Differences related to the duration of the articulation

With respect to duration, and referring to N-V pairs that are articulated with a movement distinction, in 26 out of 29 pairs (i.e. 90% of the cases), the duration of the verb is longer than the duration of the noun, while in the remaining 3 pairs (10%), the noun is longer than the related verb. Crucially, the longer nouns are all "b" variants, namely IRON$_{Nb}$, KITCHEN$_{Nb}$, and CHEF$_{Nb}$.

It should also be remarked that not all groups show the same quotient of duration, because duration appears to depend on the kind of movement; see Table 7.

Table 7. Types of movement associated with verbs and nouns, with mean duration quotient V: N for each group

	VERB MOVEMENT	**NOUN MOVEMENT**	**MEAN DURATION QUOTIENT VERB:NOUN**
GROUP 1	Path movement	No path movement	1.87:1 SD: 0.540 SE: 0.107
GROUP 2	Reduplicated movement	Simple movement	2.00:1 SD: 0.475 SE: 0.052
GROUP 3	Increased number of repetitions	Repeated hand-internal movement	1.19:1 SD: 0.522 SE: 0.065
GROUP 4	Modification of path movement	Path movement	1.78:1 SD: 0.549 SE: 0.078
GROUP 5	----------	----------	1,01:1 SD: 0.130 SE: 0.032

The first and second groups are the ones that show the most noticeable distinction between the average duration of verbs and the corresponding nouns, while there is almost no such difference in the third and fifth groups. According to these results, verbs that add path movement to the root, or change from a simple to a reduplicated movement, noticeably increase the duration of the articulation compared to the related noun (1.87:1 and 2.00:1 for group 1 and group 2, respectively). The fourth group, which is characterized by the modification of the path movement, also shows a remarkable difference between the average duration of nouns and verbs (1.78:1), although it is not as big as in the first and second groups. The average duration difference in the third group, where the difference lies in the increased number of repetitions of the verb, is much smaller (1.19:1). Finally, in the fifth group, no movement difference, and thus no difference in average duration (1.01:1), is observed. Therefore, we reach the conclusion that there is a very close relationship between the largest mean duration quotient Verb:Noun and the kind of movement.

4.3 Differences related to the non-manual markers (NMMs)

Although a movement difference is important to distinguish verbs from nouns in most N-V pairs, this is not the only morpho-phonological way of distinguishing one from the other. An important result of our empirical study is that most of the selected pairs showed non-manual differences as well. For the most part, the NMMs involved in the N-V contrast consist in mouthings for nouns and mouth gestures for verbs.

As explained in Section 2, mouthings are derived from spoken languages; they are mostly silent articulations of (parts of) spoken words, borrowed from a surrounding spoken language. For the examples we describe here, it is interesting to point out that LSC mouthing is based on spoken Spanish.

Mouth gestures, on the other hand, are oral articulations originating in sign languages themselves, and unrelated to spoken languages. Some signs may even be interpreted as ill-formed, if they are not co-articulated with the lexically specified mouth gestures.[21]

Table 8 shows the results of the analysis concerning the distinction between mouthings and mouth gestures in verbs and nouns of the selected pairs in LSC, distributed by groups.

Table 8. Percentage of mouthings and mouth gestures per groups

		NUM. OF TOKENS	**MOUTHING**	**MOUTH GESTURE**	**NO MOUTHING OR MOUTH GESTURE**
GROUP 1	NOUNS	79	65 (82%)	2 (3%)	12 (15 %)
	VERBS	61	14 (23%)	40 (66%)	7 (11%)
GROUP 2	NOUNS	151	114 (75%)	12 (8%)	25 (17%)
	VERBS	154	43 (28 %)	87 (56%)	24 (16%)
GROUP 3	NOUN	74	56 (76%)	11 (15%)	7 (9%)
	VERBS	151	43 (28%)	86(57%)	22 (15%)
GROUP 4	NOUNS	123	90 (73%)	11 (9%)	22 (18%)
	VERBS	130	24 (18%)	77 (59 %)	29 (22%)
GROUP 5	NOUN	72	63 (88%)	3 (4%)	6 (8%)
	VERBS	75	52 (69%)	18 (24 %)	5 (7%)
TOTAL	NOUNS	499	388 (78 %)	39 (8%)	72 (14%)
	VERBS	434[22]	136 (31 %)	231 (53%)	67 (15%)

[21] This is precisely what happens with the signs expressing the meanings of TO-HAVE and TO-HAVE-NOT in LSC.
[22] For pairs that have two nouns type, like $BOAT_{Na}$/$BOAT_{Nb}$, the verb was counted only once. Therefore, the total of tokens for verbs is 434 instead of 571, and the total of mouthings is 136 instead of 176.

The number of tokens coarticulated with mouthings is significantly higher for nouns than for verbs (78% of noun tokens vs. 31% of verb tokens). This difference holds across all groups, while only in the fifth group, verbs also show a high percentage of mouthings (69%). By contrast, when we look at mouth gestures, the results are reversed: for nouns, the number of tokens coarticulated with a mouth gesture is low (8%) while for verbs it is higher (53%). Overall, the results show that the percentage of verbs accompanied by mouth gestures is not as high as the percentage of nouns accompanied by mouthings (53% vs. 78%). Finally, there are also nouns (14%) and verbs (15 %) that are not co-articulated with any mouthing or mouth gesture.

In what follows, we first consider mouthings and mouth gestures on nouns and then on verbs. When nouns are considered individually, we observe three striking patterns. First, there are five nouns that have 100% of tokens co-articulated with mouthing (group 1: GRANDPARENT$_N$, group 3: CHEF$_{Nb}$, group 4: KNOT$_N$, BOAT$_{Nb}$, group 5: DEATH$_N$). Second, all nouns in the fifth group show a higher percentage of tokens co-articulated with mouthing in comparison to nouns in the other groups (CHAIR$_N$ (83%), GAME$_N$ (86%), DEATH$_N$ (100%), SURPRISE$_N$ (87%)). Finally, there is one noun with a high percentage of tokens co-articulated with mouth gestures: DEBATE$_N$ (67%) in the third group. We summarize these striking results in Table 9.

Table 9. Nouns that show the most striking results with respect to mouthings and mouth gestures

NOUN	MOVEMENT GROUP	MOUTHINGS FOR NOUNS	MOUTH GESTURES FOR NOUNS	NO MOUTHINGS AND NO MOUTH GESTURES
GRANDPARENT$_N$	GROUP 1	16/16 (100%)	0/16 (0%)	0/16 (0%)
CHEF$_{Nb}$	GROUP 3	5/5 (100%)	0/5 (0%)	0/5 (0%)
KNOT$_N$	GROUP 4	5/5 (100%)	0/5 (0%)	0/5 (0%)
BOAT$_{Nb}$	GROUP 4	11/11 (100%)	0/11 (0%)	0/11 (%)
DEATH$_N$	GROUP 5	8/8 (100%)	0/8 (0%)	0/8 (0%)
GAME$_N$	GROUP 5	24/28 (86%)	0/28 (0%)	4/28 (14%)
SURPRISE$_N$	GROUP 5	21/24 (87%)	3/24 (12%)	0/24 (0%)
CHAIR$_N$	GROUP 5	10/12 (83%)	0/12 (0%)	2/12 (17%)
DEBATE$_N$	GROUP 3	2/6 (33%)	4/6 (67%)	0/6 (0%)

Table 10 provides an overview of the set of mouthings articulated with the first eight nouns from Table 9. As mentioned before, note that the language on which LSC mouthings are based is spoken Spanish, one of the official languages in Catalonia, but the only one in which our informants were educated at oral schools.

Table 10. Examples of nouns with the highest percentage of mouthings

NOUN	WORD IN SPANISH	PHONOLOGICAL REPRESENTATION	NUMBER OF TOKENS WITH MOUTHING	MOUTHINGS (subscript numbers indicate the number of tokens per mouthing)
GRANDPARENT$_N$	abuelo Viejo	/abuélo/ /biéχo/	16/16	/ab/$_1$, /abu/$_5$, /abué/$_1$, /bu/$_2$, /be/$_1$, /bélo/$_1$, /buélo/$_1$, /abélo/$_2$, /biéxo/$_2$,
CHEF$_{Nb}$	Cocinero	/koϴinéɾo/	5/5	/koϴín/$_1$, /koϴíe/$_3$, /koϴinéro/$_1$
KNOT$_N$	Nudo	/núdo/	5/5	/na/$_1$, /núdo/$_4$
BOAT$_{Nb}$	barco	/báɾko/	11/11	/báko/$_{11}$
DEATH$_N$	muerte	/muéɾte/	8/8	/me/$_1$, /méto/$_1$, /mué/$_2$, /muét/$_2$, /muéte/$_2$
GAME$_N$	Juego	/xwégo/	24/28	/xwé/$_{16}$, /xuo/$_3$, /xwéte/$_1$, /xjuéo/$_1$, /xwégo/$_3$,
SURPRISE$_N$	Sorpresa	/soɾpɾésa/	21/24	/pésa/$_1$, /so/$_2$, /sop/$_4$, /sopé/$_4$, /sopésa/$_{10}$
CHAIR$_N$	Silla	/síʎa/	10/12	/sí/$_1$, /sía/$_9$

What Table 10 illustrates is that mouthings tend to reduce the spoken word to at least the stressed syllable and the most visible, articulatorily speaking, part of it.

When we consider verbs individually, we observe that some verbs have 100% of tokens co-articulated with a mouth gesture. This happens with DRIVE$_V$, DEBATE$_V$, SAIL$_V$, and FLY-(BY/A)-PLANE$_V$. These verbs belong to different movement groups, but all of them refer to an activity.

Table 11. Types of mouth gestures co-articulated with verbs

VERB	MOUTH GESTURES				
	'bbb'	**'mmm'**	**'puffed-cheeks'**	**'fff'**	**Other**
DRIVE$_V$	1/7 (14%)	6/7 (86%)			
DEBATE$_V$	4/12 (33%)	8/12 (67%)			
SAIL$_V$	10/12 (83%)			1/12 (8%)	**'uooo'** 1/12 (8 %)
FLY-(BY/A)-PLANE$_V$	7/ 14(50%)	4/14 (29%)	3/14 (21%)		

What this table shows is that the most common mouth gestures are 'bbb' and 'mmm'. Note, however, that it is sometimes difficult to code and describe mouth gestures. To help in this description, we include in Figure 6 some pictures that illustrate the most common mouth gestures that we found in association with verbs in LSC.

a. bbb b. mmm c. fff d. puffed cheeks

Figure 6. Pictures illustrating the most common mouth gestures in LSC.

On the other hand, there are also some verbs that show a high percentage of mouthing, like PLAY$_V$ (84%), DIE$_V$ (79%), and SURPRISE$_V$ (83%), all of them phonologically anchored to the body and belonging to the fifth group. Recall that in this group, there is no or hardly any movement difference between the noun and the verb. Mouthings for each individual verb item are listed in Table 12.

Table 12. Types of mouthing for verbs that have the highest percentage of mouthings

VERB	**WORD IN SPANISH**	**PHONOLOGICAL REPRESENTATION**	**NUMBER OF TOKENS WITH MOUTHING**	**MOUTHINGS (subscript numbers indicate the number of tokens per mouthing)**
PLAY$_V$	Jugar (‘to play) juegan (‘they play’)	/xugáɾ/ /xwégan/	16/19 (84%)	/xwá/$_9$, /xwé/$_1$, /xwégan/$_2$, /wean/$_1$, /xwégo/$_2$, /wé/$_1$
DIE$_V$	Morir (‘to die’) ha muerto (‘s/he died’)	/moɾíɾ/ /muéɾto/	15/19 (79%)	/me/$_1$, /mu/$_3$, /mo/$_2$, /mué/$_3$, /muéto/$_3$, /muó/$_2$, /méto/$_1$,
SURPRISE$_V$	Sorprenderse (‘to be surprised’) se sorprende (‘s/he is surprised’)	/soɾpɾendéɾse/ /se soɾpɾénde/	20/24 (83%)	/su/$_2$, /sop/$_5$, /sopé/$_6$, /sopésa/$_7$,

It should also be pointed out that for some pairs, mouthing is partially different in verbs and nouns, as was observed in the case of PLAY$_V$ / GAME$_N$: for tokens of the noun, the most common mouthing is /xwé/, while for verbs, it is /xwá/. The labial articulation is quite different because in Spanish, the stem for the noun *juego* ‘game’ and for the verb *jugar* ‘to play’ are also different.

4.4 Differences related to the encyclopedic content of the root

Finally, we consider whether the signs studied here showed any differences regarding the encyclopedic content of the root, and its contribution to denoting concrete, instrument, or

abstract nouns. Supalla & Newport (1978) observed that the derivational morphology for nouns and verbs in ASL was most consistently found with nouns that referred to concrete entities and verbs that denoted actions in which these entities were involved. Johnston (2001) specified that it is probably iconicity (essentially a reversible action) what underlies the observation by Supalla & Newport (1978) on concrete signs, and he explored this kind of concrete entity – action pairs in Auslan. The results show that when iconic reversible movement (pairs like $DOOR_N$/OPEN_CLOSE-$DOOR_V$) is not present, the putative derivational process involving repetition appears to be far from systematic (Johnston 2001: 248). In her study on NGT, Schreurs (2006) added eleven abstract related pairs in order to investigate whether the semantics was relevant or not at a morpho-phonological level, but she did not find any striking difference in movement patterns for all the pairs selected in her study, whatever s their conceptual content.

Following these studies and the suggestion of an anonymous reviewer, in Table 14 we provide the results of duration quotient in Verb:Noun pairs depending on the encyclopedic content of the root. In order to be more accurate in our claims, this table distributes the data by groups and types of roots. Note that the average quotient Verb:Noun is given in ms.

Table 14. Nouns classified according to encyclopedic content and morpho-phonological criteria

		CONCRETE	INSTRUMENT	ABSTRACT
GROUP 1	Number of pairs	3/5	2/5	0/5
	Average quotient V:N	2.14:1 SD: 0.691 SE: 0.230	1.63:1 SD: 0.120 SE: 0.060	
GROUP 2	Number of pairs	3/9	5/9	1/9
	Average quotient V:N	1.96:1 SD: 0.265 SE: 0.088	2.06:1 SD: 0.635 SE: 0.127	1.59:1
GROUP 3	Number of pairs	4/8	3/8	1/8
	Average quotient V:N	1.1:1 SD: 0.591 SE: 0.147	1.22:1 SD: 0.553 SE: 0.184	1.59:1
GROUP 4	Number of pairs	3/7	2/7	2/7
	Average quotient V:N	1.97:1 SD: 0.713 SE: 0.237	1.47:1 SD: 0.247 SE: 0.123	1.95:1 SD: 0.601 SE: 0.300
GROUP 5	Number of pairs	2/4	0/4	2/4
	Average quotient V:N	1.02:1 SD: 0.197 SE: 0.098		1.01:1 SD: 0.106 SE: 0.053
TOTAL AVERAGE QUOTIENT V:N		1.64:1	1.59:1	1.54:1

This table shows the mean duration average quotient Verb:Noun for roots that denote concrete, instrument and abstract concepts. It reveals that there is no difference among semantic types, at least in the light of the dataset we have analyzed. Interestingly, there are no abstract nouns belonging to the first group, nor instrument nouns that belong to the fifth group.

4.5 Interim conclusions

The questions that we raised in the introduction and that motivated our experimental investigation made us look for differences between nouns and verbs in LSC, if they existed at all, and try to determine the linguistic status of these differences. Our experimental research, designed to explore the morpho-phonological distinctions in a set of selected N-V pairs of LSC, reveals that some important differences exist among these pairs. The main distinctions found are related to movement, which also affects the duration of the articulation, and the presence of NMMs co-articulated with the signs.

In the next section, we discuss the results of our study from the perspective of the syntactic framework developed by Borer (2005a,b, 2013, 2014).

5 An exo-skeletal account of the N-V distinction in LSC

5.1 Theoretical background: the syntactic approach of Borer

An exo-skeletal approach postulates that structural properties are responsible for both the syntax and the semantic interpretation of a linguistic expression. In exo-skeletal theories, a functional structure is the skeleton of a linguistic expression, which means that it is this structure that determines the syntactic properties of the sentence, as well as its compositional meaning. An exo-skeletal model, such as the one proposed by Borer (2005a,b, 2013, 2014), where structure is built by the computational system, and where constructions are not primitive entities, is called neo-constructionist. In this sense, exo-skeletal theories postulate a strong correspondence between structure and meaning. They turn out to be syntactic theories that focus on the emergence of syntactic structure, rather than theories of the lexicon-syntax interface.

Also central to exo-skeletal theories is the view that lexical items are units endowed exclusively with encyclopedic content and phonological properties, while grammatically relevant aspects of meaning are claimed to emerge from structural properties of the sentence. Thus, in accordance with an exo-skeletal conception of the structure of the language, syntactic properties do not emerge or project from lexical properties, but from the structure itself.

Accordingly, Borer assumes that properties of the structure determine the morphological form and the formal meaning of all pieces included in the structure. Basic, underived, units are called "roots" (notation: $^{\pi}\sqrt{RRR}$).[23] A lexical root is conceived of as an atomic element, in such a way that it cannot be decomposed. Crucially, lexical roots do not have any associated lexical category; that is, they are not verbs, nouns, adjectives or adverbs: they are just roots. Hence, only when a root merges in a syntactic position, within a specific syntactic structure, it is assumed to acquire some category equivalence. For our purposes, what is interesting is that N emerges as a result of a root being rendered N-equivalent (for example, in the complement of

[23] Note that π stands for the phonological form of the root.

a D(eterminer)), while V emerges as a result of a root being rendered V-equivalent (for example, in the complement of T(ense)), as shown in (2) (C = category).

(2) a. C=N: C is N-equivalent in the context of D
b. C=V: C is V-equivalent in the context of T

The idea behind C=N and C=V is that it is the structure that determines the category membership of the items that merge in a given configuration.[24]

Roots are associated with encyclopedic information and have phonological properties; the latter involve an index referring to a phonological information packet that potentially controls root realization in context and the realization of functors locally (Borer 2013: 634).[25] However, roots have neither a category specification, nor a selection frame, nor argument structure specification, nor an overt grammatical marking of any sort (be it syntactic or morphological). This means that roots have no grammatical properties of any sort. Therefore, roots are only C-equivalent when they merge with or are modified by some function. Beyond roots, and distinct from them, Borer (2013) assumes two kinds of functors, S-functors and C-functors.

An S-functor is a relationship between some semantic range and a syntactic position with an open value where the semantic range is realized. S-functors form a pair range assignor – open value, as represented in Figure 7 (Borer 2013: 38, (20)).

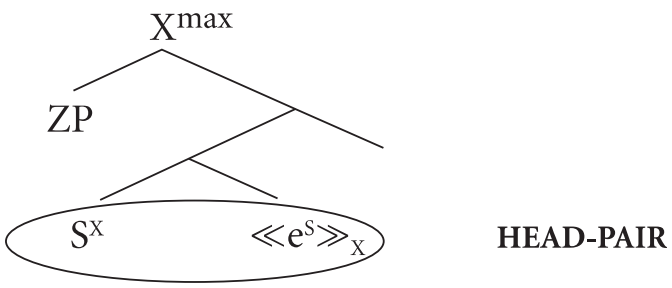


Figure 7. Structure corresponding to an S-functor

[24] Similar assumptions are made in other theoretical approaches, like Distributed Morphology (Halle & Marantz 1993), where the term root has been employed in reference to encyclopedic entries, which are likewise devoid of grammatical specification, and thus devoid of syntactic category (Borer 2005b, 2013). In fact, "[t]he Exo-Skeletal Model shares with Distributed Morphology the assumption that the (first) element which merges with a functor is a root: a (potentially) listed, underived item which is otherwise devoid of category. Beyond specifying that it may be, in some sense, listed, underived, and devoid of category, however, the properties of the items that we call here "roots" are not by any means self-evident or generally agreed upon, even within syntactic approaches to the formation of words, nor do approaches agree on what is or is not "derived", or on the formal nature of the listing under consideration" (Borer 2013: 379). See also Acedo-Matellán (2010) for a comparison between these two models.

[25] This aspect differs from other similar approaches, like Distributed Morphology, where roots are not associated with phonological information. However, Embick & Halle (2005), within this framework, appeal to the existence of (underlying) phonological properties specifically associated with roots (Borer 2013: 381, fn. 4).

S-functors are syntactic adjuncts. They can modify Extended Projections of either the nominal domain or the verbal domain, as exemplified in (3a) and (3b). “Members of the class which includes, e.g., determiners or past [or future] tense, and which are typically assumed to be linked with Extended Projections, correspond to some semantic formulas and merge, syntactically, as modifiers” (Borer 2013: 29).

(3) a. $[_{D}\ \text{THE}^{D}\ \langle\langle e^{THE}\rangle\rangle_{D}\ [_{C=N}\ ]]$
b. $[_{T}\ \text{WILL}^{T}\ \langle\langle e^{WILL}\rangle\rangle_{T}\ [_{C=V}\ ]]$

By this logic, $\langle\langle e\rangle\rangle_{D}$ in (3a) is a piece of the structure and THE is a semantic function responsible for the interpretation of that structure. In other words, the open value acquires the value THE (the semantic range S). It is also important to note that, while in (3ab), the range assignors THE and WILL are associated with a unique phonological realization, this is not the case for all range assignors. Thus, for instance, English past tense or English plural marking, conceived as range assignors (S-functors), have a non-unique phonological realization, which is contingent on the phonological context. This idea will become relevant in Section 5.2, where we analyze the syntactic status of mouthings and mouth gestures as modifiers of Extended Projections of either N-equivalent or V-equivalent roots, since they can be attached both to the nominal and the verbal domains. In Section 5.2 we also postulate that they have variable phonological realizations that are contextually driven.

Beyond S-functors, C-functors (notation: $C_{X[Y]}$) are categorial functors that define primarily a syntactic function whose role is to divide the categorial space. C-functors introduce a relation between a projecting categorial node and a particular Categorial Complement Space (CCS). For example, following Borer (2013: 314 (6a)), the English suffix *-al* is a C-functor that projects an A: $C_{A[N]}$, and its CCS is N-equivalent: C=N. This means that when the root $^{\pi}\sqrt{\text{COAST}}$ merges in an extended projection of A ({Ex [A]}) with a functor instantiated as /$_{\pi}$ *al*/, it becomes *coastal*.

Likewise, in an exo-skeletal model, roots may merge in a CCS directly. In these circumstances, they are identified by the syntactic context, namely by the extended projection where they are merged: D stands for {Ex [N]}, a nominalized Extended Projection with an N-equivalent CCS, and T stands for {Ex [V]}, and defines a V-equivalent CCS. Consider the examples in (4) (Borer 2013: 324, (24)).

(4) a. $[D\ [_{C=N}\ ^{\pi}\sqrt{\text{WALK}}]]$ b. $[T\ [_{C=V}\ ^{\pi}\sqrt{\text{WALK}}]]$
c. $[D\ [_{C=N}\ ^{\pi}\sqrt{\text{CHAIR}}]]$ d. $[T\ [_{C=V}\ ^{\pi}\sqrt{\text{CHAIR}}]]$

These representations show that roots are not categorically marked. Both variants of *walk* and *chair* in English derive from the same root. However, the nominal and the verbal instantiations of /$_{\pi}$*walk/* and /$_{\pi}$*chair/* (the verb *to chair* in the sense of “to be a person in charge of a meeting, a committee, etc.”) are not achieved through the merger of an additional nominal or verbal head, eventually to be realized as phonologically null. Rather, the representations in (4) show non-branching mono-morphemic terminals, both syntactically and morpho-phonologically.

To sum up, roots are not endowed with any structural syntactic and semantic information, but have phonological properties as well as associated encyclopedic information. C-functors are syntactic rigid designators that project a category and define a CCS. C-functors do not require but may have phonological properties. Finally, S-functors are range assignors that modify and extend functional projections by providing semantic and phonological content to them.

After this presentation of the main hypotheses on which Borer's exo-skeletal account rests, we discuss in the next section the main results presented in Section 4, concerning the role of movement and NMMs, in the light of this syntactic approach.

5.2 The role of movement from an exo-skeletal perspective

As explained in Section 5.1, properties of the structure determine the morphological form and the formal meaning of all pieces included in a syntactic structure. The meaning of these items is built by combining the substantive vocabulary (roots merged in a syntactic position), on the one hand, with the functional vocabulary and syntactic structure, on the other.

Recall that in the dataset under study, several differences were identified between nouns and verbs, concerning the type of movement involved; see Table 7 above.

If we focus our attention on groups 1 to 4, we observe that in most cases, the movement present in nouns persists in the related verbs, which leads us to postulate that the movement observed in nouns is part of the phonological representation of the root. Accordingly, the phonological properties characteristic of nouns of the first group also exist in the corresponding verb (e.g., BROOM in Figure 1), and the only difference is that the latter adds a path movement, which is not present in the articulation of the noun.[26] For the second group (e.g., COMB in Figure 2), the verb reduplicates the simple movement that already exists in the case of the noun. The corresponding verb simply increases the number of repetitions present in the noun in the third group (e.g., CLOTHES_{N}/DRESS_{V} in Figure 3), while it modifies the path in the fourth group (e.g., PLANE_{N}/FLY-(BY/A)-PLANE_{V} in Figure 4). Therefore, we conclude that in groups 1–4, the added movements that we observe in the verb members of the pairs are different phonological realizations of a C-functor for V-equivalent roots. In contrast, N-equivalent roots seem to merge directly as the categorical complement of D.

Therefore, we postulate a structural schema such as the one in Figure 8 for the derivation of BROOM_{V}, and the structure in (5), parallel to (4ac), for BROOM_{N} (first group).

[26] In Section 4, we have shown that for most pairs of the groups 1–4, the verb has a longer duration than the noun. We consider duration as a phonological correlate of path movement or reduplication and, therefore, it does not require an independent C-functor.

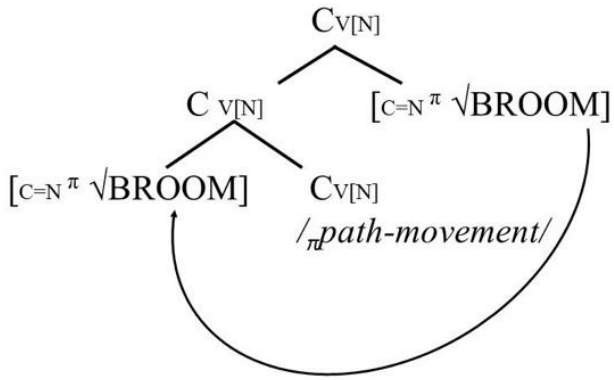


Figure 8. Structural representation for a V-equivalent derivation for a member of group 1

(5) [D [$_{C=N}$ $^{\pi}\sqrt{}$BROOM]]

Note that in Figure 8, path movement is conceived as a C-functor that projects a V: C$_{V[N]}$, while its CCS is N-equivalent: C=N. In the case of V-equivalent derivations for groups 2, 3 and 4, the C-functor would have other phonological realizations, such as reduplicated movement, increased number of repetitions, and alteration of path movement. N-equivalent roots for groups 2, 3 and 4 would also have a structure similar to (5), where the phonological representation of each root would show some differences depending on the group it belongs to. This analysis is consistent with the observation that verbs of groups 1–4 are complex morpho-phonological forms, while nouns are not.

Concerning group 5, we postulate that nouns and verbs are solely identified by the syntactic context, namely by the extended projections where they are merged, as illustrated in (6).

(6) a. [D [$_{C=N}$ $^{\pi}\sqrt{}$GAME/PLAY]] b. [T [$_{C=V}$ $^{\pi}\sqrt{}$GAME/PLAY]]

In support of this analysis recall that verbs of the fifth group do not add movement of any sort and they occur as monomorphemic forms. As a consequence, roots of the fifth group can alternate their C-equivalence between N-V, and hence they are phonologically unmarked.

5.3 The role of non-manual markers

The results obtained for NMMs coincide with the common trend identified in previous studies on various sign languages (e.g., Sutton-Spence & Woll 1999; Johnston 2001; Voghel 2005; Hunger 2006; Kimmelman 2009): mouthings are usually associated with nouns and mouth gestures with verbs. However, the presence of NMMs may be due to various factors (both syntactic and non-syntactic) that influence the likelihood of mouthings and mouth gestures, associated with members of N-V pairs, in the five groups. Let us start with the non-syntactic factors.

In general, mouthings appear to be strongly linked to certain sociolinguistic variables such as whether the interviewer is hearing or deaf, or her degree of mastery of a particular sign language, whether the deaf person attended school during the period considered optimal for language learning, and which was her dominant spoken language at school. It is, for instance, known that when a deaf person observes that the interlocutor is not fluent in the sign language, she mouths much more than in a situation where the interlocutor is a deaf signer. On the other hand, according to evidence from an independent experimental study (Vinson et al. 2010), mouthing and manual sign may dissociate from one another. This suggests that at least some mouthings and lexical signs are not linked together in the signer's mental lexicon (Lewin & Schembri 2011). However, note that this sort of sociolinguistic variables cannot explain why mouthings are linked mainly with nouns, since 78% of the nouns are articulated with some mouthing but only 31% of verbs are co-articulated with mouthings. This fact leads us to think that there must be some formal property of sign languages that accounts for the fact that N-equivalent structures tend to be modified by mouthings, while V-equivalent structures tend to be modified by mouth gestures. In this sense, the structural role of mouthings and mouth gestures would be similar to the one shown by suprasegmental elements in oral languages. Therefore, we postulate the existence of structural factors that explain the occurrence of mouthings and mouth gestures in accordance with an exo-skeletal syntactic approach.

As for the syntactic factors, Crasborn & van der Kooij (2013: 529) remark in their study of NGT that focused signs (in information focus and contrastive focus conditions) are usually accompanied by some kind of mouth action, be it mouthing or mouth gesture. Focusing now on our results in LSC, it might be the case that the experimental design favors the unstable percentage of mouthings for most pairs. By asking the informants to express in one sign what they saw in a picture, and then provide with a sentence containing that sign, they focused it. Focus on a particular sign was produced with a higher proportion of mouthings on nouns and of mouth gestures on verbs (as we will see in the next subsection).

5.3.1 Mouthings

Mouthings have their origin in the closest dominant oral language. In our LSC dataset, all mouthings come from Spanish. A second observation is that there is no regularity across all the N/V pairs in which mouthings are involved. The only exception is the pair $\text{GRANDPARENT}_{N}/\text{AGE}_{V}$, which shows 100% of mouthings in combination with noun realizations and 0% in the verbal counterpart. Yet, for most pairs, there is a remarkable difference in the percentage of mouthings associated with nouns versus verbs, being generally higher in nouns, yet not obligatory. Three pairs ($\text{GAME}_{N}/\text{PLAY}_{V}$, $\text{DEATH}_{N}/\text{DIE}_{V}$, $\text{SURPRISE}_{N}/\text{SURPRISE}_{V}$) show a high percentage of mouthing in both members of the pair.

We account for the results obtained in our study of LSC in the following way:

i) Mouthing as a phonological representation associated with the categorization of a particular root as N-equivalent (i.e., a C-functor).

ii) Mouthing as a phonological representation associated with the nominal/verbal Extended Projection (i.e., an S-functor).

The first type of explanation is postulated for all nouns that behave like the pair GRANDPARENT$_N$/AGE$_V$ in our sample. The fact that – as just said – the percentage of mouthings in the noun is 100% (16/16), while the percentage of mouthings in the corresponding verb is 0% (0/12), makes us postulate that mouthing, in this particular case, is part of the phonological representation of the C-functor that identifies this root as being N-equivalent. Therefore, the structure we propose for the derivation of GRANDPARENT$_N$ is the one in Figure 9.

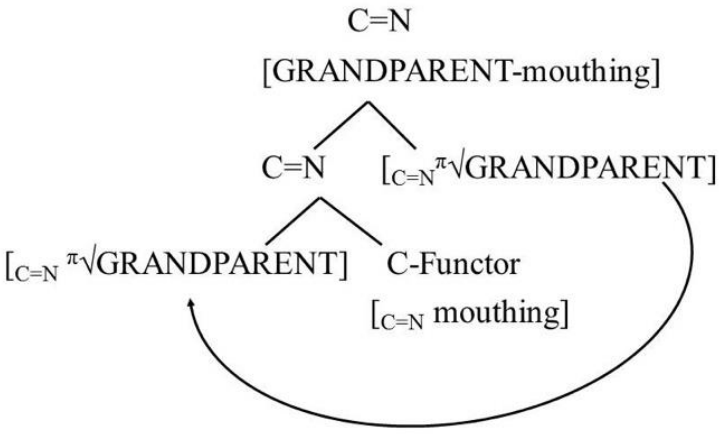


Figure 9. Syntactic representation of GRANDPARENT$_N$, in which mouthing acts as a C-functor.

For the remaining nouns in our dataset, in which mouthings appear in a higher percentage in nouns than in their verbal counterparts, but can appear optionally in both, we claim that the presence of mouthing is due to the action of an S-functor that introduces a range assignor to an open value with a specific categorical label. Therefore, we postulate a structure of the sort in (7), where the Ex-P of an N-equivalent root is an open value bound by an S-functor that assigns mouthing, as range, to it.

(7) $[_D$ mouthing^D $<<e^{mouthing}>>_D$ $[_{C=N}$ $]]$

This hypothesis, which considers mouthing as a syntactic modifier, would account for the variability we found in our dataset: for some nouns, 100% of tokens co-occur with mouthing (CHEF$_{Nb}$, KNOT$_N$, and BOAT$_{Nb}$), while for others, this is not the case (CHAIR$_N$ 83%, COAT$_N$ and BROOM$_N$ 62%, etc.). Crucially, however, in all case, the verbal counterparts show much lower percentages (COOK$_V$ 22%, TIE$_V$ 39%, SAIL$_V$ 20 %, SIT$_V$ 8%, PUT-ON-COAT$_V$ 11%, and BROOM$_V$ 22%), but mouthing is not excluded, which means that it can also be considered a range assignor of an Ex-P of a V-equivalent root with an open value, as represented in (8).

(8) $[_T$ mouthing^T $<<e^{mouthing}>>_T$ $[_{C=V}$ $]]$

Let us now consider the three N/V pairs in Table 15, which diverge from the general pattern in that both the noun and the verb display a high percentage of mouthings.

Table 15. N/V pairs with a high percentage of mouthings in both the noun and in the verb

NOUN-VERB	**MOVEMENT GROUP**	**MOUTHINGS FOR NOUNS**	**MOUTHINGS FOR VERBS**
GAME$_N$/ PLAY$_V$	GROUP 5	24/28 (86%)	16/19 (84%)
DEATH$_N$/ DIE$_V$	GROUP 5	8/8 (100%)	15/19 (79%)
SURPRISE$_N$/ SURPRISE$_V$	GROUP 5	21/24 (87%)	20/24 (83%)

Crucially, these pairs all belong to group 5, where there is no movement distinction between N and V. Note that mouthing is only present in 100% of tokens in the case of DEATH$_N$, for which we only got 8 tokens. For the remaining pairs, the percentage of mouthings is lower, but still very high in both members of the pair. The lack of a movement distinction between N/V pairs (a characteristic of group 5) might very well explain why mouthings are present in most tokens of these pairs, as predicted by the possibility that mouthing assigns range to both nominal and verbal extended projections.

5.3.2 Mouth gestures

Concerning mouth gestures, which have their origin within the sign language itself, the main observation is that they co-occur more often with verbs than with nouns, albeit not in a percentage as high as mouthings co-occurring with nouns. The results of our experiment data show that mouth gestures are realized with verbs 53% of the times, although they are not excluded from the phonological realization of nouns (8%). We therefore postulate that mouth gestures should be conceived as modifiers of V-equivalent structures and, in a smaller proportion, of N-equivalent structures.

It has been described in the literature on BSL (see Sutton-Spence & Woll 1999; Levin & Schembri 2011) that the mouth gesture ‘mmm’ means doing the activity in an easy, effortless, or average way. In our study, the most common mouth gestures found are ‘mmm’ and ‘bbb’ (see Table 11 and Figure 6), and, interestingly, verbs that are accompanied with mouth gestures in a high proportion denote activities (COOK$_V$, BROOM$_V$, DRIVE$_V$, FLY-(BY/A)-PLANE$_V$, SAIL$_V$). This suggests that quite often mouth gestures show, in a very iconic way, the manner in which the action is being performed.

Formally speaking, we propose that mouth gestures are S-functors, that is, syntactic adjuncts that modify the Ex-P of either V-equivalent or N-equivalent roots, which assign a particular range to an open value, much in the same way we have postulated for mouthings in the previous section.

The default structure would be the one represented in (9a), but mouth gesture can also be a range assignor of an open value in a nominal domain, as in (9b).

(9) a. $[_T$ mouth_gesture^T $<<e^{mouth\_gesture}>>_T$ $[_{C=V}$ $]]$
b. $[_D$ mouth_gesture^D $<<e^{mouth\_gesture}>>_D$ $[_{C=N}$ $]]$

Note that both structures, in which a mouth gesture has the syntactic status of a modifier (i.e., an S-Functor), are structurally available in LSC.

6 Conclusions

We presented an experimental investigation that explores morpho-phonological differences within related N-V pairs in LSC. Our results first and foremost confirm that such differences exist in this sign language, and align with those reported for other sign languages. But beyond this empirical confirmation, the novelty of our study is to account for a variety of linguistic phenomena in N/V pairs within an exo-skeletal syntactic approach such as Borer (2005a,b, 2013, 2014).

First, the results of our study support the distinction between five different groups of N/V pairs. This distinction is well-motivated on the basis of the presence vs. absence of movement, differences related to movement (and the duration of the articulation), and differences related to NMMs. In our dataset, no relevant differences related to the encyclopedic content of the root were found.

Second, a syntactic analysis of the role of movement in terms of C-functors for V-equivalent roots and an analysis of mouthing and mouth gestures in terms of adjunct S-functors has been defended. This analysis is compatible with the fact that (i) the percentage of mouthings is higher in N-equivalent contexts than in V-equivalent contexts; (ii) the percentage of mouth gestures is higher in V-equivalent contexts than in N-equivalent contexts; and (iii) the percentage of mouth gestures in V-equivalent roots is lower than the percentage of mouthings in N-equivalent roots.

Overall, we hope that our study on LSC will encourage further experimental investigations into this topic, also for other sign languages, i.e. investigations concerning the possible C-functors that render roots as N-equivalent or V-equivalent, and the status of mouthings and mouth gestures as S-functors.

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Appendix

Table A1. Roots included in group 1

PAIRS OF GROUP 1	**ENCYCLOPEDIC CONTENT**	**MEAN DURATION (in ms)**		**MOUTHINGS**		**MOUTH GESTURES**		**NO MOUTHINGS AND NO MOUTH GESTURES**		**QUOTIENT VERB:NOUN** **Q (V/N pair)**
		VERB	**NOUN**	**VERB**	**NOUN**	**VERB**	**NOUN**	**VERB**	**NOUN**	
$SHOWER_V$/ $SHOWER_N$	CONCRETE	497.69 (13) SD:242.03 SE:18.62	318.57 (14) SD:246.29 SE:17.59	4/13 (31%)	13/14 (93%)	8/13 (61%)	1/14 (7%)	1/13 (8%)	0/14 (0%)	1.56:1
AGE_V/ $GRANDPARENT_N$	CONCRETE	918.33 (12) SD:344.71 SE:28.73	311.87 (16) SD:145.57 SE:9.09	0/12 (0%)	16/16 (100%)	8/12 (67%)	0/16 (0%)	4/12 (33%)	0/16 (0%)	2.83:1
$BROOM_N$/ $BROOM_V$	INSTRUMENT	742.22 (9) SD:221.01 SE:24.56	430 (13) 376.21 SE: 28.94	2/9 (22%)	8/13 (62%)	7/9 (78%)	0/13 (0%)	0/9 (0%)	5/13 (38%)	1.72:1
$SAIL_V$/ $BOAT_{Na}$	CONCRETE	765.33 (15) SD:322.45 SE:22.16	443.6 (25) SD:482.51 SE: 19.30	3/15 (20%)	22/25 (88%)	12/15 (80%)	0/25 (0%)	0/15 (0%)	3/25 (12%)	1.72:1
CUT_V/ $SCISSORS_N$	INSTRUMENT	715 (12) SD:428.63 SE:35.72	460.90 (11) SD:281.16 SE:25.56	5/12 (42%)	6/11 (55%)	5/12 (42%)	1/11 (10%)	2/12 (16%)	4/11 (35%)	1.55:1
MEAN QUOTIENT FOR THE GROUP										**1.87:1**

Table A2. Roots included in group 2

PAIRS OF GROUP 2	**ENCYCLOPEDIC CONTENT**	**MEAN DURATION (in ms)**		**MOUTHINGS**		**MOUTH GESTURES**		**NO MOUTHINGS AND NO MOUTH GESTURES**		**QUOTIENT VERB:NOUN Q (V/N pair)**
		VERB	**NOUN**	**VERB**	**NOUN**	**VERB**	**NOUN**	**VERB**	**NOUN**	
DRIVE$_V$/ CAR$_N$	INSTRUMENT	461.25 (8) SD:147.11 SE:18.39	290.63 (47) SD:140.44 SE:2.99	1/8 (12%)	36/47 (77%)	7/8 (87%)	2/47 (4%)	0/8 (0%)	9/47 (19%)	1.58:1
COOK$_V$/ KITCHEN$_{Na}$	CONCRETE	620 (18) SD:335.35 SE:18.63	282.22 (8) SD:75.58 SE:9.45	4/18 (22%)	5/8 (62%)	11/18 (61%)	1/8 (12%)	3/18 (16%)	2/8 (26%)	2.19:1
COOK$_V$/ CHEF$_{Na}$	CONCRETE	620 (18) SD:335.35 SE:18.63	373.3 (10) SD:88.50 SE:8.85	4/18 (22%)	7/10 (70%)	11/18 (61%	2/10 (20%)	3/18 (16%)	1/10 (10%)	1.66:1
DRAW$_V$/ DRAWING$_N$	INSTRUMENT	895.83 (9) SD: 592.28 SE:65.81	508.12 (17) SD: 257.57 SE:15.15	4/9 (44%)	14/17 (82%)	5/9 (565)	1/17 (6%)	0/9 (0%)	2/17 (12%)	1.76:1
SPEND$_V$/ EXPENSE$_N$	ABSTRACT	624 (15) SD: 235.40 SE: 15.69	335 (8) SD: 146.68 SE: 18.33	1/15 (7%)	5/8 (62%)	10/15 (67%)	3/8 (37%)	4/15 (26 %)	0/8 (0%)	1.86:1
EAT$_V$/ FOOD$_{Na}$	INSTRUMENT	369.61 (26) SD: 266.92 SE: 10.27	200.9 (22) SD: 64.65 SE: 2.94	14/26 (54%)	20/22 (91%)	10/26 (38%)	0/22 (0%)	2/26 (8%)	2/22 (9%)	1.83:1
COMB$_V$/ COMB$_{Na}$	INSTRUMENT	868.33 (18) SD: 556.80 SE: 30.93	232 (11) SD: 73.11 SE: 6.65	5/18 (28%)	10/11 (91%)	7/18 (39%)	0/11 (0%)	6/18 (33%)	1/11 (9%)	3.17:1
IRON$_V$/ IRON$_{Na}$	INSTRUMENT	766.92 (13) SD: 685.27 SE: 52.71	390 (9) SD: 160.37 SE: 17.82	8/13 (62%)	6/9 (67%)	4/13 (31%)	1/9 (11%)	1/13 (7%)	2/9 (22%)	1.96:1
DRESS$_V$/ CLOTHES$_{Na}$	CONCRETE	524.14 (29) SD: 226.53 SE: 7.81	269.47 (19) SD: 84.03 SE: 4.42	2/29 (7%)	11/19 (58%)	22/29 (76%)	2/19 (11%)	5/29 (17%)	6/19 (31%)	1.94:1
MEAN QUOTIENT FOR THE GROUP										**2.00:1**

Table A3. Roots included in group 3

PAIRS OF GROUP 3	**ENCYCLOPEDIC CONTENT**	**MEAN DURATION (in ms)**		**MOUTHINGS**		**MOUTH GESTURES**		**NO MOUTHINGS AND NO MOUTH GESTURES**		**QUOTIENT VERB:NOUN Q (V/N pair)**
		VERB	**NOUN**	**VERB**	**NOUN**	**VERB**	**NOUN**	**VERB**	**NOUN**	
DRESS$_{V}$/ CLOTHES$_{Nb}$	CONCRETE	524.14 (29) SD: 226.53 SE: 7.81	441.25 (16) SD: 168.36 SE: 10.52	2/29 (7%)	13/16 (81%)	22/29 (76%)	3/16 (19%)	5/29 (17%)	0/16 (0%)	1.18:1
DEBATE$_{V}$/ DEBATE$_{N}$	ABSTRACT	982 (15) SD: 503.50 SE: 33.57	616.66 (6) SD: 242.71 SE: 40.45	3/15 (20%)	2/6 (33%)	12/15 (80%)	4/6 (67%)	0/15 (0%)	0/6 (0%)	1.59:1
STUDY$_{V}$/ STUDENT$_{N}$	CONCRETE	674.67 (14) SD: 432.09 SE: 30.86	367 (10) SD: 162.89 SE: 16.29	3/14 (21%)	8/10 (80%)	9/14 (64%)	1/10 (10%)	2/14 (14%)	1/10 (10%)	1.83:1
EAT$_{V}$/ FOOD$_{Nb}$	INSTRUMENT	369.61 (26) SD: 266.92 SE: 10.27	256.66 (18) SD: 105.94 SE: 5.89	14/26 (54%)	13/18 (72%)	10/26 (38%)	1/18 (6%)	2/26 (8%)	4/18 (22%)	1.44:1
COMB$_{V}$/ COMB$_{Nb}$	INSTRUMENT	868.33 (18) SD: 556.80 SE: 30.93	530 (7) SD: 342.30 SE: 48.90	5/18 (28%)	6/7 (86%)	7/18 (39%)	0/7 (0%)	6/18 (33%)	1/7 (14%)	1.63:1
COOK$_{V}$/ CHEF$_{Nb}$	CONCRETE	620 (18) SD:335.35 SE:18.63	914 (5) SD:238.60 SE:47.72	4/18 (22%)	5/5 (100%)	11/18 (61%)	0/5 (0%)	3/18 (17%)	0/5 (0%)	0.67:1
COOK$_{V}$/ KITCHEN$_{Nb}$	CONCRETE	620 (18) SD:335.35 SE:18.63	1174.28 (7) SD:683.57 SE:97.65	4/18 (22%)	5/7 (71%)	11/18 (61%)	2/7 (29%)	3/18 (17%)	0/7 (0%)	0.52:1
IRON$_{V}$/ IRON$_{Nb}$	INSTRUMENT	766.92 (13) SD: 685.27 SE: 52.71	1298 (5) SD: 530.63 SE: 106.13	8/13 (62%)	4/5 (80%)	4/13 (31%)	0/5 (0%)	1/13 (7%)	1/5 (20%)	0.59:1
MEAN QUOTIENT FOR THE GROUP										**1.19:1**

Table A4. Roots included in group 4

PAIRS OF GROUP 4	**ENCYCLOPEDIC CONTENT**	**MEAN DURATION (in ms)**		**MOUTHINGS**		**MOUTH GESTURES**		**NO MOUTHINGS AND NO MOUTH GESTURES**		**QUOTIENT VERB:NOUN Q (V/N pair)**
		VERB	**NOUN**	**VERB**	**NOUN**	**VERB**	**NOUN**	**VERB**	**NOUN**	
PUT-ON-COAT$_V$/ COAT$_N$	INSTRUMENT	605.55 (18) SD: 263.40 SE: 14.63	483.45 (26) SD: 168.90 SE: 6.50	2/18 (11%)	16/26 (62%)	12/18 (67%)	5/26 (19%)	4/18 (22%)	5/26 (19%)	1.25:1
FLY-(BY/A)-PLANE$_V$/ PLANE$_N$	CONCRETE	610 (17) SD: 357.49 SE: 21.03	298.69 (23) SD: 193.77 SE: 8.42	2/17 (12%)	17/23 (74%)	14/17 (82%)	1/23 (4%)	1/17 (6%)	5/23 (22%)	2.04:1
WISH$_V$/ WISH$_N$	ABSTRACT	543.06 (26) SD: 380.05 SE: 14.62	353.33 (21) SD: 175.91 SE: 8.38	7/26 (27%)	14/21 (67%)	13/26 (50%)	3/21 (14%)	6/26 (23%)	4/21 (19%)	1.53:1
SCRATCH$_V$/ CAT$_N$	CONCRETE	376.66 (18) SD: 124.59 SE: 6.92	329.67 (31) SD: 162.98 SE: 5.26	1/18 (6%)	27/31 (87%)	9/18 (50%)	1/31 (3%)	8/18 (44%)	3/31 (10%)	1.14:1
TIE$_V$/ KNOT$_N$	INSTRUMENT	833.47 (23) SD: 465.68 SE: 20.25	518 (5) SD: 211 SE: 42.20	9/23 (39%)	5/5 (100%)	11/23 (48%)	0/05 (0%)	3/23 (13%)	0/5 (0%)	1.60:1
DIZZY$_V$/ DIZZINESS$_N$	ABSTRACT	695.38 (13) SD: 383.22 SE: 29.48	291.66 (6) SD: 101.08 SE: 16.85	0/13 (0%)	0/6 (0%)	6/13 (46%)	1/6 (16%)	7/13 (54%)	5/6 (84%)	2.38:1
SAIL$_V$/ BOAT$_{Nb}$	CONCRETE	765.33 (15) SD:322.45 SE:22.16	299.09 (11) SD: 106.71 SE: 9.7	3/15 (20%)	11/11 (100%)	12/15 (80%)	0/11 (0%)	0/15 (0%)	0/11 (0%)	2.55:1
MEAN QUOTIENT OF THE GROUP										**1.78:1**

Table A5. Roots included in group 5

PAIRS OF GROUP 5	**ENCYCLOPEDIC CONTENT**	**MEAN DURATION (in ms)**		**MOUTHINGS**		**MOUTH GESTURES**		**NO MOUTHINGS AND NO MOUTH GESTURES**		**QUOTIENT VERB:NOUN Q (V/N pair)**
		VERB	**NOUN**	**VERB**	**NOUN**	**VERB**	**NOUN**	**VERB**	**NOUN**	
$PLAY_V$/ $GAME_N$	CONCRETE	291 (19) SD: 144.29 SE: 7.59	250 (28) SD: 183.28 SE: 6.55	16/19 (84%)	24/28 (86%)	0/19 (0%)	0/28 (0%)	3/19 (16%)	4/28 (14%)	1.16:1
DIE_V/ $DEATH_N$	ABSTRACT	440.52 (19) SD: 209.77 SE: 11.04	403.8 (8) SD: 164.49 SE: 20.56	15/19 (79%)	8/8 (100%)	4/19 (21%)	0/8 (0%)	0/19 (0%)	0/19 (0%)	1.09:1
$SURPRISE_V$/ $SURPRISE_N$	ABSTRACT	355.83 (24) SD: 169.63 SE: 7.07	377.08 (24) SD: 148.33 SE: 6.18	20/24 (83%)	21/24 (87%)	4/24 (17%)	3/24 (12%)	0/24 (0%)	0/24 (0%)	0.94:1
SIT_V / $CHAIR_N$	CONCRETE	365.38 (13) SD: 124.87 SE: 9.61	414.54 (12) SD: 201.74 SE: 16.81	1/13 (8%)	10/12 (83%)	10/13 (77%)	0/12 (0%)	2/13 (15%)	2/12 (17%)	0.88:1
MEAN QUOTIENT OF THE GROUP										**1.01:1**

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