# Handling versus Instrument:
# A crosslinguistic study of sign language morphology.

*Raquel Santiago-Batista*

The signs for hand-used objects across sign languages are performed in a very iconic way, with mainly a Handling or an Instrument form. As a previous research on this area shows, sign languages seem to have a strong preference towards one of these representation types over the other. The present study analysed form preference of five sign languages based on a list of hand-used objects selected from the dictionaries of these sign languages, in order to determine whether this preference was significantly strong within each of the sign languages. A second aim of the study was to prove whether the type of object was somehow conditioning the selection of one form over another, so that maybe a particular object type would be found to be performed always with a particular form. Finally, a comparison between sign languages of the same family was made in order to find similarities between them. The results did not show any significant difference between Handling forms over Instrument forms, nor vice versa, for any of the five sign languages subject of this study. Similarly, although the general interaction between form and object class was found statistically significant, when observed one-by-one none of the forms showed a significant effect of any of the object classes. An argument for the typological classification of sign languages according to Handling and Instrument forms is given in the Discussion section. It was also of interest for this dissertation the psycholinguistic origins of these two types of representation types, as well as the natural creation of a sign for new needs such as new-technology objects.

## Sign Languages and glossing conventions within this study

*Abbreviations of sign languages*

BSL - British Sign Language
NZSL - New Zealand Sign Language
HKSL - Hong Kong Sign Language
LSE - Spanish Sign Language
LSC - Catalan Sign Language
ISL - Israeli Sign Language
JSL - Japanese Sign Language
ABSL - Al-Sayyid Bedouine Sign Language
ASL - American Sign Language
DSL - Danish Sign Language

*Glossing conventions*

Small capitals refer to glosses of signs: TOOTHBRUSH.

Hyphens are used when a sign cannot be translated by one word: BRUSHING-ONES-TEETH.

## Introduction

Signed languages, the visual-gestural expression of the cognitive ability of language, are known to be highly iconic (Aronoff et al. 2003; Schembri et al. 2005): a large percentage of signs represent features of the world and our interaction with it. This is not a characteristic that is exclusively found among signed languages: spoken languages also exploit iconicity in various ways, using the sounds of words to represent the sounds of the world.

One specific group of iconic signs in signed languages has attracted the interest of sign linguists: Handling signs (depicting the way we handle objects in use, e.g. the sign glossed as HAMMER in British Sign Language, performed with a handshape and a movement that represents the action of holding a hammer and using it), and Instrument signs (depicting the object itself, or a part of it: what is also known in the linguistics and clinical literature as 'body-part as object', e.g. the sign glossed as SCISSORS in British Sign Language, performed with the fist closed, and the index and middle fingers extended and moving as if they were the blades of the object). These two types of representation –Handling and Instrument– are going to be analysed and compared crosslinguistically in this dissertation.

In the conference on Theoretical Issues in Sign Language Research, held in 2010, Carol Padden presented[1] the analysis of 6 sign languages regarding their use of Handling and Instrument forms (those sign languages were: Israeli Sign Language, New Zealand Sign Language, Japanese Sign Language, Al-Sayyid Bedouine Sign Language, American Sign Language and Danish Sign Language). From a set of 27 target meanings (nouns for 27 hand-used objects), elicited in 5 to 9 signers for each of the 6 sign languages, Padden and her colleagues conclude that there is a strong language-specific pattern favouring one form over the other (namely, the 3 first sign languages mentioned above show a strong tendency towards Handling signs –the distribution of the 27 signs in ISL was: 62% of signs being Handling, 35% being Instrument, and 3% being Other forms; in NZSL the distribution was: 67% Handling, 33% Instrument; and the distribution in JSL was: 64% Handling, 30% Instrument, 6% Others–, whereas the 3 last sign languages show a preference for Instrument signs as

[1] Padden, C., Aronoff, M., Meir, I., and Sandler, W. (2010), 'In search of grammar'. Unpublished work. Presentation accessible on the website of the TISLR 10 (www.purdue.edu/tislr10).

follows: ABSL has a 85% of Instrument, 13% Handling, 2% Others; ASL has a distribution of 75% Instrument, 23% Handling, 2% Others; and DSL shows a 60% of signs being Instrument, a 36% being Handling, and a 4% falling into the Others category). Their 27 target meanings were classified in four object classes: Hand Tools (e.g. hammer), Utensils (e.g. spoon), Clothes (e.g. hat) and Cosmetics (e.g. lipstick). This dissertation explores the validity of Padden and colleagues' claims, by using a larger set of target meanings (N=155) and a more exhaustive classification of representation types (see Methods below).

Padden et al. research opens the discussion about morphological typology in signed languages. Although some of the studies that have attempted to propose a typological classification for signed languages have tried to match their features with those of spoken language typology (e.g. Bellugi and Klima 1984, for ASL), recent studies are focusing on the fact that modality differences may affect the way we classify languages (Grinevald 2003; Meir et al. 2005; Schuit 2007; Schwager and Zeshan 2008; Zeshan 2008). Brentari (2002) and Hohenberger (2007) suggest a classification of sign languages based on word shape (i.e. whether they are mono- or polymorphemic –regarding affixal morphology–, and mono- or polysyllabic – according to the number of syllables in the stem of words). As an example of one of the junctions of this classification we have English in the monomorphemic/polysyllabic group, because English words tend to have more than one syllable in the stem, but very little affixal morphology. A language such as West Greenlandic would work as an example of the polymorphemic/polysyllabic group (with a rich system of affixation, and multiple syllables in the stems of words). At the other end we can find Chinese as an example of the monomorphemic/monosyllabic group. Signed languages would be a type on their own, placed in the junction of polymorphemic/monosyllabic languages, because, as Brentari (2003, p. 57) states, "no spoken language has been found that is both as polysynthetic as sign languages and yet makes the morphological distinctions primarily in monosyllabic forms".

If, as Padden stated in her presentation at TISLR10, signed languages show a strong preference towards Handling forms or Instrument forms regarding signs for objects that are held with the hand, it may be the case that we are in front of a feature to classify signed languages morphologically. In her presentation, Padden compared Instrument forms with the instrumental case of spoken languages such as Russian

(where a case marker in nouns indicates the instrument used to carry out the action). However, it can also be the case that Handling and Instrument signs are lexical forms that can compare to the semantic elements pointed by Talmy (1985, 2003) regarding lexicalization of verbs expressing manner and classifier constructions. Talmy's theory on the relationship of meaning and surface elements for spoken languages is perfectly applicable to the Handling and Instrument forms in signed languages. Let's look at the following examples from spoken languages:

1) The pencil **rolled off** the table.[2]
2) El llapis **va caure** de la taula **rodolant**.[3]
   *The pencil* ***fell*** *from the table* *(by)* ***rolling***.

In sentence 1) the verb expresses the manner in which the pencil fell, and this is a common type of verbs in the Germanic languages. On the other hand, 2) shows the same sentence in Catalan –a Roman language–, where the only way of including the manner is to express it by means of a gerund (*rodolant* –rolling), whereas the verb (*caure* –to fall) only indicates the final effect of the action, in Talmy's terms. Observe now the following examples, again from English and Catalan[4]:

3) He **hammered** the piece **flat**.
4) (Ell) **va aplanar** la peça **amb un martell**.
   *He* ***flattened*** *the piece* ***with a hammer***.

These new set of sentences show an instrumental verb in the English example 3), compared to the way Roman languages perform these type of sentences. The difference in both sets of sentences is found in whether the instrumental meaning is expressed within the verb (within the surface element, using Talmy's terms), or it is expressed by an element other than the verb.

Fixed lexical signs –like the ones analysed in this work– share many of the characteristics of classifier (or depicting) constructions, and are part of the core native lexicon of signed languages (Brentari and Padden 2001). As Bretari and Padden (2001) define it in their study of the ASL lexicon, the native lexicon is the one that

---

[2] Example from Talmy (1985, p. 61).
[3] The translation to –and comparison with– the Catalan version is mine.
[4] Examples 3) and 4) are mine.

contains all the native sign vocabulary, whereas the non-native lexicon is the one that is borrowed from the spoken English language by means of fingerspelling. The native lexicon would be divided, according to the authors, into core and non-core. Classifier constructions, unlike fixed lexical signs, would be in the non-core native lexicon of sign languages. Classifier constructions, within sign languages, are defined as "a rich and complex morphological system […] used for the purpose of denoting spatial relations and motion events and for characterizing shapes and dimensions of objects" (Sandler and Lillo-Martin 2006, p. 76). They are widespread amongst signed languages, due to the fact that they represent entities and manipulation in an iconic way (Quinto-Pozos et al. submitted). It has been broadly agreed (Supalla 1978, 2008; Schembri 2003) that there are two main groups of classifiers in signed languages: one of them being handling classifiers, where the hand depicts how objects are handled or touched (such as holding a toothbrush or using a computer –although some researchers, like Brennan (1992), argue that handling and touching should be considered separated classes, they are considered as one in this dissertation). The second main group of classifiers are entity classifiers, which are the representation of objects or parts of them. This group is separated in two subgroups, the so-called Size and Shape Specifiers (SaSS, which depict the basic size or shape of an object, e.g. cylindrical, small, rounded), and the instrument classifiers, where the hand depicts the object itself or part of it. Because of their iconicity, classifiers (also called depicting constructions by Liddell 2003 and Schembri 2003), may have gestural origins, according to Quinto-Pozos et al. (submitted).

But regardless of their iconicity and their similarities with gesture, it is important to note that these constructions are fully linguistic entities –and not mere pantomime–, evidenced by the fact that their iconicity does not facilitate the access to semantic features in naming tests for aphasic patients: Marshall et al. (2004) report the case of a patient who, after a cerebral vascular accident on the left hemisphere of the brain, showed a dissociation between sign and gesture: his gesture production was barely affected, whereas he had difficulties to access sign, even when sign and gesture were very similar.

The term 'classifiers' in sign language linguistics has been borrowed from spoken language linguistics. As Aikhenvald (2000) states, "there is always some semantic basis to the grouping of nouns into classes, but languages vary in how much semantic

transparency there is […]. This semantic basis usually includes animacy, humanness and sex, and sometimes also shape and size" (p. 21). These noun classifiers, according to Aikhenvald, are mostly found in fusional or agglutinative languages, and regardless of the extensive discussion about the typology of signed languages, they seem to fall into the latter typology (Schuit 2007). However, sign classifiers (or depicting constructions) are crosslinguistically more similar to each other in signed languages than they are among spoken languages (Quinto-Pozos et al. submitted). This similarity is expected to be found, in terms of tendency towards Handling or Instrument forms, among the signed languages analysed in this dissertation.

I would like to include here as well the psycholinguistic perspective of Handling and Instrument forms. It is common knowledge that hearing people with no contact with a sign language tend to gesture actions with handling pantomimes and not with instrument ones (e.g. when asked: "Show me how would you stir the sugar in your coffee with a spoon, without having a real spoon", people naturally gestures the circular movement of the wrist as if holding a spoon in the hand). However, when there is a failure in the processing of language, caused by brain damage, this pattern suffers changes that have been briefly described in some researches. Among hearing non-signers, Heilman (1979) reported the preference to use a body-part as the object when patients with ideomotor apraxia were asked to pantomime how would they use a certain object (e.g. they extended the index finger as if it was a key, instead of making believe that they were holding a key, which would be the natural way of pantomiming the action of opening a door with a key). Before Heilman's study, Goodglass and Kaplan (1963) had reported the occurrence of body-part as object in 20 aphasics. Their results prove that although none of the patients showed any difficulty in holding and using the actual objects whose use they were asked to pantomime, they did use a body-part (e.g. fist, finger) to represent the object, when it was not present, in most of the tests. The authors suggest this pattern to be a way of avoiding an impaired function, although they do not hypothesize about the reason for that disruption. In 1948, Goldstein had suggested that apraxia could be a defect of non-verbal symbolization, compared to aphasia being a disturbance of verbal symbolization. Among aphasic signers, on the other hand, a disruption in the comprehension of BSL signs has been found by Marshall and colleagues (2004) with iconic signs that share the pattern of gesturing and pantomiming.

Within this study I will try to find out, first of all, whether the preference for one type of representation over the other (namely, Handling and Instrument), as Padden and colleagues state, is a consistent pattern within a given sign language; that is, if the difference between Handling forms and Instrument forms is statistically significant within each of the 5 sign languages subject of study. Secondly, I will look for a possible regularity in the selection of Handling or Instrument forms, kept regardless of the different object classes: or is it maybe the case that the type of object determines the selection of one representation form or another? (e.g. Tools tending to be performed as Handling or as Instrument more than with any other form). Thirdly, I will compare sign languages of the same linguistic family in order to see if they share a significant preferential pattern for one form or another. Finally, and observing the answers to these questions, I will try to argue if this preference can be considered a feature to classify signed languages typologically.

## Methods

Following Padden et al. classification of forms and object classes (with the modifications considered to be needed), this dissertation will analyse Handling and Instrument forms based on the dictionaries[5] of 5 sign languages in order to determine whether sign languages have a preferential pattern, as Padden et al. argue, and if this pattern is statistically significant. The 5 sign languages to be analysed are: British Sign Language (BSL) and New Zealand Sign Language (NZSL), both belonging to the same linguistic family; Spanish Sign Language (LSE) and Catalan Sign Language (LSC), both being part of another linguistic family, and Hong Kong Sign Language (HKSL), which does not belong to any of the two previous families of sign languages.

The selection of the sign languages to be included in this study was determined by the availability of resources in the library of DCAL (Deafness, Cognition and Language Research Centre, UCL), at the moment of collecting the data. Although they host a very rich library (which contains not a bad number of sign language dictionaries), most of the foreign sign language dictionaries were written in a language that I did not have access to. An attempt to access online dictionaries (such as the Netherlandse Gebarentaal –Sign Language of the Netherlands) encountered the same problem: not knowing the language in which the online dictionary was created made it impossible for me to consider those sign languages for my masters dissertation.

In order to achieve a number of tokens that was large enough to assess Padden et al. conclusions, four main object classes were created (with 2 to 4 subcategories –see Table 1). Padden et al. object classes were slightly different (e.g. Food was excluded because the signs for them entail multiple actions; mechanical tools, such as TYPEWRITER, were not included because they have moving parts; containers such as CUP or BOWL were excluded because the signs were ambiguous, i.e., the researchers could not determine whether these signs were Handling or Instrument). The reason for excluding them was that their codification of the signs included only 3 categories: Handling, Instrument, Others. However, I considered the possibility of creating a new codification of forms that would allow me to include those object classes that were excluded in their study.

---

[5] Find the complete reference of all the dictionaries in the References section.

The first step was to create a list of target meanings falling into only one of the subcategories of each object class, The initial list of words contained 199 target meanings, out of which a final list of 155 target meanings[6] was selected –a total of 44 target meanings were not found in any of the 5 dictionaries.

| | | | |
|---|---|---|---|
| **Tools and Utensils** (51)* | DIY (12) | **Food** (60) | Fruits (17) |
| | Kitchen (15) | | Vegetables (16) |
| | Technology (14) | | Dishes (14) |
| | Office Depot (9) | | Ingredients (13) |
| **Clothing** (31) | Clothes (17) | **Cosmetics and Hygiene** (13) | Hygiene (9) |
| | Accessories (14) | | Make up (4) |

Table 1. Object classes and their subcategories.

Although the first intention was to analyse them separately, the low figures in all the subcategories obliged me use the larger numbers, that is, just the 4 main object classes regardless of their subgroups (Tools and Utensils, Food, Clothing, Cosmetics and Hygiene).

The second step of this research was to look for these words in each of the 5 dictionaries for the 5 sign languages to be analysed. The main problem encountered was that by using Padden et al. codification of the representation types (namely, Handling, Instrument, Others), a very productive type of sign was falling into the Others category, which made it too large not to have it into consideration. This productive type of sign is the above mentioned Size and Shape Specifiers (SaSS). Thus, a second codification system was needed, for which differences between the

[6] The complete list of target meanings can be found in the Appendix.

* This group includes the sign GUN, which provides interesting patterns to be discussed later, but was not included for the statistical analysis (because it is neither a tool nor a utensil).

role of both dominant and non-dominant hands[7] have been taken into account (see Table 2).

| | |
|---|---|
| **Handling** | **H:** one- or two-handed signs (when there is symmetry) where the hands depicts the way we use an object (whether holding it or touching it). |
| | **2H:** two-handed signs where both hands depict Handling hands but playing different roles. |
| **Instrument** | **I:** one- or two-handed signs (when there is symmetry) where the hands depicts the object itself (or a part of it). |
| | **2I:** two-handed signs where both hands depict Instrument forms but playing different roles. |
| **Mixed** | **Hd+Ind:** Handling in dominant hand and Instrument in non-dominant hand. |
| | **Id+Hnd:** Instrument in dominant hand and Handling in non-dominant hand. |
| **Other** | **SaSS:** Size and Shape Specifiers (signs where the hands –mainly pointing fingers but sometimes also the whole hand– draw in the air the shape of the object). |
| | **NN:** neither Handling nor Instrument signs. Signs that are non-iconic or that make use of fingerspelling. |

Table 2. Codification of the forms.

Within the Handling type, I have included signs whose forms depict the way we hold and use objects, whether they are performed with one hand, or both hands: if they were one handed Handling forms (e.g. the before mentioned TOOTHBRUSH in BSL), or both hands are depicting the same handshape (e.g. BSL sign COMPUTER, where the fingers of both hands move as if typing the keyboard), then they were codified as H; when both hands are depicting a Handling form but using different handshapes (e.g. BSL sign PEELER, where the non-dominant hand is facing upwards with all fingers

[7] We call the dominant hand of a signer the one that he or she naturally uses for signing –usually, the dominant hand for signing is the same as for any other action, such as writing. (Sandler and Lillo-Martin 2006).

slightly bent, as if holding a potato, whereas the dominant hand presents a handshape that represents holding a peeler and moves as if peeling the potato), they have been coded as 2H. The same criteria has been followed for Instrument forms.

The Mixed group has been the most controversial and in it had to be collapsed into Handling and Instrument categories. Signs were classified as Mixed when one hand was performing a Handling form, whereas the other hand was performing an Instrument form. The 2 subcategories depend on whether the Handling or the Instrument forms was performed with the dominant or the non-dominant hand. For the final analysis, only the dominant hand has been taken into account and the sign has been reclassified into either Handling or Instrument types. An example of a Mixed sign would be the LSE sign TOOTHPASTE, where the non-dominant hand represents an object (the toothbrush) by means of an Instrument form (by extending the index finger as if it was the toothbrush), while the dominant hand represents the action of holding the toothpaste and (with a lateral movement over the extended finger of the non-dominant hand) putting some paste on the toothbrush, thus a Handling form.

Therefore, as a difference with Padden et al. study, regarding the final classification of forms this study includes the Size and Shapes Specifiers: a type that was very productive and that was found to be of preference for Food and for Clothing signs. More about this issue will be discussed below.

It is also important to note that whenever a sign is a compound, if any of the parts of the compound falls into one of the main categories of form I have considered the sign as being part of that form category. Otherwise, it has fallen into the NN category. An example of a compound sign would be the NZSL sign SUNGLASSES, where the first part is the sign SUN, whereas the second part is the sign GLASSES, which in NZSL is represented with an Instrument form (as if the hands were the glasses by the thumb and middle fingers in a rounded shape in front of the eyes).

The final number of signs falling into each of the form categories, for each of the object classes, in all 5 sign languages, can be seen in Table 3 and Table 4. Another important remark to be made in here is that not all the target meanings were found in every dictionary (e.g. ‘sunglasses’ was found only in the NZSL dictionary; ‘screw’ was only found in LSE and LSC, and so on), thus, some sign languages have more

target meanings from the final list of 155 words than others. However, the analysis has been done taking into account signs, instead of target meanings, because the amount of target meanings and signs did not match in any of the sign languages. We have to keep in mind that signed languages do not have a writing system, therefore dictionaries are usually written in the spoken language of the environment (English, for instance, for the BSL and the NZSL dictionaries; Spanish for the LSE dictionary, etc.), which makes difficult sometimes the correspondence word-by-word, as it happens in any other bilingual dictionary. This is why some signs may have more than one word as a gloss in the dictionary. Or it can also be the opposite case: that to represent one concept, a particular sign language has more than one sign. Hence the difference between "Total target meanings found" and "Total signs" within Table 3 (e.g. for a final list of 109 target meanings found in the NZSL dictionary, we have a final set of 132 signs, whereas for 115 target meanings found in the LSC dictionary, we end up with a set of 105 signs). These final sets of signs are the ones used for the statistical analyses, and will be referred, from now on, as the Independent Data Sets.

| | **BSL** | **NZSL** | **HKSL** | **LSE** | **LSC** |
|---|---|---|---|---|---|
| **Total target meanings found (out of 155)** | 96 | 109 | 68 | 82 | 115 |
| **Total signs:** | 99 | 132 | 72 | 80 | 105 |
| **Tools and Utensils** | 36 | 41 | 25 | 18 | 32 |
| **Food** | 33 | 62 | 26 | 40 | 43 |
| **Clothing** | 24 | 21 | 16 | 17 | 23 |
| **Cosmetics and Hygiene** | 6 | 8 | 5 | 5 | 7 |

Table 3. Number of target meanings and signs found in the dictionaries for each of the 5 sign languages.

| | Handling | Instrument | SaSS | NN | Total |
|---|---|---|---|---|---|
| **BSL** | 39 | 24 | 18 | 18 | 99 |
| **NZSL** | 49 | 25 | 35 | 23 | 132 |
| **HKSL** | 28 | 21 | 19 | 4 | 72 |
| **LSE** | 30 | 24 | 14 | 12 | 80 |
| **LSC** | 35 | 31 | 23 | 16 | 105 |
| **Total** | 181 | 125 | 109 | 73 | 488 |

Table 4. Independent Data Sets. Number of signs, for each sign language, falling into each of the 4 main form categories.

Because Padden et al. analysis was based on a data set that was shared by all 6 sign languages, in order to be able to have some results that could be more similar, or at least comparable, to Padden et al. results, I have selected, among the 155 target meanings, a second set of 36 target meanings that have been found across all 5 dictionaries, and will be referred as the Common Data Set (see Table 5).

| | Handling | Instrument | SaSS | NN | Total |
|---|---|---|---|---|---|
| **BSL** | 13 | 15 | 7 | 12 | 47 |
| **NZSL** | 15 | 17 | 12 | 12 | 56 |
| **HKSL** | 14 | 13 | 9 | 3 | 39 |
| **LSE** | 14 | 12 | 5 | 4 | 35 |
| **LSC** | 12 | 13 | 4 | 6 | 35 |
| **Total** | 68 | 70 | 37 | 37 | 212 |

Table 5. Common Data Set. Number of signs (from the 36 common target meanings), for each of the 5 sign languages, that fall into each of the 4 main form categories.

There was an attempt of creating two more data sets: the first one called the Elicited Signs, the second one called the Padden's Like Data Set. The aim of the first data set was to prove whether native signers of BSL and LSC (the two sign languages that I have access to) had a natural tendency towards any type of sign when facing target meanings for which there may not exist a sign yet (e.g. iPad, Kindle, Kinect, and the like[8]). In order to determine whether signers choose naturally a Handling form or an Instrument form when facing new objects for which they may need to create a sign, a small list of target meanings was created and 5 native signers of British Sign Language were asked to sign them (the participants were shown individual pictures for each of the objects, with the name on them[9]). The small size of this data set as well as the small size of the participants found for the elicitation of the signs made it impossible to include this data set among the analyses. More on this issue will be found in the Discussion section.

Regarding the second intended data set, the idea was to follow Padden et al. classification of forms and object classes, and reclassifying the Independent Data Sets according to theirs. However, some difficulties were found when trying to place some of the target meanings into each of their object classes (e.g. Padden et al. placed 'toothbrush' within the Hand Tools group, whereas 'spoon' and 'fork' were in the Utensils group –I know about the classification of these two target meanings because they are used as an example in the presentation when introducing the object classes, but I was not able to figure out what was their criteria for placing, for instances, 'toothbrush' in Hand Tools and not in Utensils, or where were some of the other target meanings placed). This resulted in a biased classification of the signs of my original Independent Data Sets, which gave different results depending on the consideration of few signs as Hand Tools or as Utensils. For these reasons, this data set was finally discarded.

A generalized linear model analysis, with a poisson distribution corrected for overdispersion and for underdispersion, was run on both data sets: Independent Data Sets and Common Data Set, respectively.

---

[8] A complete list of these objects can be found in the Appendix.

[9] An example of picture is shown in the Appendix.

## Results

Whether the analysis is run on the Independent Data Sets or the Common Data Set it always shows a significant effect in the interaction between form and object class ($p < 0.001$). However, no significant differences have been found between forms within each of the sign languages, apart from few cases that will be commented below.

### *Interaction Form*Object Class*

Regarding the interaction between form and object class, the analysis of the Independent Data Sets shows a significant effect of object class, with the signs for Tools (across sign languages) represented with Handling forms significantly more frequently than represented with SaSS forms (mean difference = 9.51, $p = 0.027$) or with NN forms (mean difference = 10.42, $p = 0.005$); for Tools performed with Instrument forms the mean difference is only significant compared to the NN category (mean difference = 10.99, $p = 0.001$). Looking at Figure 1 we can see a general tendency for Tools to be performed with either Handling or Instrument forms, and a strong tendency for signs in the Food and Clothing classes to be performed with either Handling or SaSS forms (with a slight preference for the latter).

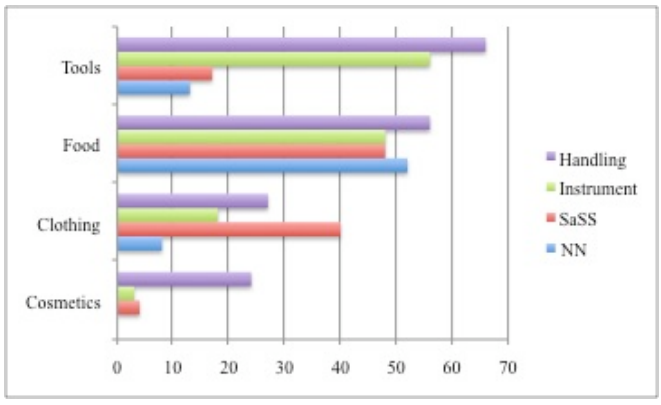



Figure 1. Independent Data Sets. Number of signs (for all sign languages collapsed) according to their form and object class.

When we look at the general results from the analysis of the Common Data Set (Figure 2), we find a significant difference between frequency of signs for Tools represented with Instrument forms compared to those represented with SaSS forms (mean difference = 5.06, p = 0.002) or NN forms (mean difference = 4.76, p = 0.001), but no significant difference is found between the two main forms (Handling and Instrument) regarding the object class of Tools.

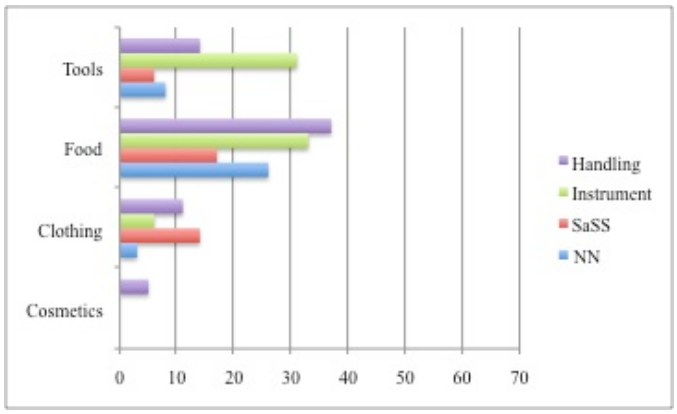



Figure 2. Common Data Set. Number of signs (for all sign languages together) according to their form and object class.

Comparing object classes and forms within each sign language separately, we can observe in Figures 3 to 7 a tendency of all sign languages to perform Tools signs with Handling and Instrument forms, and a tendency for Food and Clothes signs to be performed with a SaSS form. However, none of these tendencies has been found to be statistically significant.

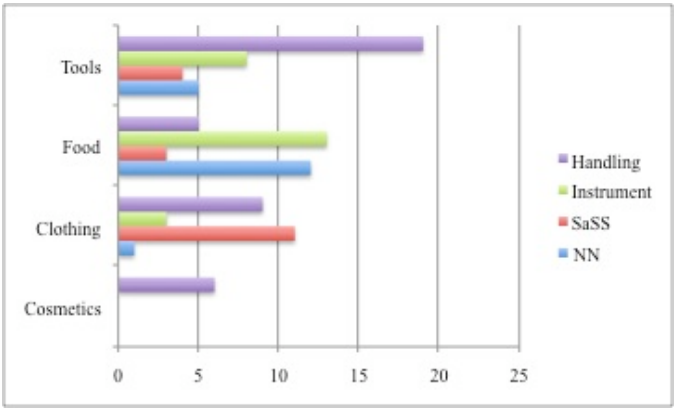



Figure 3 (BSL). Number of signs regarding object class and form.

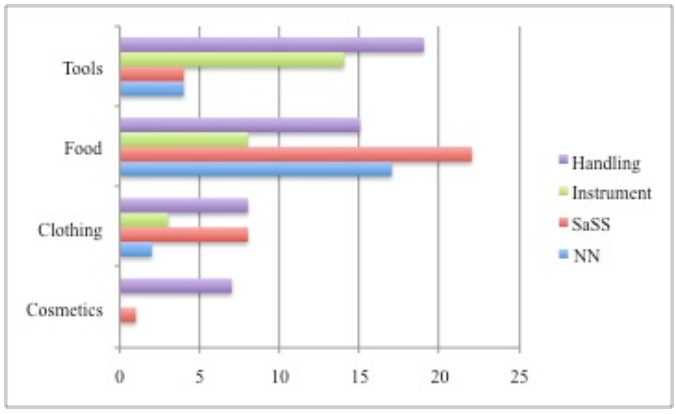



Figure 4 (NZSL). Number of signs regarding object class and form.

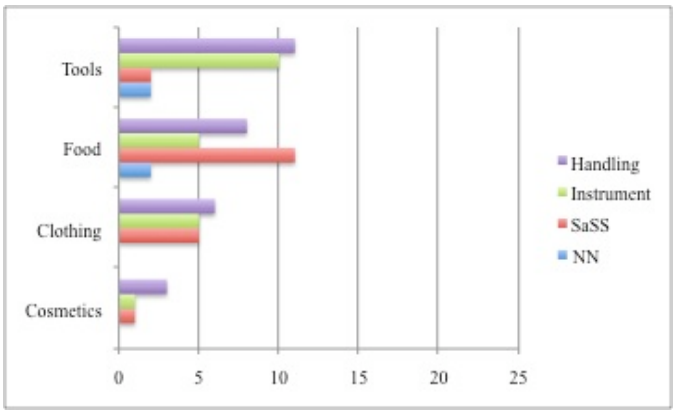



Figure 5 (HKSL). Number of signs regarding object class and form.

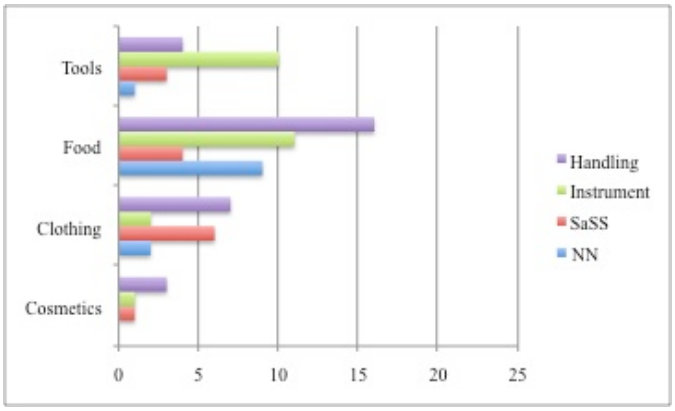



Figure 6 (LSE). Number of signs regarding object class and form.

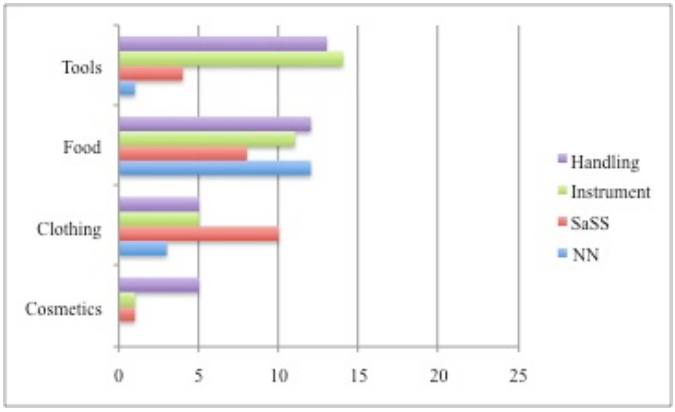



Figure 7 (LSC). Number of signs regarding object class and form.

*Interaction Sign Language*Form*

The Independent Data Sets shows no difference between Handling and Instrument forms in any of the sign languages. Figure 8 shows the counts for each form within each of the 5 sign languages (when using the Independent Data Sets). Although a tendency can be observed towards Handling forms in all sign languages, the differences have not found to be significant. No significant differences have been found either between Handling and Instrument forms using the Common Data Set (see Figure 9) –observe that when using the Common Data Set, the tendencies seem to contradict those of the Independent Data Set for some of the sign languages. This may be due to the small size of the sample for the Common Data Set.

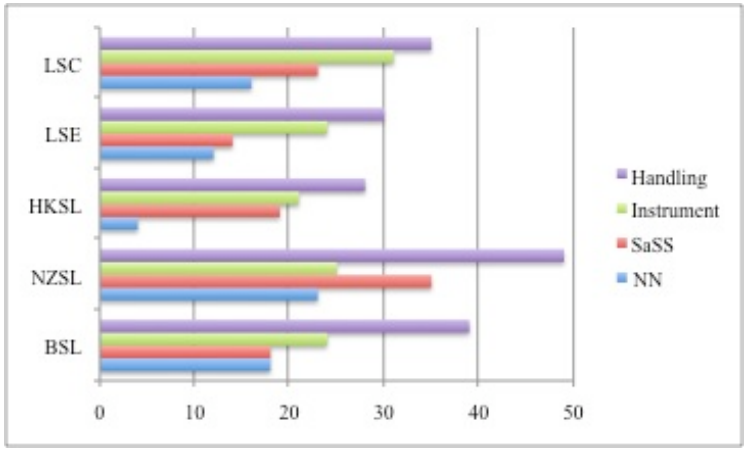



Figure 8. Independent Data Sets. Number of signs falling in each of the forms for each of the 5 sign languages.

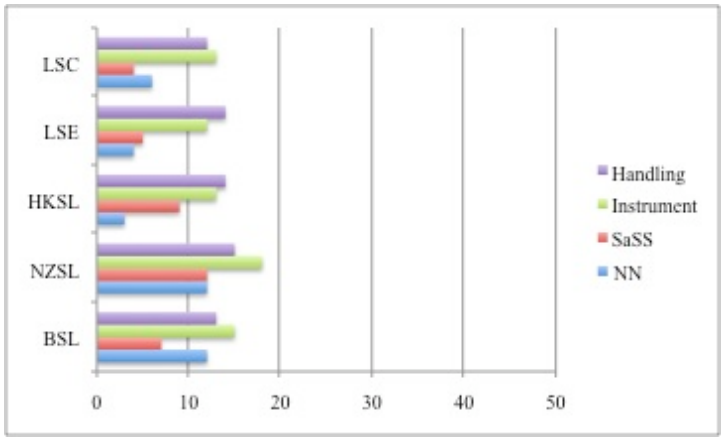
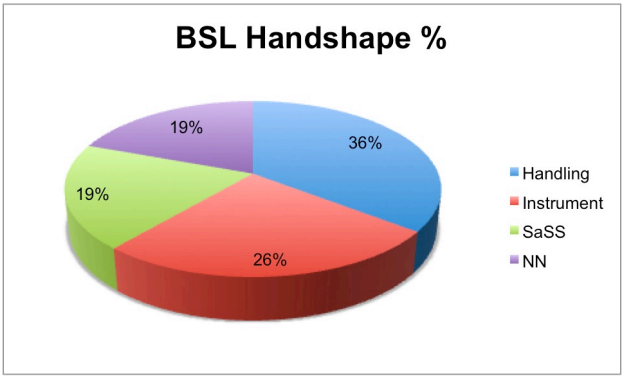



Figure 9. Common Data Set. Number of signs falling in each of the forms for each of the 5 sign languages.

Regarding whether there are any similarities between sign languages belonging to the same linguistic family, Figures 10 to 14 below (expressed in percentages) show no difference in distribution of forms, either within sign languages of the same linguistic family (i.e. comparing BSL and NZSL, on one hand; and LSE and LSC, on the other hand), or across families (i.e. comparing, for example, BSL to LSE, or to HKSL):



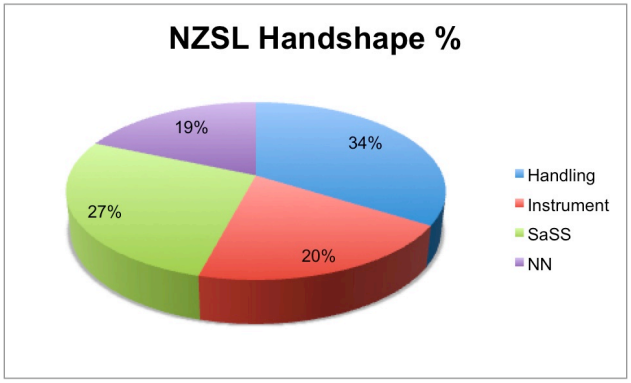




Figure 10 (left –BSL), Figure 11 (right –NZSL). Number of signs falling in each of the forms for each of these 2 sign languages belonging to one linguistic family.

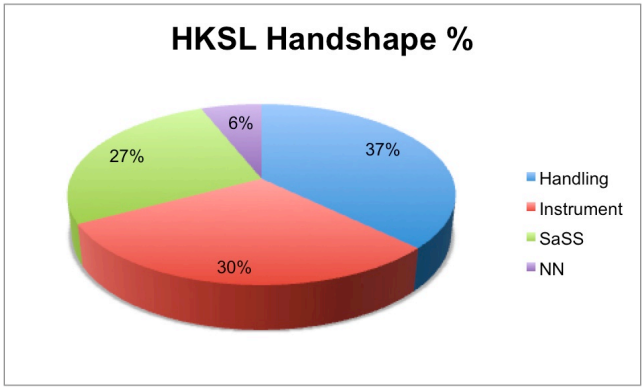
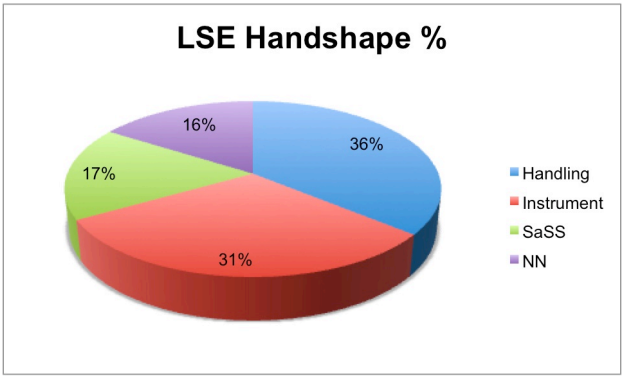



Figure 12 (HKSL). Number of signs falling in each of the forms.



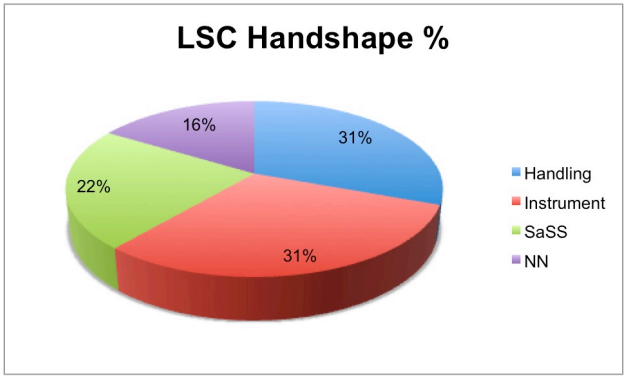




Figure 13 (left –LSE), Figure 14 (right –LSC). Number of signs falling in each of the forms for each of these 2 sign languages belonging to one linguistic family.

*Elicited signs for new-technology objects*

As mentioned in the Methods section, it was attempted the elicitation of signs for a group of hand-used objects whose new incorporation to our everyday lives has provoked the need for creating signs to relate to them: e.g. mobile phone, iPad, Kindle (just as an example of some of these new target meanings). Although the sample was too small (only 15 target meanings and 5 native signers were included), some patterns can be seen among the signs: the ones relating to new-technology objects which have been among us for at least one decade (such as fax, mobile phone, laptop or memory stick) were performed with one of the two main representation forms subject of this study. However, new-technology objects which have been recently introduced in our lives seem to have a tendency to be performed by fingerspelling the initials of their names, or even the whole names (e.g. fingerspelling P-S for Play Station, or fingerspelling X-B-O-X for XBox).

**Discussion**

If we go back to the research questions, regarding the preference of sign languages for Handling or for Instrument forms, the results obtained do not show a significant difference between the use of one pattern towards the other in any of the 5 sign languages analysed here. Although it is observable, when using the Independent Data Sets, a tendency of all of them towards Handling forms compared to Instrument forms, this general tendency seems to be the opposite for British Sign Language, New Zealand Sign Language and Catalan Sign Language when looking at the Common Data Set. This may be caused by the small size of the sample of this data set –the only 36 target meanings found across all 5 dictionaries. It is important to note that the distribution of the forms across all sign languages (but specially when comparing New Zealand Sign Language percentages with those given by Padden et al. in the TISLR10) does not support Padden et al. results: the differences between Handling and Instrument forms in their distributions were wider then in my study. Could it be due to the fact that their list of target meanings was too small? It seems so, given the fact that the list used for this dissertation was larger that theirs. Maybe the type of objects that they chose biased their results?

In order to answer this last question, we need to look at the effect of object class in form: the second of the aims of this dissertation. Although the results show a significant general interaction of these two factors, when looking at the mean differences no significant differences are found between the number of Tool signs performed as Handling compared to other forms, just a tendency for Tool signs to be performed with Handling forms. Another tendency can be observed, however not statistically significant either, of Clothing signs to be performed as Size and Shape Specifiers across sign languages, as well as Food signs to be performed in some of the sign languages with Size and Shape Specifiers forms. Therefore, it does not seem that this could be the cause for Padden et al. results to tend so strongly towards the two main forms. The lack of significance in these results can help considering the results for form preference as more robust, because the type of object does not influence the type of representation (i.e. although some slight interactions between form and object class are observed when looking at them in detail, they do not seem to bias the tendencies of sign languages towards one form or another: if the analyses were run with only one or two of the object classes, the distribution of the forms would have been very similar to the one obtained in the results observed above).

Regarding the third research question, i.e. the possible similarities between sign languages belonging to the same linguistic family, the results show similar distribution of the forms within each family, but also across families, which does not support the idea that sign languages from the same linguistic family would look more alike between them than compared to sign languages from different families. Moreover, as proved by the pie graphs included in the Results section, all 5 sign language show a very similar distribution of all the forms, even if we take into account that each of the sign languages had a different set of signs to be analysed.

All these results validate Padden et al. theory that sign languages have a preference towards either Handling or Instrument forms when performing noun signs for hand-used objects, and that their results do not seem to be biased by the type of object. However, the results obtained with the analysis of a data set that is five times bigger than their data set show no significant differences between the two main forms, which makes this tendency look not as strong as Padden et al. stated.

The last aim of this study was to determine whether Handling and Instrument forms can be considered as features for the typological classification of signed languages. Looking at the fact that all 5 sign languages analysed in this study, as well as the 6 analysed by Padden et al., show both types of forms in their inventories, and that these two main forms seem to be the preferred ones when performing signs for hand-used objects, it is possible that these type of signs (classifier based) which entail manner or instrument within their representation forms are the clue to classify sign languages as being Handling or Instrumental. Whether the results of the current analysis are not confirming the significance of the preference for one form over the other, it is at least evident that sign languages are expressing manner and instrument within their forms, whether they account for nouns (as it is the case of this study) or for verbs. A deeper analysis including verbs as well as nouns might enable to state a wider range of semantic elements that would result in a more exhaustive classification of signed languages according to the way they express meaning.

The collection of the data for this dissertation included a slight look at the verbs related to the nouns used for the analysis. Almost every verb-sign that was found in a dictionary, in correspondence with a noun-sign, shared the handshape with the corresponding noun (e.g. if the noun-sign TOOTHBRUSH in British Sign Language was performed with a Handling form, the sign BRUSHING-ONES-TEETH was as well performed with a Handling form), and even some had the same sign for both verb and noun most of the times. However, some of the signs showed a very interesting disagreement of the patterns for noun and for verb: for example, the sign GUN in Hong Kong Sign Language can be performed in 3 different ways, two of them being Instrument and one of them being Handling, whereas the sign SHOOTING-WITH-GUN is performed with a classifier in the non-dominant hand (fist closed with thumb extended as a PERSON-classifier) and Instrument in the dominant hand –as if pointing with the gun towards the person. Similarly, GUN in Spanish Sign Language is performed with an Instrument form, whereas SHOOTING-WITH-GUN is performed with a Handling form. Another interesting example is the sign SHAVER in Catalan Sign Language, performed with a Handling form (as if the hand was holding an electric shaver), whereas the verb TO-SHAVE is performed with an Instrument form (fist closed, index finger slightly bent as if the finger was a razor). The latter are few examples of disagreement between noun-signs and the related verb-signs, which

would be an interesting issue for a study of the typology of sign languages: should we consider these particular double patterns an exception within sign languages, or maybe they occur more often than expected? If so, would it imply a new classification of sign languages which will have to consider verbs and nouns differently? Could we find a sign language having a large amount of Handling signs for nouns and a large amount of Instrument signs for verbs, or vice versa? Further research is needed to account for this issue.

A deeper look into these particularities may give some light to the nature of these kind of signs, their evolution and lexicalization. Is there a natural tendency towards Handling or Instrument over each other determined by the language itself or by the signers? An interesting study in order to see whether signers tend to create signs for new hand-used objects based on their main (or preferential) form or, on the contrary, fingerspelling is the first step into the lexicon when a new sign is needed, would imply a larger number of target meanings, as well as maybe an inventory of non-existing invented objects which obliged the participants to create a new sign for that object. It could be, just by looking at this small sample, that signs may have adapted, after some years of use, to match the less marked forms of Handling and Instrument.

Regarding the new light that this dissertation adds to the literature reviewed in the Introduction, we cannot leave aside the fact that this study, unlike Padden et al. research, was made using dictionaries instead of signers. This may have biased the amount of signs to be analysed for each sign language. Moreover, the fact that sometimes one target meaning had several ways of being performed has complicated the analysis more than expected. The list of target meanings was large enough to account for reliability of the results for the Independent Data Set, but not for the Common Data Set. This fact made very difficult the task of comparing the results of each of the data sets. The fact that the Common Data Set was a selection of signs under the condition of being found in all 5 dictionaries, thus resulting in a very small sample, left to the level of chance the possibility for a sign of being part of this data set. Hence the decision of not considering the results obtained with the Common Data Set as relevant.

From a different perspective, the issue of Handling versus Instrument forms rises some questions about the nature of the psycholinguistic processing of these forms. It has been proved in this dissertation that signers use both types of forms in their core lexicons, regardless of the tendency of the sign language towards one over the other. However, regardless of the findings based on case studies with brain-damaged patients mentioned in the Introduction section, little we know about the processing of these patterns: it may seem that Handling and Instrument forms are processed differently in the brain (evidenced by the fact that a brain injury can alter the performance and the comprehension of Handling patterns in favour of Instrument), but what are the implications of these differences within the preference of one form or the other in the core lexicons of sign languages, is still a question to be answered. Specific research on this area is needed in order to convey the nature of Handling and Instrument signs, their processing and their performance.

The present study has accounted for the preference of a particular form over the others, when performing signs of hand-used objects, for only 5 of the more than one hundred signed languages in use nowadays. For these results to be of relevance they should have included a larger amount of signed languages as well as a larger list of signs. Moreover, the sources should have been signers, instead of dictionaries. However, given the limitations of space and time, and the nature and purpose of this dissertation –which did not allow the inversion of human and material resources that is necessary to conduct such a research–, I consider that the results obtained with the data collected and analysed here provide a good starting point for further studies on representation forms and sign language typology, as well as for psycholinguistics.