Research Article

Giorgia Zorzi*, Raquel Veiga Busto, Gemma Barberà, Alexandra Navarrete-González, and Josep Quer

Choice of classifier handshape in Catalan Sign Language: A corpus study

https://doi.org/10.1515/opli-2025-0051
received July 24, 2024; accepted April 11, 2025

Abstract: Classifier predicates are sign language modality specific constructions that are widely spread in all attested sign languages. Extended research has been devoted to the study of these structures, but many aspects related to their nature remain unclear. This article examines the factors that influence the choice of handshape in classifier predicates referring to anthropomorphic entities in Catalan Sign Language (LSC). We present the results of a corpus study investigating the choice between the 1- and the 2-handshape. Our findings indicate that the choice between these two handshapes is affected by the discourse status of the referent, whether the event encodes manner of motion and whether the action is (un)controlled by the moving referent. Moreover, our study shows that, in LSC, handshapes that are articulatory more complex (e.g. the 2-handshape with respect to the 1-handshape) are used to convey more detailed information about the events and the discourse referents. This accounts for the use of the 2-handshape when manner of motion, in addition to path, is expressed, when referents are maintained in the discourse and when controlled actions expressing the controlled movement of the body and the legs are conveyed.

Keywords: Catalan Sign Language, classifier predicates, manner, discourse status, (un)controlled actions, markedness

1 Introduction

One distinctive characteristic of sign languages is the widespread use of the so-called classifier predicates. The term encompasses a number of different types of forms which encode some iconic features of the referent they stand for. Whole entity or semantic classifier predicates, for instance, represent classes of referents such as vehicles, humans, animals, long objects, and flat objects through handshapes, and the movements they undergo or the locations where they are placed through hand displacement. Body part classifiers can be considered a subtype of whole entity/semantic classifiers that stands for the referent of which the limbs are represented. Other types of classifier predicates are handling classifiers, which represent how the hand manipulates objects, and descriptive ones (size and shape specifiers), where the movement of the hand delineates the static outline of the referent (Supalla 1986, Emmorey 2003, Tang et al. 2021, Zwitserlood 2012).

Despite being an integral part of sign language discourse, the status of classifiers predicates is subject to debate due to their highly iconic nature and the thorough use of the affordances of the signing space. Abstract

*** Corresponding author: Giorgia Zorzi,** Department of Language, Literature, Mathematics and Interpreting, Western Norway University of Applied Sciences (HVL), Bergen, Norway, e-mail: giorgia.zorzi@hvl.no
Raquel Veiga Busto: Department of Arts and Humanities, Universidad Rey Juan Carlos, Madrid, Spain; Institute for Logic, Language and Computation, University of Amsterdam, Amsterdam, The Netherlands, e-mail: raquel.veiga.busto@gmail.com
Gemma Barberà: Department of Translation and Language Sciences, Universitat Pompeu Fabra, Barcelona, Spain, e-mail: gemma.barbera@upf.edu
Alexandra Navarrete-González: Basque Center on Cognition, Brain and Language (BCBL), Donostia – San Sebastián, Spain, e-mail: a.navarrete@bcbl.eu
Josep Quer: ICREA; Department of Translation and Language Sciences, Universitat Pompeu Fabra, Barcelona, Spain, e-mail: josep.quer@upf.edu

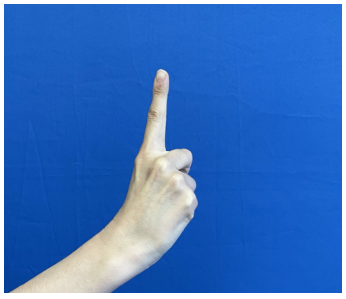


Figure 1: 1-handshape.

movements, locations, and orientation of the hands are interpreted more or less directly as the mapping onto signing space of actual movements, and locations and orientations in the reported scene or event, in a gestural-like manner. Handshapes, instead, are lexicalized differently in each sign language, in particular in the domain of whole entity/semantic classifiers. The main point of disagreement among the analyses (see aforementioned references) is whether classifier predicates are fully decomposable into discrete morphemic units or they rather mostly rely on gestural articulations grounded in iconicity and depiction. Some of the classifier handshapes are quite widespread crosslinguistically, like the 1-handshape (Figure 1) or the 2-handshape (Figure 2) for standing or moving humans (or anthropomorphic entities). In the default case, the referent is introduced first in an explicit way, typically by a noun phrase, and among other strategies, it can be referred back to by the use of a classifier construction if movement or location is predicated of that referent.[1]

Catalan Sign Language (*llengua de signes catalana* [LSC]) also instantiates these two handshapes to refer to the class of anthropomorphic referents:[2] in combination with the relevant motion or location in the expression of abstract predicates, they are used to convey the movement or location of the anthropomorphic entity. This article concentrates on the choice of classifier handshape in constructions involving the 1- and the 2-handshape referring to anthropomorphic characters in a retelling of a cartoon and the factors that may determine that choice.

This study was conducted within the scope of the crosslinguistic project "Whole Entity Classifiers in Sign Languages: A Multiperspective Approach," led by the University of Bergen (Norway). The project aimed to identify the factors that influence the choice of handshape in classifier predicates across sign languages. The investigation was conducted independently for each sign language, but most of the research teams involved in this project used the same video stimuli and the same annotation criteria. The stimuli consisted of several episodes of the Canary Row cartoons (Freleng 1950). The elements considered as potential factors affecting the choice of classifier handshape include, among others, whether the action represented a location or a motion event, whether the action was controlled, if manner or path was expressed, what the discourse status of the referent represented was, if the movement was depictive, as well as aspects of the shape and direction of the movement (cf. Section 2.2.1 for the complete list of variables taken into account and annotated in this research).

In this project, we focus on two main categories: whole entity and body part classifiers instantiated by the 1- and the 2-handshape, and variants of the latter. While previous research has shown that the 1-handshape is mainly used to denote whole entity classifiers (Zwitserlood 2012), there is an ongoing debate about the specific nature of the 2-handshape to denote legged entities. Benedicto and Brentari (2004) distinguish two forms of the 2-handshape in American Sign Language: one without movement (2-handshape), which is analyzed as a whole entity classifier, and one incorporating movement of the selected fingers (2m-handshape), which belongs to the group of body part classifiers. For Russian Sign Language, Kimmelman et al. (2020) point out that the 2m-handshape represents a complex event with two subevents: the movement of the legs controlled by the person expressed by the movement of the fingers, and the movement of the body that is given by the movement of the

1 The pronominal properties of classifier handshapes have been established since the beginning of sign language research (for instance in Klima and Bellugi (2012)).

2 For a detailed inventory of the classifier handshapes in LSC, see Quer et al. (2005), Navarrete-Gonzalez (2020). For the use of classifier predicates as reference tracking strategy in LSC, see Sections 4.1.2 and 4.2.2 in this article and Barberà and Quer (2018) for a more detailed account.

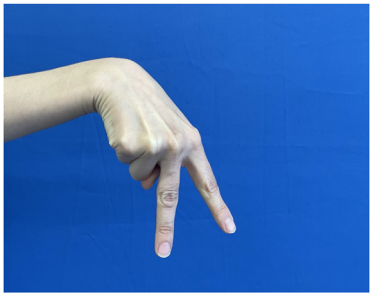


Figure 2: 2-handshape.

hand. This classifier predicate can only have one overt argument as subject: the person moving, which can move in a controlled or uncontrolled way, but whose movement of the legs is controlled.

It is important to note that, despite both handshapes are able to refer to anthropomorphic entities, they differ in terms of markedness: the 1-handshape belongs in the set of most unmarked handshapes with respect to simplicity in featural representation, low articulatory complexity, crosslinguistic frequency of occurrence, earliness in child acquisition, appearance in the passive hand of asymmetric two-handed signs, least errors in aphasic production, etc. (for a summary, see Sandler and Lillo-Martin (2006, 161)). The 2-handshape is not categorized as a marked handshape according to these criteria, but comparatively it realizes a higher degree of markedness in comparison with the most unmarked set where the 1-handshape is included (for instance, Boyes Braem (1990) includes it in Stage 3 (out of 4) of handshape acquisition by children).

The results of our study show that, among the factors analyzed, only the expression of manner of motion, the discourse status of the referent, and whether the action is controlled by the moving entity appear to influence the choice between the 1- and the 2-handshape in the LSC data analyzed. In addition, the gender of the signer appears to play a role in the selection of the specific variant of the 2-handshape, which may incorporate either bending or moving fingers. For the linguistic features that appear to be relevant, we propose the following hypotheses to explain the patterns. First, path of motion is expressed by the movement of the hand in space, and therefore, it may be conveyed by either the 1- or the 2-handshape. On the other hand, the simultaneous expression of path and manner requires an additional movement type, which can be either bouncing of the hand or internal movement of the fingers. For this, LSC favours the use of the 2- over the 1-handshape to simultaneously express path and manner. Second, the 2-handshape is morphologically more complex, and it is needed to add new meaning to the discourse context by contributing more information. This is the reason why it is found more often in maintained contexts. Third, in our dataset, the 1-handshape is mostly used to encode controlled actions, and the 2-handshape and its variants can be used to express both controlled and uncontrolled actions. The feature of control can be linked to the agentivity of the subject, which is typical of intransitive unergatives. In these data, whole entity classifiers are used to express both intransitive unaccusative and unergative verbs. Moreover, a more complex variant of the 2-handshape, the 2m-handshape, is very often used to express controlled actions conveying both the movement of the body and of the legs of the referent moving, in line with what has been observed for the expression of both path and manner.

The remainder of this article is organized as follows. Section 2 presents our dataset and the methodology used in this study. The next section outlines the results. Section 3.1 addresses the factors that influence the choice between the 1- and the 2-handshape, and Section 3.2 discusses the factors that affect the selection of the specific variant of the 2-handshape. Section 4 discusses the results, and Section 5 concludes the article.

2 Dataset and methodology

2.1 Corpus study

The LSC Reference Corpus contains more than 55 h of video recorded data from 50 deaf LSC signers, aged-between 18 and 80 years old, from different regions of Catalonia. Participants in the corpus were divided

into three age groups: 18–30, 31–50, and 51–80. They were recorded in pairs consisting of a woman and a man of the same age and from the same region and deaf club (Barberà et al. 2015). Each pair of participants carried out a series of activities suggested by a deaf interviewer. The data annotated for this study correspond to the third activity, which consists of a story retelling of three episodes of a Canary Row video (Freleng 1950).

Part of the recorded video data has been annotated by deaf researchers using the software ELAN (Crasborn and Sloetjes 2008), developed at the Max Planck Institute for Psycholinguistics (Nijmegen, The Netherlands). In this study, we excluded all data that have not yet been annotated or that, while being annotated, has not yet been revised. The remaining dataset totals 53 min and corresponds to data from 29 LSC signers (14 female, 15 male). Of these, 14 were from Barcelona and the remaining 15 from other areas of Catalonia, namely, Lleida (4), Terrassa (4), Tarragona (4), and Girona (3). Most of the signers were above the age of 31 at the time of data collection (18–30 = 8; 31–50 = 12; 51–80 = 9). The age of acquisition of LSC was divided in age intervals, namely, 0–6; 7–15; 16–100; and Unavailabe. Of the 29 signers, 21 were exposed to LSC before the age of 6 (0–6 = 21; 7–15 = 4; 16–100 = 2; Unavailable = 2). Table 1 presents this information divided according to participants' gender.

2.2 Procedure

2.2.1 Search and annotation

We searched the corpus data for annotations containing the gloss "CL" (classifier). Furthermore, we examined the entire dataset to determine if additional signs could be coded. Adhering to the project's guidelines, the classifiers annotated for this study were produced either with the 1- or the 2-handshape. Our search yielded a total of 377 classifiers.

To annotate the potential factors that could influence the handshape choice in LSC, we used the ELAN template and the annotation guidelines developed for the project, which can be accessed at https://osf.io/7n2kp. Below, we list and present the annotation tiers contained in the template. A sample annotation can be found in Figure 3.

(i) **Classifier predicate (CLP) handshape**: Within the 1-handshape and the 2-handshape, it distinguishes instances of bent and moving fingers, as well as instances of thumb extension. These were annotated as 'b,' 'm,' and 't.'

(ii) **CLP congruence**: It distinguishes simple movements that are congruent with lexical signs with the same meaning from complex, depictive movements. Values: congruent/depictive.

Table 1: Signers from the LSC Corpus considered in this study

		Female	Male	Total
Area	Barcelona	7	7	14
	Lleida	2	2	4
	Terrassa	2	2	4
	Tarragona	2	2	4
	Girona	1	2	3
Age group	18–30	4	4	8
	31–50	6	6	12
	51–80	4	5	9
Age of acquisition	0–6	12	9	21
	7–15	0	4	4
	16–100	1	1	2
	Unavailable	1	1	2
Total		14	15	29

Figure 3: Screenshot of ELAN with the annotation template used in the project.

(iii) **CLP event**: It identifies whether the action represents the motion of the referent or its location. Values: event/location.

(iv) **CLP manner**: For motion predicates only, it distinguishes if the predicate describes the manner of the motion (e.g. 'the cat jumps'), the path of the motion (e.g. the cat moves from point A to B), or both (e.g. the cat moves from point A to B while jumping). Values: manner/path/both.

(v) **CLP controlled**: Only for motion predicates, it distinguishes if the motion along the path is controlled by the moving referent. Values: controlled/uncontrolled/unclear.

(vi) **CLP discourse status**: It refers to the discourse status of the referent of the classifier, by distinguishing introduction (first appearance of the antecedent), maintenance (the topical discourse referent is the

same as in the previous clause), and reintroduction (the topical discourse referent differs from that in the previous clause). For LSC, we expanded the controlled vocabulary to include those scenarios where the noun phrase updates the discourse status instead of the classifier predicate. Consequently, we added three values to the original list to include introduction, maintenance, and reintroduction of nominals.[3] Values: introduced/maintained/reintroduced/intro-nominal/maintained-nominal/reintro-nominal/unclear.

(vii) **CLP movement**: It refers to the shape traced by movement of the hand. Open list of possible values: straight, spiral, arc, circular, arc bouncing, straight bouncing, zigzag, complex (for movements that contain turns or stops).

(viii) **CLP direction**: It refers to the direction to which the hand moves. Open list of possible values: towards, away, up, down, right, left, away left, away right, away behind back, away and then towards, up and down, in front, left and right (for back and forth), away down.

(ix) **CLP scene**: In the cartoon, there are specific fragments that include multiple actions represented by classifier predicates with the 1- and the 2-handshape. For LSC, only the first three fragments of the cartoon were retold in the corpus. An example of an action included in the first fragment is '(cat) descending stairs.'

(x) **CLP mouthing**: Annotated only if there was a clear mouthing during the predicate.

(xi) **CLP meaning**: It describes the event denoted by the classifier predicate. Open list of values: jump, sit, fall, arrive, appear, leave, bump into, approach, pass by, among many others.

(xii) **CLP interaction**: It refers to whether there is another referent represented by the other hand or by the body of the signer. Values: yes(body)/yes(hand)/no/unclear.

(xiii) **CLP second hand**: Annotated only if there is another referent represented by the second hand, it distinguishes the class of the referent. Values: human (including anthropomorphic animals)/animate/inanimate.

(xiv) **CLP comments**

Except for tiers with open lists of possible values, the list of values for each tier was provided in controlled vocabularies.

2.2.2 Specific criteria for handshape categorization

We established specific criteria for the annotation and categorization of the 1- and 2-handshape. The 1-handshape was annotated as a classifier predicate depicting an anthropomorphic animal when the index finger was moved as a whole and the tip of the index finger (representing the head of the animal) matched the position of the animal in the event that was being depicted. Instances of the 1-handshape that did not follow these criteria were considered to be representing only a trajectory movement, not the animal, and thus were not included in the analysis.

As for the 2-handshape, we categorized its variants according to (i) the specificities of the LSC phonological repertoire, as these might vary across sign languages, and (ii) the patterns detected in our data for the expression of manner. We considered that the N-handshape, where the index and middle fingers are non-spread, is a phonetic variant of the 2-handshape, as the two configurations are not used contrastively with anthropomorphic referents in classifier predicates and they may occur in the same context. Furthermore, aspects of the form of the handshape, like bent fingers or moving fingers for the 2-handshape, were also

3 The definition of a clause employed within this project comprised a predicate along with its semantic arguments and adjuncts. Hence, the presence of a noun phrase corresponding to the referent of the classifier predicate in the same clause was not considered relevant in the annotation, because what determined the discourse status was the classifier predicate per se. Moreover, what mattered was whether the same referent had been mentioned in the previous clause. In the LSC team, we additionally decided to exclude scene-setting topics and, to be more explicit regarding what the annotators considered a clause, we added the tier **CLP clause segment** to the annotation template.

considered in the annotation and analysis of the data. Out of context, some of the phonetic variations observed in the handshapes can be considered allophonic, such as the non-spread variant of the 2-handshape (N-handshape, Table 2). Still, the variation may also be meaningful in a particular context in LSC, like using a bent 2-handshape (2b-handshape) to refer to a sitting person or a bent 2-handshape with the thumb opposed (2bt-handshape) to refer to a (non-anthropomorphic) four-legged animal referent.

As for the combination of the values 1/2/N with the modifiers t/b/m (thumb extended, bent fingers, and moving fingers, respectively), instances of the 2-handshape with thumb extended (2t-handshape) and bent fingers (2bt-handshape) were considered as allophones of the 2-handshape (Table 2). It is worth noting that LSC has two specific handshapes (the 3- and the 3b-handshape), which are articulated with the same form as the 2t- and the 2bt-handshape. These handshapes are used to represent reptiles and bird legs (3-handshape) and four-legged animals (3b-handshape) Quer et al. 2005, Navarrete-González 2020). In our data, it is not possible to disambiguate which of the two handshapes we are dealing with (2- or 3-handshape). Signers mostly anthropomorphize animals, but some instances of classifier handshapes with thumb extended also coincide with the referents that are usually depicted by the 3-handshape. Since we do not have a way of disambiguating these uses, we considered instances of the 2bt-handshape as variants of the 2-handshape.

In the annotation of manner, as well, a specific criterion was included: we decided to annotate all variants of the 2-handshape with moving fingers as encoding manner (Section 2.2.3). This decision partly influences results in the analysis of how manner and path are expressed in LSC, as explained in Section 4.2.

2.2.3 Reliability of the annotations

On the basis of the glosses and the classifier predicates annotated by deaf LSC researchers, the data for this particular study were annotated by two researchers (annotator 1 and 2) and revised by two others (reviewer 1 and reviewer 2). Annotator 1, who is the first author of the article, is a non-native hearing signer with 10 years of experience as a LSC researcher and a background as a sign language linguistics professor. Annotator 2, second author of the article, is a non-native hearing signer with 15 years of experience as a sign language interpreter and 7 as a LSC researcher. Reviewer 1 is a non-native hearing signer with 20 years of experience as a sign language linguistics professor and 17 as a researcher. Reviewer 2 is a non-native hearing signer with 9 years of experience as a sign language interpreter and researcher, and 5 years of sign language linguistics and interpreting teaching experience.

In the annotation process, annotator 1 and annotator 2 first coded over 24% of the data simultaneously to compute inter-annotator reliability. These data consisted of seven videos with a duration of nearly 13 min and a total of 90 classifier predicates referring to anthropomorphic referents. Annotations were then extracted to an Excel file using the ELAN software. Inter-annotator reliability was calculated looking at the percentage of overlapping in the values given by the two annotators for each tier. Three tiers were excluded from the calculation, namely, 'CLP mouthing,' which had only one annotation, 'CLP meaning,' which lacked a predefined list of values necessary for a one-to-one comparison, and 'CLP scene,' where the same actions could appear in multiple fragments (e.g. 'fly/fall out' occurs in both fragments 1 and 3). Furthermore, signers did not always retell the story in the same exact order of the video, making it difficult to calculate the agreement between annotators.

Inter-annotator reliability showed an overall congruence between annotators 1 and 2 of 81.85% (Table 3). Tiers with open values, such as 'CLP movement' and 'CLP direction,' showed less agreement. In particular, the tier 'CLP movement' had an average of 70% agreement between annotators and 'CLP direction' had a mean of 80%. This is partially due to the fact that selecting a value was more interpretative in these cases. For example, the value '1' was given only if the value coded was the exact same one and '0' otherwise, including cases where one annotator coded 'circle' and the other 'spiral.' Finally, coincidence between annotators was also lower than the mean in the tiers 'CLP manner' (63%) and 'CLP congruence' (73.3%). Given the relatively low agreement between annotators in these two tiers, the annotated data were revised. Following discussion with the members of the project, the annotation guidelines were updated to include a more detailed explanation of the

Table 2: Handshape configurations for the variants of the 2-handshape

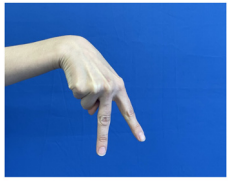
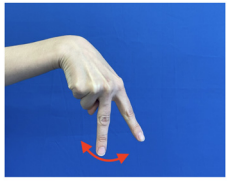
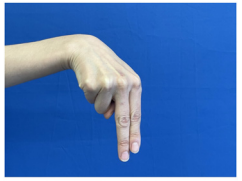
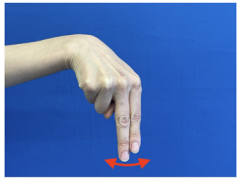
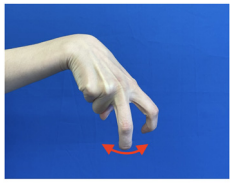
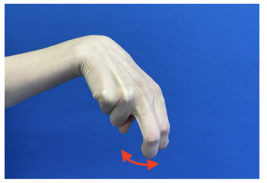
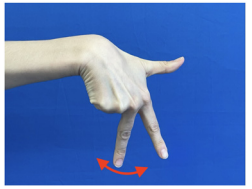
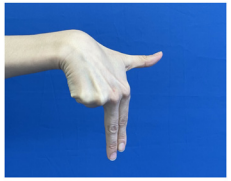
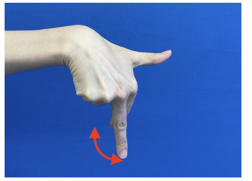
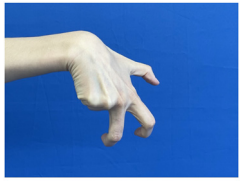
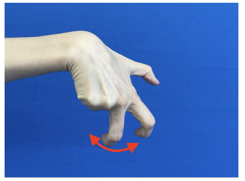
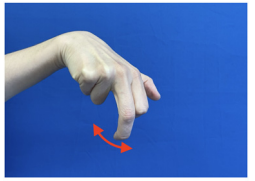
	Spread		Non-spread	
	Non-moving	**Moving**	**Non-moving**	**Moving**
Extended	 2	 2m	 N	 Nm
Bent	 2b	 2bm	 Nb	 Nbm
Thumb-opposed extended	 2t	 2tm	 Nt	 Ntm
Thumb-opposed bent	 2bt	 2btm	 Ntb	 Nbtm

Table 3: Mean values of inter-annotator reliability for each tier

Tier	Inter-annotator agreement (%)
CLP handshape	94.4
CLP congruence	73.3
CLP event	94.4
CLP manner	63.3
CLP controlled	88.8
CLP discourse status	84.4
CLP movement	70
CLP direction	80
CLP interaction	84.4
CLP second hand	85.5
Total	**81.85**

values and a list of predicates encoding manner, path and both manner and path. Crucially, it was agreed that i) manner does not include path modulations (e.g. zigzag), which should be annotated in the 'CLP movement' tier only, ii) manner is marked if there is an internal movement of the fingers or the hand is bouncing (in addition to the movement showing the trajectory), and iii) classifiers produced with fast movements mark manner. To give an example, 'falling' and 'climbing' were not considered to express manner if there was no overt encoding of the movement by moving the fingers. In addition, the LSC team agreed not to consider the non-manual markers that co-occurred with classifier predicates to provide information about manner, such as the speed of the event. Finally, for the tier 'CLP congruence,' it was decided that classifier predicates corresponded to the value congruent when they were produced with a neutral movement that does not specify the direction of the referent, as in the verb GO. On the other hand, it was agreed that the value depictive corresponded to classifiers with internal movement of the fingers and a complex trajectory, as in those encoding 'animal climbing while waving its legs.'

This information was used to revise the files that were used to calculate the agreement between annotators, as well as to complete the annotation of the remaining dataset. Subsequently, reviewer 1 and reviewer 2 revised all the data in accordance with the updated guidelines.

3 Analysis and results

All analyses were conducted with the statistical software R (R Core Team 2021), performed using the glmer function (family = 'binomial') of the lme4 package (Bates et al. 2015). The statistical analysis of the data was conducted for most of the factors listed in Section 2.2.1, including discourse status, congruence, interaction, manner, and controlled. Three factors, namely, movement, direction, and meaning, were not used in the analysis because they lacked a restricted set of values (no controlled vocabulary was used, hence there was a high level of variation in the annotation values). Moreover, the scene factor was not included because of the difficulty in identifying the different scenes in the signed text. Since there was almost no instances of locative uses of classifier predicates, mouthings, and use of the non-dominant hand, we did not include event, mouthing, or second hand as factors. The data analyzed with the statistical software R were directly converted into cvs files from ELAN using the *signglossR* (Börstell 2022) package in R.

We first looked at the factors that influence the choice between the 1- and the 2-handshape. Then, we investigated the factors that could affect the choice between the 2- and the 2b-handshape (with bent fingers), as well as between the 2- and the 2m-handshape (with moving fingers). In addition, we assessed the potential influence of participants' age and gender in the selection of the classifier handshape. It is worth noting that only anthropomorphic referents have been annotated and that the episodes that are being retold in the LSC Reference Corpus predominantly involve actions such as 'walk,' 'climb,' 'be thrown,' and 'descend/go

down.' All the data annotated as 1- and 2-handshapes and their corresponding variants were included in the analysis.

The data that support the findings of this study and the R script are openly available in OSF at http://doi.org/10.17605/OSF.IO/FHTC9.

3.1 The 1-handshape vs the 2-handshape

Across the dataset, we annotated a total of 377 instances of classifiers, 52 of which were produced with the 1-handshape (13.8%) and 325 with the 2-handshape (86.2%). It is then possible to observe that our data are skewed, with the 2-handshape being used much more frequently than the 1-handshape. This aspect will be relevant in the discussion of the data.

In the generalized linear mixed model analysis, we included handshape (1-handshape and 2-handshape) and one factor in each model as independent variable (discourse status, congruence, interaction, manner, controlled). Participants were inserted as random variables. The factors that resulted significant for the choice between the 1- and the 2-handshape were manner, discourse status, and controlled. However, when considering the total number of instances, some linguistic specificities are interesting to note. Therefore, for each of these three factors, we report here both the absolute number of occurrences and the percentage they represent for the values that were included in the analysis.

In the glmer model with manner as independent variable, path and both (path and manner) were the only two values considered because almost no instance of classifier predicates expressing only manner was present. We found a strong significant difference in the use of the 1- and the 2-handshape in classifier predicates expressing both path and manner and those expressing only path (β = −1.7890, SE = 0.5632, z = −3.177, p = 0.001). Specifically, the 2-handshape was found to be proportionally used more often in classifier predicates expressing both path and manner (33.2%) in comparison to the 1-handshape, which was very rarely used in this context. The 1-handshape was proportionally used more often when only path was conveyed (92.7%). Figure 4 presents a summary of the data considering the semantic encoding of path-only and both path and manner (i.e. the few instances annotated as 'manner' and 'unclear' are not reported here).

Despite the significant effect found in the glmer model, it is important to also consider the absolute number of occurrences with respect to this factor. Although the 1-handshape is used proportionally more often than the 2-handshape to express path, the 2-handshape is also commonly employed to encode path-only (Table 4).

With respect to discourse status, in the glmer model, we considered only maintained and reintroduced as values because there were almost no instances for introduced, intro-nominal, maintained-nominal, and reintro-nominal. We found a significant difference between the values maintained and reintroduced for the choice between the two handshapes (β = −0.98, SE = 0.43, z = −2.27, p = 0.023). The 2-handshape was found to be used proportionally more often for maintained referents (88.8%) than the 1-handshape (75.6%), while the

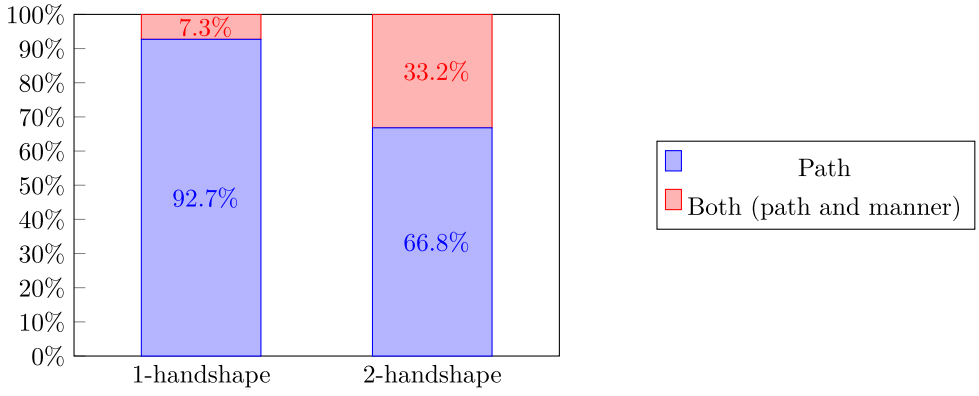


Figure 4: Proportion of the use of the 1- and the 2-handshape to express path and both (path and manner).

Table 4: Absolute number of occurrences of the 1- and the 2-handshape to express path and both (path and manner)

	Path	Both (path and manner)
1-handshape	38	3
2-handshape	173	86

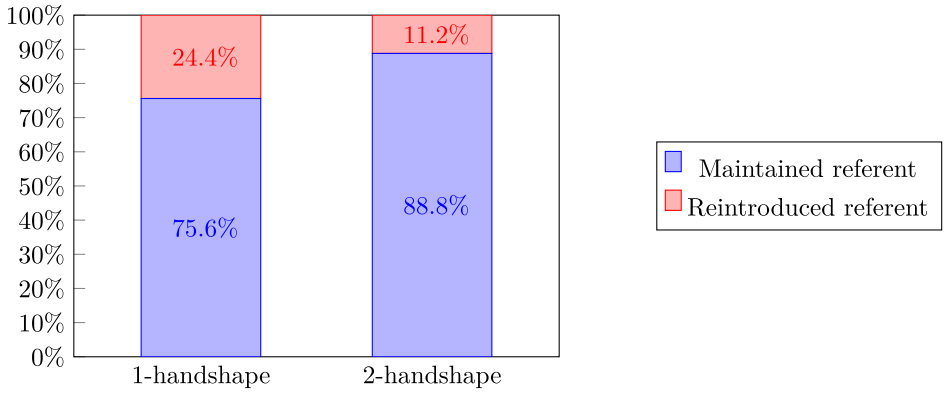


Figure 5: Proportion of the use of the 1- and the 2-handshape to refer to maintained and reintroduced referents.

1-handshape was used proportionally more often with reintroduced ones (24.4%) than the 2-handshape (11.2%). Figure 5 presents a summary of the values just reported.

As it will be discussed in Section 4, it is also relevant to consider the absolute number of instances of the 1- and the 2-handshape when they are used to refer to maintained and reintroduced referents (Table 5).

The third factor that significantly affects the choice between the 1- and the 2-handshape is whether the action expressed by the classifier predicate is controlled or uncontrolled by the moving referent. The glmer model showed a strong effect in the use of the 1-handshape to express an action controlled by the moving referent (β = 1.3281, SE = 0.5081, z = 2.614, p = 0.0089) instead of the 2-handshape. The 1-handshape was proportionally used more often to express actions such as 'walk,' 'climb up/down' and 'descend/go down (walking),' with a 90.2% occurrence. Uncontrolled actions referred to verbs translated as 'be thrown out' and 'fall down the pipe'. Figure 6 presents the proportion of the use of the 1- and the 2-handshape to express controlled and uncontrolled actions.

Despite the fact that there is a statistical significant effect for the choice of the 1-handshape when a controlled action is expressed, it is interesting to also look at the absolute number of occurrences of both the 1- and the 2-handshape. As shown in Table 6, there is a high number of instances of the use of the 2-handshape with controlled actions, even though proportionally this is not significant.

We also ran a glmer model where we looked at these three factors together. We did not find any effect of interaction, but we did have an additive effect. There is a strong additive effect that confirms that the three factors are independently important in influencing the choice between the 1- and the 2-handshape (manner: β = 2.0687, SE = 0.6469, z = 3.198, p = 0.00138; discourse status: β = 1.1776, SE = 0.4965, z = 2.372, p = 0.01769; controlled: β = −1.8364, SE = 0.5834, z = −3.148, p = 0.00165).

Table 5: Absolute number of instances of the 1- and the 2-handshape to refer to maintained and reintroduced referents

	Maintained referent	Reintroduced referent
1-handshape	31	10
2-handshape	230	29

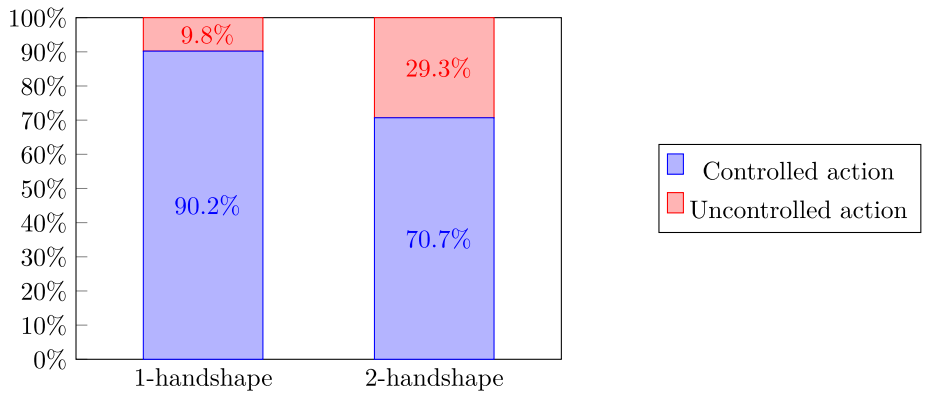


Figure 6: Proportion of the use of the 1-handshape and the 2-handshape to express controlled and uncontrolled actions.

Table 6: Absolute number of occurrences of the 1- and the 2-handshape to express controlled and uncontrolled actions

	Controlled action	Uncontrolled action
1-handshape	37	4
2-handshape	183	76

All in all, for LSC, we found that the choice between the 1- and the 2-handshape is influenced by whether manner or path was expressed, what the discourse status of the referent represented was, and if the action represented by the classifier predicate was controlled or not. These observations were further confirmed by the additive effect found in the glmer model where these three factors were taken into account together, showing that all of them are independently important and contribute to the choice between the 1- and the 2-handshape. We did not find any significant difference due to the gender or the age of the signer.

3.2 Variants of the 2-handshape

When conducting the statistical analysis for the comparisons of different factors between classifier predicates with the 2-handshape vs with the 2b- or the 2m-handshape, different variations in the phonetic configuration of the fingers were included in the 2-handshape. In the analysis of the 2- vs the 2m-handshape, the following variations were included for the 2-handshape: 2 (extended fingers), 2m (moving fingers), 2t (thumb opposed), Nm (non-spread moving fingers), N (non-spread fingers). As for the 2b-handshape, the following variations were considered: 2b (bent fingers), 2bm (bent moving fingers), 2bt (bent fingers with thumb opposed), 2btm (bent moving fingers with thumb opposed), Nb (non-spread bent fingers), Nbm (non-spread bent moving fingers), Nbt (non-spread bent fingers with thumb opposed). In the comparison of the 2- vs 2m-handshape, the following variations were considered for the 2-handshape: 2b (bent fingers), 2t (thumb opposed), Nm (non-spread moving fingers), and N (non-spread fingers); and the 2m-handshape was analyzed including the following variations: 2m (moving fingers), 2bm (bent moving fingers), 2btm (bent moving fingers with thumb opposed), Nbm (non-spread bent moving fingers), and Nm (non-spread moving fingers). These distinctions are summarized in Table 7.

To look at the factors that influence the choice between the 2- and the 2b-handshape, we included age and gender as independent variables in the glmer model analysis (one at a time). No other factors were analyzed. To look at the factors that influence the choice between the 2- and the 2m-handshape, we included manner, controlled, discourse status, age, and gender as independent variables in the glmer model analysis (one at a time). Participants were inserted as random variables.

Table 7: Grouping of handshapes for the comparisons of different factors between classifier predicates with the 2-handshape vs with the 2b- or the 2m-handshape

	2-handshape	2b-handshape	2m-handshape
2 vs 2b	2m, 2t, Nm, N	2bm, 2bt, 2btm, Nb, Nbm, Nbt	—
2 vs 2m	2b, 2bt, 2t, Nb, Nbt, N	—	2m, 2bm, 2btm, Nbm, Nm

When considering age as a factor for the use of the 2- and the 2b-handshape, no significant effect was found. Similarly, age had no significant effect on the choice between the 2- and the 2m-handshape.

Looking at gender as a factor, there was an effect in both the glmer models to analyze the choice between the 2- and the 2b-handshape and between the 2- and the 2m-handshape (respectively β = −1.0146, SE = 0.4036, z = −2.514, p = 0.0119, and β = 0.9804, SE = 0.4379, z = 2.239, p = 0.0252). Concerning the 2- and 2b-handshape, these results show that the 2-handshape is proportionally used more often by men (69%) than women, who instead use the 2b-handshape (54%) more often than men. As for the 2- and the 2m-handshape, women proportionally use more often the 2-handshape (55%) than men, who prefer the 2m-handshape (64%).

Focusing specifically on the factors that influenced the choice between the 2- and the 2m-handshape, we observed a strong statistical effect of manner. The 2m-handshape is proportionally more frequently used to express the combination of path and manner than the 2-handshape (β = 3.8667, SE = 0.4466, z = 8.657, p = <0.001). The 2m-handshape is used 83.5% of the times to express both path and manner, while the 2-handshape is used almost 89% of the times to express path-only. Figure 7 presents these data considering the values path and both, which were the only two values included in the dataset.

Regarding discourse as factor, only maintained and reintroduced were considered as values. We found no significant statistical effect (β = 1.1003, SE = 0.5793, z = 1.899, p = 0.0575), but there is a tendency showing that the 2-handshape seems to appear more often than the 2m-handshape to express actions referring to a reintroduced referent (14%), while both the 2- and the 2m-handshape occur often with maintained referents (86 and 95%, respectively). See Figure 8 for a visualization of the data. In this dataset, only instances of maintained and reintroduced for the 2- and the 2m-handshape were present.

Considering controlled as a factor, a very strong significant effect was found indicating that the 2-handshape is proportionally used more often to express uncontrolled actions (40% of the times) than the 2m-handshape, which is almost never used in this context (β = 2.5867, SE = 0.5305, z = 4.876, p = <0.001). On the other hand, the 2m-handshape is used 94% of the times in contrast to the 2-handshape (60%) to express a controlled action (Figure 9).

No interaction was found in the glmer model that took into account the factors that were individually significant for the choice between the 2- and the 2m-handshape.

All in all, we found that the contrast between the 2-handshape variants involving (non-)moving fingers is determined by whether path and manner or path only are encoded and by whether the action represented by

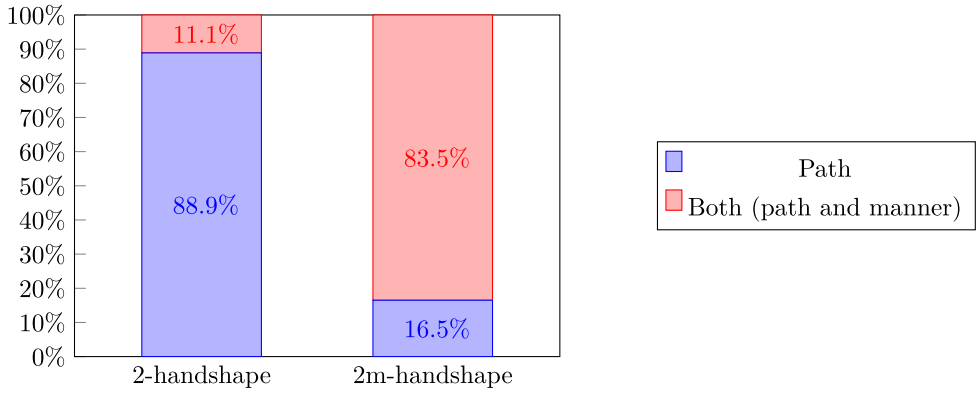


Figure 7: Proportion of the use of the 2- and the 2m-handshape to express path and both (path and manner).

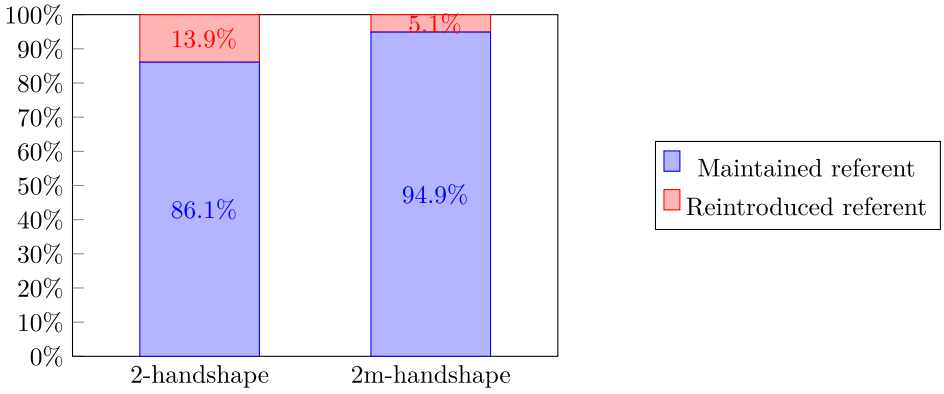


Figure 8: Proportion of the use of the 2- and the 2m-handshape to refer to maintained and reintroduced referents.

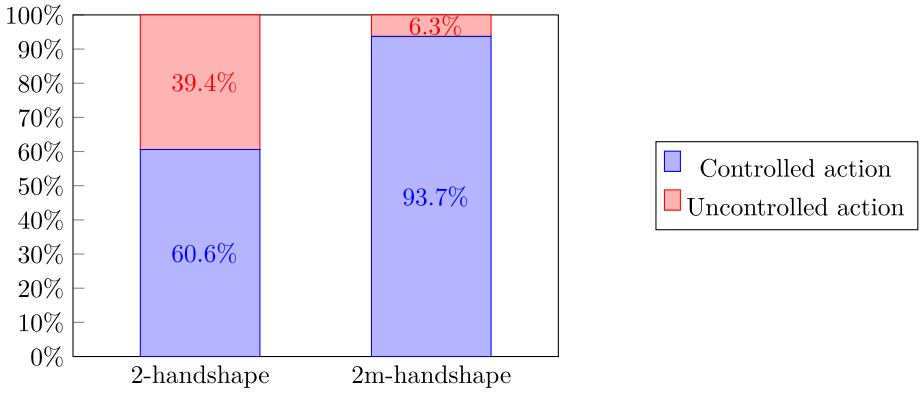


Figure 9: Proportion of the use of the 2- and the 2m-handshape to refer to controlled and uncontrolled actions.

the classifier predicate is controlled. Unlike the case of the 1- and the 2-handshape, the discourse status of the referent has no significant effect. The signer's gender has an effect on the choice between handshape with or without bending fingers and with or without moving fingers. Finally, we found no significant effect of the signer's age with respect to the choice between configurations involving either (non-)moving or (non-)bent fingers.

3.3 Summary

The interactions observed between classifier handshapes and the factors manner of motion, discourse status of the referent, (un)controlled actions, and signer's gender are summarized in Table 8.

4 Discussion

The factors that significantly affect the choice of the 1- and 2-handshape to refer to anthropomorphic entities in LSC are the expression of manner of motion, discourse status, and whether the action is controlled. We discuss these factors and the way they affect handshape choice in LSC. We first discuss the correlation between the three factors and the choice between the 1- and the 2-handshape, and afterwards the correlation between the factors and variants of the 2-handshape.

Table 8: Summary of factors that affect the choice of classifier handshape in the LSC data analyzed, where '–' indicates that the interaction was not analyzed and 'NI' indicates that no interaction was found

Handshape	1 vs 2	2 vs 2b	2 vs 2m
Manner	1 used more for path-only; 2 used more for both path and manner	—	2m used more for both path and manner; 2 used more for path-only
Discourse	1 used more for reintroduced referents; 2 used more for maintained referents	—	Tendency for to 2 to occur more than 2m with reintroduced referents
(Un)controlled	1 used more for controlled actions; 2 used more for uncontrolled ones	—	2m strongly associated with controlled actions
Additive model	1 used more for path-only, with reintroduced referents and controlled actions; 2 used more for path and manner, with maintained referents and uncontrolled actions	—	—
Gender	NI	Women use bent fingers (2b) more often than men	Men use moving fingers (2m) more often than women

4.1 The 1-handshape vs the 2-handshape

4.1.1 Expression of motion events

One of the factors that most significantly affects the choice between the 1- and the 2-handshape in LSC classifier predicates is whether the event encodes manner of motion. Our results indicate that, when only path is expressed, both the 1- and the 2-handshape are possible. The 1-handshape is used proportionally more often to express path than the 2-handshape, but the 2-handshape is also very common to encode path only. Since our dataset contains more occurrences of the 2-handshape than the 1-handshape, in absolute numbers, the 2-handshape is used more frequently to express path-only than the 1-handshape (see Table 4 in Section 3.1). On the other hand, the 1-handshape is very rarely used to convey manner, either manner-only or in combination with path. By contrast, the 2-handshape may encode path-only, or it may additionally specify manner. Therefore, if the motion event encodes manner or both path and manner, the configuration selected is almost invariably the 2-handshape.

Our results are consistent with findings from Russian Sign Language and Sign Language of the Netherlands, for which Kimmelman and Evgeniia (2025) found that the expression of path and manner is strongly associated with the 2-handshape. This pattern is not unexpected since the two selected fingers of the 2-handshape may move independently, allowing the signers to providee more details about the manner of the motion event. As noted by Loos et al. (2022), classifier predicates that use the 2-handshape in American Sign Language encode manner by moving the fingers and path by displacing the hand through space, which is the same pattern we observed in our data. However, in LSC at least, the choice of the 2-handshape does not appear to be motivated by phonological restrictions associated with the 1-handshape to encode manner. In fact, although extremely uncommon, we find examples where the 1m-handshape is used to express both path and manner of motion. Figure 10 shows an instance of a classifier predicate encoding the meaning '(cat) crawling inside the pipe'.[4]

Spoken languages have been argued to lexicalize path and manner of motion differently (Talmy 1985, Talmy 1991). For example, Romance languages are typically characterized as verb framed, as they lexicalize path on the main verb and manner in subordinate verbs or adverbials, whereas Germanic languages are

4 Given the movement of the bent selected finger, this instance was not ambiguous with being interpreted as expressing the trajectory of the movement (see Section 2.2.2 for details on the annotation of the data).

Figure 10: 1m-handshape ('crawling up the pipe').

characterized as satellite-framed, as they encode manner on the verb and express path in non-verbal elements (but see the study by Beavers et al. (2010) for an alternative analysis).[5] Figure-type languages constitute an additional distinction within the satellite-framed category, whereby the verb indicates the type of object that moves (i.e. the figure) and path is encoded by elements associated with it (Talmy 1985). Tang (2003), on the basis of Hong Kong Sign Language data, argues that sign languages can be said to be figure-type because in classifier predicates, they morphologically conflate the motion (in the form of MOVE or BE) and figure of the event.

Our data seem to suggest that manner of motion is a semantic specification that adds on top of path. However, for a better understanding of our results, it should be acknowledged that the episodes retold by the signers contain motion events in which path is inherently present ('descend stairs,' 'walk,' 'climb up,' and so on), as the main focus of the story is on the physical displacement of the referents in space. This observation alone may explain why, in our dataset, manner is almost never the only specification of the classifier predicate. However, this does not explain why, although LSC classifier predicates are able to conflate path and manner and most scenes in the data also describe the manner of motion, signers often choose to leave manner unexpressed. Since classifier predicates can provide detailed information about the location, motion, and shape of the referents, they are characterized as highly iconic elements (Quer et al. 2005). As noted earlier in this section, classifiers articulated with either the 1- or the 2-handshape do not appear to be subject to specific articulatory restrictions when encoding both the path and manner components of the event. Still, our data do show a clear preference for disregarding manner information in the classifier predicate, and this preference is irrespective of the age and gender of the signer. This suggests that even when the language allows for the iconic representation of visual information, signers may choose not to encode certain aspects of the event in the classifier predicate. Our results are in line with findings from sign languages like Turkish, German, American, Croatian, and Austrian Sign Language. It has been observed that signers of these languages do not necessarily exploit iconicity, and they may express location and motion without resource to the iconic elements that modality affords, such as classifier predicates (Perniss et al. 2011, Arik 2015). It has also been observed that, while there is a crosslinguistic preference to encode path over manner, there is variation in the coding of event information, with some languages showing a wider use of path and manner combinations than others (Arik 2010).

The simultaneous encoding of path and manner in classifier predicates has been described for several sign languages (see, for example, Supalla (1990) for American Sign Language; and Stoianov et al. (2022) for Cena and Brazilian Sign Language). Because Talmy (1985)'s typology cannot account for languages that conflate path and manner, this classification has been extended with a third category, equipollently framed languages, in which path and manner are encoded by equivalent grammatical forms (Slobin and Hoiting 1994, Slobin 2004, 2006. This category is sometimes referred to as 'complex verb-framed' and includes languages with serial verb constructions and bipartite verbs, which are verbs containing two morphemes of equal status, one expressing manner and the other path. Several sign languages have been analyzed as belonging to the complex verb-framed category (Slobin and Hoiting 1994, Tai and Su 2013) because i) they encode path obligatorily on the main verb, and ii) they can

5 For example, Spanish encodes path in the main verb and manner in subordinate elements, as in: *entrar corriendo*, where *entrar* ('come in') encodes path and *corriendo* (lit. 'running') expresses manner of motion. On the other hand, English encodes manner in the verb and path in a non-verbal complement, as in: *rush in*, where *rush* expresses manner and *in* path.

Figure 11: Simultaneous expression of manner and path ('climb up the pipe').

Figure 12: Sequential expression of manner and path ('climb up the pipe').

optionally express manner with another verb or conflate manner with the path verb. LSC has also been shown to resort to this kind of strategy in motion serial verb constructions (Benedicto et al. 2008).[6] To check if the same patterns were employed in our dataset, we examined the expression of the event 'the cat climbed up the pipe' taking into account the signs that preceded and followed the classifier predicate. For this event, we indeed observed the two patterns, namely, that classifier predicates can express path and manner simultaneously and that manner may be encoded using a different verb. For example, in Figure 11, the signer expresses the event 'the cat climbed up the pipe' by using a classifier which encodes the figure ('the cat') and conflates path and manner. In turn, the non-dominant hand expresses the ground. However, this alternative was rare, and most signers chose to express the same event with a series of two or more sequential elements, one of which encoded manner and the other either path and manner or path-only (Figure 12). A final group of signers did not encode manner even when using series of predicates, combining classifier predicates articulated with the 1- and the 2-handshape to represent the trajectory of the moving entity only.

What these data show is that the possibility of encoding different components of a motion event simultaneously does not preclude using other mechanisms. While path and manner are not always conflated in LSC, the manner component may still be represented in a sequential form. If the two semantic specifications are presented simultaneously, the 2-handshape is used. If presented sequentially, both handshapes are possible, as they both may be used to convey the path of motion.

4.1.2 Discourse status of the referents

In addition to the effect of manner of motion in the choice of the classifier handshape, we further found an effect of the discourse status of the referent, with the 2-handshape being used more frequently than the 1-handshape to maintain a discourse referent. In what follows we discuss this pattern.

6 As noted earlier, other analyses suggest that the simultaneous encoding of handshapes representing referents and path movements puts sign languages in the figure-type category (Aronoff et al. 2003, Tang 2003) and yet others that serial verb constructions of languages such as American Sign Language belong to the manner-type category (Supalla 1982).

Previous research has focused on the anaphoric relation between classifier predicates and the corresponding discourse referent. Studies have argued for several sign languages that classifiers function as agreement markers or proforms for the referent on the verb (Supalla 1982, Glück and Pfau 1998, Benedicto and Brentari 2004, Zwitserlood 2012). More generally, accessibility accounts are based on the idea that referential expressions differ in their potential to establish an anaphoric link. Ariel (1990) and Gundel et al. (1993) defend the proposal that the form of the expression used to create an anaphoric relation is determined by the level of accessibility or activation of a discourse referent at a given point in discourse. Highly accessible referents are retrieved by light expressions with null or very weak descriptive content (like pronouns), while inaccessible or less salient referents are retrieved by heavier expressions (like definite noun phrases). Accessibility accounts have also shown that modality-specific elements found in sign languages, like classifier predicates, occupy a particular position in the hierarchy scale of the accessibility structure (see Swabey (2002), Frederiksen and Mayberry (2016) for American Sign Language; Kibrik and Prozorova (2007) for Russian Sign Language; and Simoens and Barberà (2021) for LSC).

More specifically, Barberà and Quer (2018) proposed that whole entity and body part classifiers are proforms that involve two dynamic operations. On the one hand, when a classifier predicate is used, the interpretation of the referent is dependent on a previously established discourse referent, as in the case of pronouns. In this operation, classifier handshapes function as semantic variables. On the other hand, the classifier predicate as a whole has a context change potential (Heim 1982) since it includes descriptive content as part of a full predication. The descriptive content is in charge of updating the discourse context. In the discussion presented here, our focus is on the second operation.

Returning to our results, we observed that the 2-handshape is more frequently used to refer to a referent that has been already introduced and needs to be maintained. While this may appear to contradict the accessibility hierarchy, which proposes that salient referents are expressed with less marked referring expressions (e.g. the 2-handshape is more marked than the 1-handshape), we propose to analyze this distinction not in terms of accessibility but rather according to morphological and information structural motivations. Specifically, the 2-handshape is more often found in maintained contexts because newer and detailed information is expected to appear depicting the actions that are being performed by the maintained referent. Classifier handshapes are not only variables that introduce and refer back to a discourse referent (first dynamic operation), but they also add descriptive content to it (second dynamic operation) (Barberà and Quer 2018). The context change potential is only possible when considering the whole classifier predicate (i.e. the handshape and the predicate together). The 2-handshape, which is morphologically more complex than the 1-handshape, is needed to contribute more information to the context and adds new meaning. The context change potential is possible due to the handshape complexity and richness, which adds new and focal information to the discourse. Therefore, the 2-handshape contributes to the event interpretation. This morphological complexity required for discourse operations aligns with the result discussed in the previous section, according to which the 2-handshape is used to encode the components path and manner of a motion event.

The sequence of stills in Figures 13–15 shows an example of the dynamics of a discourse fragment. The discourse referent is first introduced by the nominal CAT (Figure 13). Right after, the referent is retrieved by the 1-handshape to express that the cat is going down the pipe, therefore conveying a path meaning (Figure 14). After a sequence of several clauses, the same referent is reintroduced by the nominal CAT, and immediately after, it is retrieved by the 2-handshape to express that the cat rolls down the street, thus expressing both the path and the manner of the motion event (Figure 15). This sequence of examples shows that while the anaphoric relation between the discourse referent 'cat' and the classifier is achieved by means of the 1-handshape, the new descriptive content is provided by the 2-handshape and the movement. The context is updated with the new information 'rolling down,' which adds the meaning of path and manner of motion to the particular discourse.

4.1.3 Expression of (un)controlled actions

An additional factor that proved relevant for the choice between the 1- and the 2-handshape was whether the classifier predicate was expressing a controlled or an uncontrolled action. Statistically, the 1-handshape

Figure 13: Nominal CAT.

Figure 14: 1-handshape ('going down the pipe').

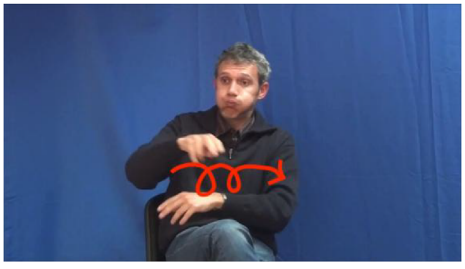


Figure 15: 2-handshape ('rolling down the street').

resulted in being used significantly more often to express a controlled action than the 2-handshape. On the other hand, the 2-handshape was chosen more often to express actions that were uncontrolled by the moving entity. For Russian Sign Language, instead, Khristoforova (2018) found that the handshape choice of a classifier predicates does not depend on the action being controlled or uncontrolled. Importantly, though, the skewed distribution of the LSC data and its limitations need to be acknowledged. Most actions produced in the data were controlled, such as 'walk,' 'go down the stairs/building,' or 'climb up/down'. Only two actions were uncontrolled, and they were translated as 'fall' and 'be thrown out'. Moreover, as reported in Table 6, there were only four instances of classifier predicates produced with the 1-handshape expressing uncontrolled actions. The absolute numbers presented in Table 6 also show that the 2-handshape was generally used more than the 1-handshape to express controlled actions, although it could also be used to express uncontrolled ones.

It is important to remark that, among the four instances of the 1-handshape used to express verbs such as 'fall,' some might express the trajectory of the movement rather than the referent moving. As presented in Section 2.2.2, we did take into account this aspect, but there were instances where the trajectory of the movement and the referent moving could have been expressed in the same way. Figure 16 is an example of such cases, but here the gesture expressed by the mouth and the cheeks might indicate the aspect of the action 'fall down,' and it was therefore more likely to be interpreted as referring to the referent moving than to

Figure 16: 1-handshape ('fall down inside the pipe').

the trajectory of the movement itself. Another example of the 1-handshape used to express 'fall down' is presented in Figure 17. In this case, the directionality of the handshape is not initiated with the point of the selected finger, clearly representing a 1-handshape classifier.

In the literature, only a few sign language studies have investigated the relation between the form of the predicate and the expression of controlled vs uncontrolled actions, and they linked it to the argumental structures of classifier predicates and the semantic roles of their arguments. In general terms, controlling an action can be associated with agentivity and, therefore, with the argument structure of the predicate. Schlesinger (1992), in fact, remarks that typical agentive properties are control and intention. In relation to the study of classifier predicates in signed languages, the focus has been on determining what type of classifier handshape is used to express intransitive unaccusative and unergative verbs, and transitive verbs. Intransitive verbs only have one argument, the subject. In intransitive unaccusative verbs, such as 'fall,' the subject is a theme, and it refers to a referent producing an uncontrolled action. In intransitive unergative verbs, such as 'walk' or 'climb up,' instead, the subject has the semantic role of an agent, which is expressing a controlled action. Transitive verbs, instead, take two arguments, a subject and a direct object. Given that in our LSC data there are only intransitive unaccusative and unergative verbs used with the 1- and the 2-handshape to express (un)controlled actions, we will restrict our observations to unaccusative and unergative verbs.

For American Sign Language, it has been shown that whole entity classifiers can be found only with intransitive unaccusative verbs, while body part classifier constructions can only enter intransitive unergative structures (Benedicto and Brentari 2004). Kimmelman et al. (2019, 2020) confirm the same observations for unaccusative verbs in Sign Language of the Netherlands, German Sign Language, Russian Sign Language, and Kata Kolok. However, they also found many instances of whole entity classifier predicates used unergatively.[7] For LSC and Argentinean Sign Language, Benedicto et al. (2007) found confirmation that predicates with a whole entity classifier are intransitive unaccusative and handling classifiers are transitive, while body part classifiers show a less consistent pattern (for a reanalysis of body part classifiers in American Sign Language as transitives, see Grose et al. (2007)).

For the LSC data in this study, we assume that the 1- and the 2-handshape and their variants are instances of whole entity classifiers (see Section 4.2.3 for a discussion about the observations on the 2m-handshape). Thus, in our LSC data, it is possible to observe that both intransitive unaccusative and unergative verbs can be expressed using a whole entity classifier, partially in contrast with what has been claimed by Benedicto and Brentari (2004) for American Sign Language and with Benedicto et al. (2007) for LSC, and in line with Kimmelman et al. (2019) for several signed languages.[8] Due to the very few instances of the 1-handshape with unaccusative verbs, no claim can be made with respect to the choice of the 1- or the 2-handshape with these verbs. For unergative verbs, instead, both the 1- and the 2-handshape can be used, with a preference for the 2-handshape. Crosslinguistically, uncontrolled actions are typically expressed by unaccusative verbs, while controlled actions are expressed by unergative verbs. In our LSC data, though, both controlled and

7 In their data, both the 1-handshape and the 2b-handshape were considered whole entity classifiers.

8 Note that Benedicto et al. (2007) also need to qualify the validity of tests to identify a construction as unaccusative or unergative. For instance, they point to the fact that the WILLINGLY test might be detecting animacy rather than agentivity in LSC.

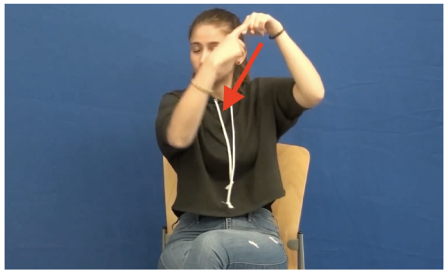


Figure 17: 1-handshape ('fall down inside the pipe').

uncontrolled actions can be expressed using a whole entity classifier. Regarding the choice of the classifier handshape, both the 1- and the 2-handshape can be used to express controlled actions, with a preference for the 2-handshape.

4.2 Variants of the 2-handshape

4.2.1 Expression of motion events

As in the case of the choice between the 1- and the 2-handshape, we found a strong effect of manner of motion for the choice between the 2- and the 2m-handshape, with the 2m-handshape being used more often to express path and manner than the 2-handshape and the 2-handshape being used more often to express path. This suggests that, in LSC, the claim made in Section 4.1.1 according to which the 2-handshape is compatible with the expression of both path and manner and path-only needs to be redefined. In our dataset, the 2-handshape is predominantly associated with the encoding of path-only, while the 2m-handshape is associated with the expression of both path and manner. This effect may partly result from our annotation criteria and partly from a language-specific preference for the expression of manner. As noted in Section 2.2.3, the annotation guidelines of this project indicated that a classifier predicate encoded manner if it was produced with internal movement of the fingers, if the hand was bouncing or if the classifier was produced with a fast movement. Because classifier predicates that did not meet these criteria were not considered to encode manner, the strong significant effect found for the 2m-handshape in expressing both path and manner is to be expected. Nevertheless, these results also show a general preference in LSC for expressing manner of motion through internal movement of the fingers, rather than by bouncing the hand or by faster movements. In fact, while bouncing and other complex movements are also employed to encode manner, finger movement remains the preferred strategy across all signers.

4.2.2 Discourse status of the referents

Regarding discourse status as factor, a tendency is found with the 2-handshape and the 2m-handshape showing similar results with maintained discourse referents. This supports the hypothesis presented in Section 4.1.2 that classifier handshapes are not only variables that introduce and refer back to a discourse referent, but they also add descriptive content to it (Barberà and Quer 2018). Classifier predicates are complex and morphologically rich elements that contribute to updating the discourse context via new information. The context change potential is possible due to the handshape complexity and richness, by adding new and focal information to the discourse. The 2- and 2m-handshapes therefore contribute to the event description, and they are morphologically very complex. For the case of the 2m-handshape, the internal movement of the fingers expresses manner, which may be combined at the same time with a path forward movement (Figure 18) and a downward movement (Figure 19).

Figure 18: 2m-handshape moving forward.

Figure 19: 2m-handshape moving downward.

4.2.3 Expression of (un)controlled actions

As for the choice between the 2- and 2m-handshape for (un)controlled actions, the 2-handshape was found to be used significantly more often with uncontrolled actions than the 2m-handshape. The 2m-handshape was almost never selected to express uncontrolled actions. This strong effect is influenced by the distribution of the data, in which there were few instances of uncontrolled verbs compared to the amount of controlled ones. Nevertheless, it is important to acknowledge the extensive use of the 2m-handshape with controlled actions (94%) in contrast to the 2-handshape (60%). In the literature, the 2m-handshape has been analyzed as a body part classifier by Benedicto and Brentari (2004) in American Sign Language,[9] while Kimmelman et al. (2020) consider it a complex event with two subevents: the movement of the body of the referent and the movement of their legs. While the movement of the body can be uncontrolled, the movement of the legs must be controlled by the referent moving. We will not discuss the nature of the 2m-handshape classifier in LSC, but it is important to observe that the 2m-handshape is preferred for the expression of controlled actions where both the movement of the body and of the legs are controlled. The 2-handshape classifier can also be used with controlled actions, but it does not give any information about the movement of the legs. Building on the considerations made for (un)controlled actions in Section 4.1.3, we can conclude that unergative verbs in LSC can be expressed with both the 2- and the 2m-handshape. However, the 2m-handshape is preferred over the 2-handshape. This observation is also in line with what has been suggested for the expression of manner in our LSC data (Section 4.2.1), where the 2m-handshape is used more often to express both path and manner. The 2m-handshape, in fact, allows to express the movement of the body without necessarily encoding path, while manner can be expressed through internal movement of the fingers expressing the controlled movement of the legs.

9 As opposed to the 2-handshape, taken to be a whole entity classifier.

4.2.4 Signer's age and gender

We expected age to be a relevant factor in the choice between the 2- and the 2b-handshape. For spoken languages, it has been shown that age can influence language production, affecting the coordination of sensory, motor, and cognitive processes. Effects of aging on speech production include decreased speaking rates (Duchin and Mysak 1987), changes in voice fundamental frequency (Gorham-Rowan and Laures-Gore 2006), and lower speech accuracy (Bilodeau-Mercure et al. 2015). We expected older signers to show a motor decline and, therefore, a tendency to adapt the production of the classifier predicate to their motor capacities. Thus, we expected older signers to produce more bent fingers (2b-handshape) than the younger ones. However, this expectation was not met, given that all groups of signers used the 2b-handshape more often than the non-bent one, and in similar proportions. Therefore, bending fingers might be a feature of the predicates in the sample rather than phonetic variation related to age, as we initially expected. Indeed, events like 'descend the stairs,' 'walk,' 'climb,' or 'fly/run in circles,' were almost invariably expressed with a bent articulation. Similarly, most signers expressed motion events such as 'be thrown out'/'fall' and locative events such as 'stand' with non-bent fingers.

We did find, however, that the choice between the 2- and the 2b-/2m-handshapes was influenced by gender, with women using proportionally more often the 2b-handshape than men, and men using proportionally more often the 2m-handshape than women. As noted in Section 4.2.1, manner was sometimes encoded by bouncing the hand or by using other complex movements, rather than through internal movement of the fingers. Importantly, the proportion of bouncing movements used to encode manner of motion is similar across groups, suggesting that the lower use of moving fingers among women is not due to a preference for alternative strategies across groups. In light of these results, we checked the proportion of encoding of manner information across groups. We found that the apparent effect of gender on the choice between moving and non-moving fingers seems to be influenced by men encoding path and manner more frequently than women (about 66% of all the classifier predicates expressing both path and manner were produced by men). Therefore, we conclude that this effect is derived from differences in the information male and female signers in this dataset choose to present. Further research is needed to confirm if this tendency appears in other datasets as well.

5 Conclusions

The present study has used corpus data to investigate the choice between the 1- and the 2-handshape in classifier predicates referring to anthropomorphic referents in the retelling of three episodes of a Canary Row video. This is the first study addressing the factors that influence the choice of classifier handshapes in LSC.

All in all, our results indicate that the factors that significantly affect the selection of classifier handshape in this dataset are the expression of manner, the discourse status of the referent and the controlled vs uncontrolled nature of the action. Furthermore, our study shows that handshapes that are articulatory more complex (e.g. the 2-handshape with respect to the 1-handshape, and the 2m-handshape with respect to the 2-handshape) are used in LSC to convey more detailed information about the events and the discourse referents represented. This explains the use of more complex handshapes when manner of motion is expressed, when newer information about the discourse referents is added to the discourse and when controlled actions expressing the controlled movement of the body and of the legs are conveyed. Moreover, our data show that unergative verbs (controlled actions) can be expressed with whole entity classifiers produced either with the 1- or the 2-handshape. Gender plays only a marginal role in the choice of the 2-handshape variants, and age does not play any role.

Future research should assess the robustness of our findings using more diverse datasets. This is especially relevant considering that i) the data used in this research contain a higher number of occurrences of the 2-handshape compared to the 1-handshape, and ii) only a specific discourse genre has been investigated.

Moreover, our results suggest that understanding the choice of classifier handshape in LSC may benefit from considering the surrounding discourse and conducting a qualitative study of the data. Therefore, it may be valuable to explore in more detail larger segments of the discourse, which may include examining how classifier predicates combine with other lexical verbs in serial verb constructions and within broader contexts.

Acknowledgments: We thank the *Institut d'Estudis Catalans* for making the LSC Reference Corpus available for this study. We also thank the reviewers of this article for the valuable feedback.

Funding information: This research has been partially possible thanks to the following financial support. We thank Western Norway University of Applied Sciences for the finantial support in making this publication Open Access. Zorzi acknowledges the support of the Centre for Advanced Study in Oslo, Norway, which funded and hosted Vadim Kimmelman's Young CAS Fellow research project "Whole-Entity Classifiers in Sign Languages: A Multiperspective Approach" during the academic years of 2022–2024; Veiga Busto acknowledges the Netherlands Organization for Scientific Research (NWO, grant number VI.C.201.014); Barberà, who is a Serra Húnter fellow, and Quer acknowledge the grant PID2020-119041GB-I00 funded by MICIU/AEI/10.13039/501100011033; Navarrete-González acknowledges the Spanish Ministry of Science, Innovation and Universities, the European Union "NextGenerationEU/PRTR" and the Spanish State Research Agency for the funding of the Juan de la Cierva fellowship (JDC2022-049289-I), and also the Basque Government through the BERC 2022-2025 program, and the Spanish State Research Agency through BCBL Severo Ochoa excellence accreditation CEX2020-001010/AEI/10.13039/501100011033.

Author contributions: All authors have accepted responsibility for the entire content of this manuscript and approved its submission. All authors contributed to the study conception and design. The data were annotated by GZ and RVB, and the annotations were reviewed by GB and ANG. Data analysis was performed by GZ. The results were discussed by GZ, RVB, GB, and ANG. The structure and content of the first draft of the manuscript was discussed by all authors. Section 1 was written by JQ, RVB, GB, and GZ. GZ wrote Sections 3, 3.1, 4.1.3 with JQ, and 4.2.3. RVB wrote Sections 2.1, 2.2.1, 2.2.3, 3.3, 4.1.1, 4.2.1, 4.2.4, and 5. GB wrote Sections 4.1.2 and 4.2.2. ANG wrote Sections 2.2.2 and 3.2. All authors approved the final manuscript.

Conflict of interest: Authors state no conflict of interest.

Supplemental data: The data that support the findings of this study are openly available in OSF at http://doi.org/10.17605/OSF.IO/FHTC9.

References

Ariel, Mira. 1990. *Accessing noun-phrase antecedents*, London: Routledge.

Arik, Engin. 2010. "Describing motion events in sign languages." *Poznannn Studies in Contemporary Linguistics* 46 (4): 367–90.

Arik, Engin. 2015. "Expressing manner, location and orientation in manner-only motion events in Turkish Sign Language." *Trames* 19 (3), 205–20.

Aronoff, Mark, Irit Meir, Carol Padden, and Wendy Sandler. 2003. "Classifier constructions and morphology in two sign languages." In *Perspectives on Classifier Constructions in Sign Languages*, edited by Karen Emmorey, 53–84. Mahwah, NJ: Lawrence Erlbaum Associates.

Barberà, Gemma and Josep Quer. 2018. "Nominal referential values of semantic classifiers and role shift in signed narratives." In *Linguistic Foundations of Narration in Spoken and Sign Languages*, edited by Annika Hübl and Markus Steinbach, 251–74. Amsterdam: Benjamins.

Barberá, Gemma, Josep Quer, and Santiago Frigola. 2015. "Primers passos cap a la documentació de discurs signat. El projecte pilot de constituci' del corpus de la llengua de signes catalana [First steps towards the documentation of signed discourse. The pilot project for the creation of the Catalan Sign Language corpus.]." *Treballs de SociolingüÂŋstica Catalana*, 25: 287–302.

Bates, Douglas, Martin Mächler, Ben Bolker, and Steve Walker. 2015. "Fitting Linear Mixed-Effects Models Using lme4." *Journal of Statistical Software* 67 (1): 1–48.

Beavers, John, Beth Levin, and Shiao Wei Tham. 2010. "The typology of motion expressions revisited." *Journal of Linguistics* 46 (2), 331–77.

Benedicto, Elena and Diane Brentari. 2004. "Where did all the arguments go? Argument-changing properties of classifiers in ASL." *Natural Language & Linguistic Theory* 22 (4): 743–810.

Benedicto, Elena, Sandra Cvejanov, and Josep Quer. 2008. "The morphosyntax of verbs of motion in serial constructions: a crosslinguistic study in three signed languages." *Signs of the Time. Selected Papers from TISLR 8*, edited by J. Quer, 111–32. Hamburg: Signum.

Benedicto, Elena, Sandra Cvejanov, and Josep Quer. 2007. "Valency in classifier predicates: A syntactic analysis." *Lingua* 117 (7): 1202–1215.

Bilodeau-Mercure, Mylène, Vanessa Kirouac, Nancy Langlois, Claudie Ouellet, Isabelle Gasse, and Pascale Tremblay. 2015. "Movement sequencing in normal aging: speech, oro-facial, and finger movements." *Age* 37 (4): 9813, doi: 10.1007/s11357-015-9813-x.

Börstell, Carl. 2022. "Introducing the signglossR package." In *Proceedings of the LREC2022 10th Workshop on the Representation and Processing of Sign Languages: Multilingual Sign Language Resources*, edited by Eleni Efthimiou, Stavroula-Evita Fotinea, Thomas Hanke, Julie A. Hochgesang Jette Kristoffersen Johanna Mesch, and Marc Schulder, 16–23, Marseille, France: European Language Resources Association.

Boyes Braem, Penny. 1990. "Acquisition of the handshape in American Sign Language: a preliminary analysis." In *From Gesture to Language in Hearing and Deaf Children*, edited by Virgina Volterra and Carol J. Erting, Eds., 107–27. Berlin: Springer Verlag.

Crasborn, Onno and Han Sloetjes. 2008. "Enhanced ELAN functionality for sign language corpora." In *Proceedings of LREC 2008, Sixth International Conference on Language Resources and Evaluation*, edited by Nicoletta Calzolari, Khalid Choukri, Bemte Maegaard, Joseph Mariani, Jan Odjik, Stelios Piperidis, and Daniel Tapias. 39–43, Paris: European Language Resources Association.

Duchin, Sandra W. and Edward D. Edward. 1987. "Disfluency and rate characteristics of young adult, middle-aged, and older males." *Journal of Communication Disorders* 20: 245–57.

Emmorey, Emmorey, ed. 2003. *Perspectives on Classifier Constructions in Sign Languages*. Mahwah, NJ: Lawrence Erlbaum Associates.

Frederiksen, Anne and Rachel Mayberry. 2016. "Who's on first? Investigating the referential hierarchy in simple native ASL narratives." *Lingua*, 180, 49–68.

Freleng, Friz. 1950. *Canary Row*, New York: Warner Bros. Animated cartoon.

Glück, Susanne and Roland Pfau. 1998. "On classifying classification as a class of inflection in German Sign Language." In *Proceedings of the 6th Annual Conference of the Student Organization of Linguistics in Europe*, edited by Anikó Lipták Tina Cambier-Langeveld and Michael Redford, 59–74, Leiden: SOLE.

Gorham-Rowan, Mary M. and Jacqueline Laures-Gore. 2006. "Acoustic-perceptual correlates of voice quality in elderly men and women." *Journal of Communication Disorders* 39 (3): 171–84.

Grose, Donovan, Ronnie B. Wilbur, and Katharina Schalber. 2007. "Events and telicity in classifier predicates: A reanalysis of body part classifier predicates in asl." *Lingua* 117 (7): 1258–1284, doi: 10.1016/j.lingua.2005.06.014.

Gundel, Jeanette K., Nancy Hedberg, and Ron Zacharski. 1993. "Cognitive status and the form of referring expressions in discourse." *Language*, vol. 69, 274–307.

Heim, Irene. 1982. *The semantics of definite and indefinite noun phrases*. PhD diss., Amherst: University of Massachusetts.

Kimmelman, Vadim, Roland Pfau, and Enoch Aboh. 2020. "Argument structure of classifier predicates in Russian Sign Language." *Natural Language and Linguistic Theory* 38: 539–79.

Klima, E. S. and U. Bellugi. 1979. *The signs of language*. Harvard: Harvard UP.

Kimmelman, Vadim and Khristoforova Evgeniia. 2025. "Classifier handshape choice in Russian Sign Language and Sign Language of the Netherlands." *Open Linguistics* 11 (1): 20250047, doi: 10.1515/opli-2025-0047.

Kibrik, Andrej A. and Evgenija Prozorova 2007. "Referential choice in signed and spoken languages." In *Proceedings of 6th DAARC*, edited by R. Mitkov A. Branco, Tony McEnery and F. Silva, 41–6, Porto: Centro de Linguistica da Universidade do Porto.

Khristoforova, Evgenija. 2018. "Agentivity of semantic classifiers in russian sign language." *Acta Linguistica Petropolitana*. XIV, 468–84.

Kimmelman, Vadim, Vanja de Lint, Connie de Vos, Marloes Oomen, Roland Pfau, Lianne Vink, Enoch Aboh. 2019. "Argument structure of classifier predicates: Canonical and non-canonical mappings in four sign languages." *Open Linguistics* 5 (1): 332–53, doi: 10.1515/opli-2019-0018.

Loos, Cornelia, Austin German, and Richard P. Meier. 2022. "Simultaneous structures in sign languages: Acquisition and emergence." *Frontiers in Psychology*, 13: 992589, doi: https://doi.org/10.3389/fpsyg.2022.992589.

Navarrete-González, Alexandra. 2020. "Phonology: 1. Sublexical structure." In *A Grammar of Catalan Sign Language (LSC)*, edited by Josep Quer and Gemma Barberaa, SIGN-HUB Sign Language Grammar Series, 1 edition.

Perniss, Pamela, Asli Ozyürek, and Inge Zwitserlood. 2011. "Does space structure spatial language? Linguistic encoding of space in sign languages." In *Proceedings of the 33rd Annual Meeting of the Cognitive Science Society*, edited by Laura Carlson, Christoph Hölscher, and Thomas F. Shipley, 1595–600, Austin, TX: Cognitive Science Society.

Quer, Josep, Eva M. Rondoni, Gemma Barberà, Santiago Frigola, Delfina Aliaga, Josep Boronat, Joan M. Gil, Pilar Iglesias, and Marina Martínez. 2005. *GramàÂătica bàsica LSC*, Barcelona: FESOCA, DOMAD.

Sandler, Wendy and Diane Lillo-Martin. 2006. *Sign Language and Linguistic Universals.* Cambridge: Cambridge University Press.

Schlesinger, Izchak M. 1992. "The experiencer as an agent." *Journal of Memory and Language*, vol. 31, 315–32.

Simoens, Ryan and Gemma Barberá. 2021. "Adquisició del canvi de rol i dels classificadors en el discurs narratiu en llengua de signes catalana (LSC) com a L2: Un estudi pilot." *Zeitschrift für Katalanistik* 34, 193–226.

Slobin, Dan I. 2004. "The many ways to search for a frog: Linguistic typology and the expression of motion events." In *Relating events in narrative: Typological and contextual perspectives*, edited by Sven Strömqvist and Ludo Verhoeven, 219–57. Mahwah, NJ: Lawrence Erlbaum Associates.

Slobin, Dan I. 2006. “What makes manner of motion salient? explorations in linguistic typology, discourse, and cognition.” In *Space in Languages: Linguistic Systems and Cognitive Categories*, edited by Maya Hickman and Stöphane Robert, 59–81. Amsterdam/ Philadelphia: John Benjamins.

Slobin, Dan I. and Nini Hoiting. 1994. “Reference to movement in spoken and signed languages: Typological considerations.” In *Proceedings of the Twentieth Annual Meeting of the Berkeley Linguistics Society*, 487–505.

Stoianov, Diane, Diná Souza da Silva, Jó Carlos Neves Freitas, Anderson Almeida-Silva, and Andrew Nevins. 2022. “Comparing iconicity trade-offs in cena and libras during a sign language production task.” *Languages* 7 (2), 98, doi: 10.3390/languages7020098.

Supalla, Ted. 1990. “Serial verbs of motion in ASL.” In *Theoretical Issues in Sign Language Research 1*, edited by Susan D. Fisher and Patricia Siple, 127–52, Chicago, IL: University of Chicago Press.

Supalla, Ted. 1986. “The classifier system in American Sign Language.” In *Noun Classes and Categorization*, edited by Colette G. Craig, 181–214. Amsterdam: John Benjamins.

Supalla, Ted. 1982. *Structure and Acquisition of Verbs of Motion and Location in American Sign Language*. PhD diss., San Diego, CA: University of California.

Swabey, Laurie. 2002. *The Cognitive Status, Form and Distribution of Referring Expressions in ASL and English Narratives*. PhD diss., Minnesota: University of Minnesota.

R Core Team. 2021. *R: A Language and Environment for Statistical Computing, R Foundation for Statistical Computing*, Austria: Vienna.

Tai, James H-Y. and Shiou Su. 2013. “Encoding motion events in Taiwan Sign Language and Mandarin Chinese: Some typological implications.” In *Breaking down the barriers: inter- disciplinary studies in Chinese linguistics and beyond*, edited by Guangshun Cao, Hillary Chappell, Redouane Djamouri, Thekla Wiebusch, 79–98. Taipei, Taiwan: Institute of Linguistics, Academia Sinica.

Talmy, Leonard. 1985. “Lexicalization patterns: Semantic structure in lexical forms.” In *Language typology and lexical description: Vol. 3. Grammatical categories and the lexicon*, edited by Timothy Shopen, 57–149. Cambridge: Cambridge University Press.

Talmy, Leonard. 1991. “Path to realization: A Typology of Event Conflation.” In *Proceedings of the Seventeenth Annual Meeting of the Berkeley Linguistics Society*. 480–519.

Tang, Gladys. 2003. “Verbs of motion and location in Hong Kong Sign Language: Conflation and lexicalization.” In *Perspectives on Classifier Constructions in Sign Languages*, edited by Karen Emmorey, 143–65. Mahwah, NJ: Lawrence Erlbaum Associates.

Tang, Gladys, Jia Li, and Jia He. 2021. “Classifiers – theoretical perspectives.” In *Routledge Handbook of Theoretical and Experimental Sign Language Research*, edited by Josep Quer Annika Herrmann, and Roland Pfau, 139–73. London/New York: Routledge.

Zwitserlood, Inge. 2012. “Classifiers.” In *Sign language – An International Handbook*, edited by Roland Pfau, Markus Steinbach, and Bencie Woll, 158–86. Berlin: Mouton de Gruyter.