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Formal Representation of Interrogation in French Sign Language

Anonymous submission

Abstract

This paper concerns the marking of interrogation in French Sign Language (LSF). Early work on Sign Languages (SLs) underlined the role of non-manual elements in the production of interrogatives. Studies often point to the role of eyebrows depending on the type of question: eyebrows would usually be raised for the production of yes/no questions, while they would be lowered for other types of questions. For LSF, previous studies seem to validate this contrast. We tested this thoroughly in the framework of AZee, a formal approach to SL modeling based on the identification of linguistic associations between forms and identified meanings, called *production rules*. We present our methodology to extract AZee *production rules*, consisting of data searches alternating form and meaning criteria gradually converging to strong associations, ultimately leading to production rules. Our results (i) show no link between raised or lowered eyebrows and a specific type of question, (ii) highlight instead the role of another non-manual marker: the advancement of the chin. However, since eyebrows remain frequently involved in the analyzed questions (all types included), we intend to further focus on the potential role of the signer's expectations while formulating his request.

Keywords: Sign language, Formal representation, Interrogation, Non-manual, LSF, SL Synthesis, AZee

1. Introduction

This article deals with a specific problem: interrogatives in French Sign Language (LSF), hitherto unaddressed through a formal approach. However, this phenomenon is essential if one wants to generate dialogues in sign language (SL), particularly in the case of chat agents.

Current approaches to describe SLs formally are often elaborated from spoken languages, which are linear systems (see [Hadjadj, Filhol, and Brafport \(2018\)](#) for a review of existing systems). This may pose some fundamental problems since SLs are multi-linear visual-gestural languages. In contrast, the AZee model aims at integrating all the forms and phenomena observable in SL ([Filhol, 2008, 2021](#)). It is a corpus-based approach that defines systematic links between observed forms and interpreted meanings. It allows a formal representation of SL utterances. Our general goal is to extend the LSF coverage with AZee.

The following section (section 2) gives an overview of claims from previous studies on the topic of interrogatives for SL, and more specifically for LSF. We briefly present the basics of AZee approach and the methodology to enrich its system in section 3, after what we introduce the data we analyzed, and detail the application of the methodology on the data (section 4). Then, we show how our results confirm previous claims in literature and generate a way to cover interrogatives with AZee (section 5). Finally, we discuss the contribution of this work (section 6) and we propose some direction for future studies (section 7).

2. Interrogatives in Sign Languages

The relevant literature underlines the role of non-manual elements in the production of interrogatives in SLs ([Petronio and Lillo-Martin, 1997](#); [Neidle et al., 2000](#)) for American SL, ASL; ([Coerts, 1990](#); [Klomp, 2021](#)) for Dutch SL, NGT; ([Sutton-Spence and Woll, 1999](#)) for British SL, BSL; or ([Dubuisson et al., 1991](#)) for Quebec SL, LSQ; see also ([Cecchetto, 2012](#)) for a review of previous work on several SLs). Most of these studies establish the role of different non-manual markers depending on the type of question. In these studies, the eyebrows seem to be raised and the head in a forward position for the production of so-called closed questions,¹ while the eyebrows would be lowered for the production of so-called open questions.²

However, since the beginning of the interest for this subject, some authors have pointed out the complexity of this phenomenon. Firstly, sometimes this dichotomy does not always seem so obvious ([Fant, 1977](#); [Baker and Cokely, 1980](#); [Dubuisson et al., 1991](#)). Secondly, non-manual elements can combine with other markers that have nothing to do with questioning, for instance, emotions ([Weast, 2008](#); [de Vos et al., 2009](#); [Wilbur, 2012, 2020](#)). Additionally, less studied SLs such as Croatian Sign Language could display a slightly less marked pattern ([Zeshan, 2004](#); [Šarac et al., 2007](#)).

The only recent publication dealing with LSF, ([Sallandre et al., 2021](#)), is based on a previous grammar of LSF that is widely used in teaching ([Moody, 1983](#)). It tends to validate the formal opposition between closed-ended and open-ended

¹ Closed questions: questions to be answered with "yes" or "no" (e.g. in English, "Is he coming tonight?").

² Open questions: questions that can't be answered with a simple "yes" or "no" (e.g. "What is your name?").

questions.

Finally, when it comes to SL avatar animation, it is often based on SL linguistics, which provides organization rules for animation data. Thus, the distinction between types of questions seems to be used also in this domain (McDonald et al., 2017).

3. The AZee approach

Since we chose AZee approach, here is a summarized presentation of its main principles. Then, we explain the corpus-based methodology to enrich the existing AZee system.

3.1. Production rules

AZee is a formal approach to SL modeling. It depends on identified linguistic associations between observable forms (i.e. timed body articulations) and identified meanings, for instance “pretty, beautiful”. These associations are called *production rules*, and are generally given a name. For instance in LSF, production rule `pretty` associates the meaning “pretty, beautiful” with the form given in Figure 1.

Production rules can be parameterized with named arguments, which can be mandatory or optional (Hadjadj et al., 2018). For instance, the rule `pretty` has no argument. In contrast, the rule `inter-subjectivity` which supports meaning “everybody agrees on *sig*” has one argument named *sig*, which represents the object of agreement. The associated form is a lip pout produced over the form of *sig*.

Combining our two example rules, the following expression composes the meaning: “everybody agrees that [it is] beautiful”:

```
:inter-subjectivity
  'sig
    :pretty
```

Combining the associated forms results in fine detail synthesis and articulation synchronisation (Filhol et al., 2017; Filhol and McDonald, 2018, 2020). Such *discourse expressions* can build up to arbitrary size, reflecting both the signed forms to be produced and the meaning to be interpreted from them.

The set of all production rules found for a given SL constitutes what is called the *AZee production set* for that language. The next section explains how these rules are extracted from corpus data, a methodology which we will be applying in section 4.

3.2. Rule extraction methodology

Production rules only come from SL data. It is an essential point that makes it a rigorous corpus-based approach. A precise methodology exists to

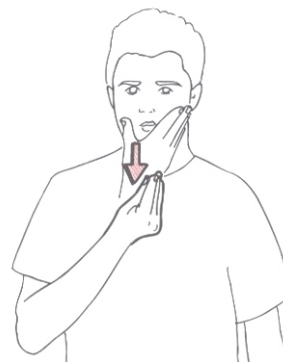


Figure 1: Form for “pretty, beautiful” in LSF

extract AZee production rules from data (Hadjadj et al., 2018). It consists in data searches alternating form and meaning criteria, gradually converging to strong associations ultimately leading to production rules. Form observations are done on videos with the naked eye, so it is the case in the work reported here, although additional software measurements would be possible for more accurate data, in particular for better analysis of dynamics. Meaning interpretation, though, is always assumed to be performed by a human in the process, which is also the case here.

We explain the steps of the process below, as we will be applying it later in section 4:

1. start with an arbitrary form or meaning criterion C to explore;
2. locate and list all occurrences of C in a selected SL corpus, and let N_{occ} be the number of occurrences;
3. for each occurrence of C listed, add description elements:
 - of interpretation if C is a form criterion;
 - of observed form if C is a meaning;
4. identify groups of at least two occurrences with identical description elements, and let N_{out} be the number of occurrences not included in any group;
5. if all of the following conditions are satisfied:
 - C is a meaning criterion;
 - a unique group was identified in step 4;
 - N_{out} is below a threshold, e.g. 15% of N_{occ} ;

then the form elements defining the unique group $C.1$ can be considered invariant, and we define a new production rule associating C with the invariant form, and this iteration stops;

6. if this iteration has not stopped, for each group identified in step 4 defined by semantic or form feature f :

- if C is a meaning that can already be expressed using known production rules justifying form f or, conversely, f is a meaning that can already be expressed using known production rules producing form C , then no new rule is to be found, nor any new search to be fired;
- otherwise, recursively apply this methodology with a new iteration starting with criterion f —note that this new search must apply to the whole corpus again, not be restricted to the occurrences defining this group.

4. Applying the methodology

We applied the methodology presented in the previous section (section 3) on a data set of LSF, presented first. Then, after refining the notion of “interrogative” for a solid starting criterion, we detail the iterations and the resulting numbers.

4.1. Data

The LSF video data we analyzed come from *Dicta-Sign* corpora (LIMSI, 2020), (Hanke et al., 2010; Matthes et al., 2010). These are semi-elicited dialogues, likely to contain interrogatives, and already translated into written French. 12 videos (total duration: 1 hour 21 minutes and 47 seconds) produced by 8 dyads of signers were examined.

4.2. Starting criterion

The first step to apply the methodology is to choose a starting criterion, of either meaning or form. In this study, being interested in interrogative utterances, we thought of the following meaning criterion: “a question is asked by the signer”. But we faced the issue of determining what was indeed meant by “question” here.

We therefore clarified our starting criterion as follows. We will be calling this criterion “**IR**” (information request) henceforth:

- the signer is requesting information or confirmation from the addressee;
- the signer does not know the information, but expects the addressee to know;
- the signer expects the addressee to provide it immediately and will wait for it before proceeding.

Indeed, we had to exclude what is often called “rhetorical questions” or “question-answer pairs” (Herrmann et al., 2019), which are frequent in LSF, as in other SLs. These are “questions” whose aim is to keep the interlocutor’s attention before introducing new information, but with no real interrogative meaning (e.g.: ‘DATE WHEN JANUARY’ in LSF, whose sole purpose is to give an information about a date, here January, and not to question the addressee about the date in question). Finally, we also had to keep in mind that some LSF productions that would not be translated into written French as interrogatives could semantically correspond to interrogatives.

4.3. Running the iterations

We applied the methodology outlined in section 3, starting with our newly defined meaning criterion, IR. An overview of the whole process is given in Figure 2.

The first step is to identify and list all occurrences of criterion IR (meaning criterion of a request of information) in the selected corpus. We found 182 occurrences. For each occurrence of IR, we then indicate elements of form since IR is a meaning criterion. In this case we observed mixes of various form features such as the advancement of the chin (which we will note “AC” henceforth), and posture holds at the end of the production (“H”). We also chose to document eyebrow activity to test the commonly admitted proposition about questions: “RE” for raised eyebrows, “LE” when lowered. Two groups emerged depending mostly on eyebrow activity, as summarized below. $N_{out} = 25$ covers the entries that fall in neither of the groups. 15 of these entries show no advanced chin or no final hold. The other 10 do show both, but contain no eyebrow activity.

Iteration IR (meaning)

- $N_{occ} = 182$
- Groups found:
 1. **AC + RE + H** (96 entries)
 2. **AC + LE + H** (61 entries)
- $N_{out} = 25$

Following the methodology, we must now take each of the formed groups separately, because more than one surfaced. For each, we can either recognize a meaning–form association already accounted for by other rules of the known AZee production set, or explore further by going through the steps again, starting with the criterion defining the group. The latter case applies for both groups here, hence two new necessary iterations, one starting

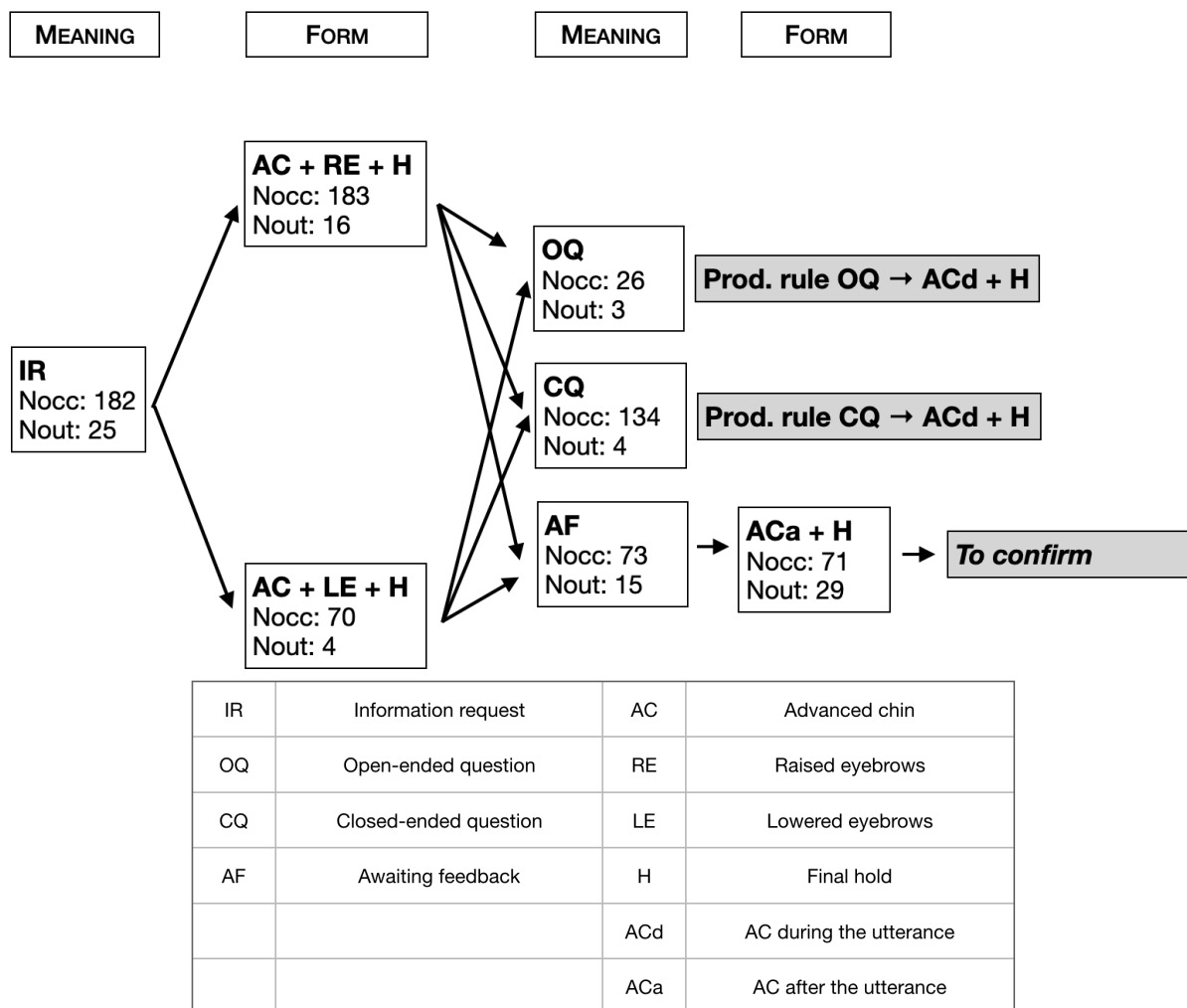


Figure 2: Overview of iterations for IR

with search criterion “AC + RE + H” and the other “AC + LE + H”.

Searching for “AC + RE + H” yields 183 occurrences. To annotate the interpreted meaning, we chose to label open vs. closed questions (“OQ” and “CQ” respectively) as it is reported relevant in the literature.³

We also found another type of production, which fell in neither of these two cases: that of the signed flow being suspended by the signer, signifying some form of feedback is awaited (noted “AF”). This contrasts with IR since it is not an *actual* answer that is expected from the addressee. Examples are given below.

Iteration AC + RE + H (form)

- $N_{occ} = 183$
- Groups found:

1. **OQ** (15), e.g. “What do you think about going by camper van?”
2. **CQ** (97), e.g. “Are we going by plane?”
3. **AF** (55), e.g. “I have two proposals for a trip...”

- $N_{out} = 16$

Since this iteration searched for a form criterion, this could not be a stopping case. We therefore continue with iterations until one is reached. The first search is from criterion “OQ”, in which we noticed we could be more specific yet about the timing of the AC form feature. The chin forward movement always started *during* the argument utterance, a refined criterion we note “ACd”, see Figure 3. Together with H, it allowed to capture almost the whole list of occurrences.

Iteration OQ (meaning)

- $N_{occ} = 26$

³See footnotes 1 and 2 for a reminder of these two question types.

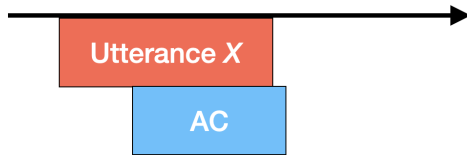


Figure 3: Form synchronization “ACd”: time flows left to right, left boundary of AC between utterance boundaries



Figure 4: Form synchronization “ACa”: argument utterance and AC intervals do not overlap

- Single group found: **ACd + H** (23)
- $N_{out} = 3$

This is a possible stopping case, because we find a single form for an identified meaning, and a number of outliers that is low enough ($< 12\%$).

A new production rule named `Open question` can now be defined. It associates meaning OQ with form ACd + H.

Starting with “CQ” yields an outcome similar to the previous with OQ.

Iteration CQ (meaning)

- $N_{occ} = 134$
- Single group found: **ACd + H** (130)
- $N_{out} = 4$

This is also a possible stopping case. A new production rule named `Closed-question` can be defined. It associates meaning CQ with form ACd + H. We notice that the two new production rules, `Open question` and `Closed question` share an identical form, which is represented on Figure 3. This will be addressed in the results section.

The following iteration, starting with the “AF” criterion, contrasts in form with the prior “OC” and “CQ”. In the case of awaited feedback, the forward chin movement tended to happen *after* the argument utterance. This refined form criterion “ACa” (fig. 4) is now different to ACd (fig. 3).

Iteration AF (meaning)

- $N_{occ} = 73$
- Single group found: **ACa + H** (58)
- $N_{out} = 15$

$N_{out} = 15$ correspond to occurrences where the chin is not advanced *after* the utterance but rather *during* it. Because it is above the 15% threshold of N_{occ} , at this point this only shows that 79% of AF occurrences display a chin advancement (AC). We decided to continue the iteration with the highlighted form criterion.

Iteration ACa + H (form)

- $N_{occ} = 71$
- Single group found: **AF** (42)
- $N_{out} = 29$

Since this circles back to a previous examined meaning criterion, unsuccessfully searched, and since the present study is focused on IR, we did not pursue this iteration and chose to leave it for future work. This iteration will be done in further studies to confirm or refine with form-meaning association. At this point, results imply that: occurrences ACa are almost always occurrences of AF. However, AF occurrences can have a form that is not ACa.

We now come back to the last unaddressed iteration, namely AC + LE + H, which we processed using the same meaning features as they were equally present.

Iteration AC + LE + H (form)

- $N_{occ} = 70$
- Groups found:
 1. **OQ** (11)
 2. **CQ** (37)
 3. **AF** (18)
- $N_{out} = 4$

Each of these three groups are defined by a criterion for which a search has already been performed. So there is nothing here to explore further.

5. Results

Our results point toward two main directions. First, it allows the extraction of two new AZee production rules that we can merge into a single one, as we will explain. Secondly, it emphasizes another phenomenon that will need refinement.

5.1. A new production rule

At the end of the iterations, two new production rules have been extracted from the data.

- `Open question`

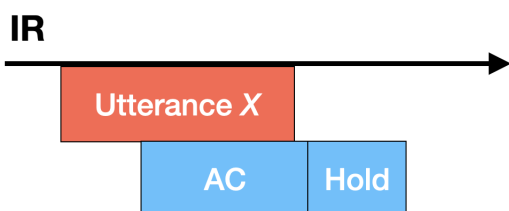


Figure 5: Form synchronization of IR

- Meaning: Open question on utterance X
 - Form: Neck starts moving chin forward *during* utterance X (i.e. before the end of X) and final hold
- Close question
 - Meaning: Close question on utterance X
 - Form: Neck starts moving chin forward *during* utterance X (i.e. before the end of X) and final hold

These two rules share an identical form. This is not a problem, however, a closer look at their respective meanings shows that they could be merged to a more generic production rule. Indeed, from a meaning point of view, “open questions” and “closed questions” are both cases of IR. This leaves us with a single rule, *Information request*, encompassing both and detailed below. It is also illustrated through the synchronization of forms on Figure 5.

- Information request
 - Meaning: Information request through utterance X
 - Form: Neck starts moving chin forward *during* utterance X (i.e. before the end of X) and final hold

5.2. Emergence of another phenomenon

The methodology triggered the emergence of a new meaning criterion. It is “Awaiting feedback” (AF), that is actually semantically close to IR.

Indeed, in both cases, the signer is particularly involved in the ongoing interaction. To be more precise, AF semantically differs from IR by the fact that it is not an *actual* answer that is expected by the signer, but rather a simple form of acknowledgment or back-channeling. The form associated to this meaning criterion seems to also be close to IR’s since it involves AC too.

Because that is somewhat beyond the scope of this paper, we decided not to pursue iterations for AF. However, it seems that its form would differ from IR in its synchronization. Indeed, the application of our methodology shows that the unique form

Type of qu.	RE	LE
CQ.	140 occ. (70%)	58 occ. (29%)
OQ.	21 occ. (61%)	13 occ. (38%)

Table 1: Search for meaning criteria “CQ” and “OQ” extended to a larger data set

associated with IR is “AC *during* the utterance”. Concerning AF, the current state of progress of the methodology does not allow us to establish a new production rule.

6. Discussion

This study participated in clarifying the role of eyebrows when requesting an information in LSF. This is an effect of the application of our methodology on SL data.

6.1. IR criterion and the role of eyebrows

The methodology applied with starting criterion IR led to exploring two form criteria (“Advanced chin + Raised eyebrows + ‘Final hold’”; “Advanced chin + Lowered eyebrows + ‘Final hold’”) which did not end up to meaning criteria linked with traditional specific question types (i.e. open *versus* close question). Instead, it looped back to IR with a single form cue: “Advanced chin” (AC).

In this respect, these findings do not confirm some claims in the literature on interrogatives concerning an assumed difference of marking between open and closed questions. In fact, no specific shape of eyebrows linked with a particular type of question could be identified. Searching for “closed questions”, we found 72% were produced with raised eyebrows, and 57% for “open questions”. Comparable proportions were also found for lowered eyebrows, regardless of the type of question (42% for open questions; 27% for closed ones).

We extended the analysis to 22 minutes and 32 seconds of supplementary data from Dicta-Sign corpus and found even less relation between the type of question and the form of eyebrows (Table 1). It appears then that the distinction widely reported in the literature is not confirmed by our results.

6.2. Advantages of the methodology

The merging of the two new production rules into a single one shows that the starting criterion, meaning criterion IR, finally made a come back in our search. This is an interesting example of the unpredictable aspect of our method using binary criteria (meaning ones *versus* form ones). It presents the advantage of letting criteria gradually emerge from SL data no matter what the researcher’s intuitions are. Of course, choices are made by the

researcher: see for instance the choice to focus on eyebrows in meaning groups AC + RE + H and AC + LE + H, instead of something else. Although this choice was influenced by the literature, we could have chosen to examine something else. Still, it is worth noting that the application of the methodology progressively took us away from this form criterion, revealing it to be irrelevant for meaning criterion IR. At the end, criteria can always be split, or circle back.

This work also led us to define precisely our starting criterion to search in data. If finding occurrences of a given criterion proves to be an ambiguous process, it indicates that the searching criterion is not precise enough and needs refinement. This first step finally made us consider the meaning criterion "Information request" (IR) as more accurate than "Interrogative" or "Question", which turned out less precise.

On a larger scale, this allows us to question traditional categories of analysis in linguistics that are frequently elaborated initially for (some) spoken languages. These categories are not necessarily inaccurate but they certainly mold the way we work on SLs. Caution is therefore required when it comes to applying them to the analysis of these languages without prior critical exam. In this, the methodology used in the present work helps bringing out new categories based on the SL data, and undoubtedly more accurate ones to implement for SL generation.

7. Conclusion and prospects

Our results do not confirm the hypothesis that eyebrows play a dominant role in requests for information in LSF. We now need to continue applying our method to refine the eyebrows form. Indeed, on 182 occurrences of information requests, 93% ($n = 170$) display a movement of eyebrows (raised or lowered). Different eyebrow positions might be cues of something different than the type of question. In this regard, following some recent studies, we intend to focus on the role of potential *biases* in requests, such as the signer's prior belief (Pena, 2019; Oomen and Roelofsen, in prep.), rather than the traditional opposition open-questions *versus* closed-questions. This distinction might indeed be more relevant for LSF. A study focusing on precise facial expressions in LSF in the framework of AZee is currently conducted and might bring additional information on the role of emotions on eyebrows.

We also intend to continue iterations for AF meaning criterion. To do so, it might be useful to extend this analysis to LSF data containing other discourse genre. Indeed, this would allow us to check if the distinction between timing of chin advancement⁴ is

⁴Starting *during* the utterance for IR rather than *after*

confirmed by SL data, or if the meaning AF involves another form. Other LSF data could also allow to test close semantic categories such as "Imperative", which also involves a request of reaction from the interlocutor. In terms of form, we should pay attention as well to the dynamics of the advancement movement in addition to its timing: for instance, a clear-cut one or a progressive one.

Finally, within the frame of AZee, the addition of a new production rule in the AZee production set increases its potential coverage of LSF. The previous set of AZee rules covered 96.1% of LSF discourse in the only corpus entirely represented with AZee, *40-brèves* corpus (LIMSI and LISN, 2022), (Challant and Filhol, 2022). As this corpus does not include any questions, we are not yet in a position to quantitatively evaluate the new coverage rate on this corpus. Other studies will follow to further enrich the AZee system, thanks to the ongoing representation with AZee of the *Mocap1* corpora (LIMSI and CIAMS, 2020), (Benchiheub et al., 2016). This corpus, made up mainly of image descriptions, is a specific register of LSF that represents a challenge in terms of linguistic description and modeling. It is indeed hardly modeled with sole glosses. Our initial findings underline the descriptive potential of the AZee system in this area. This is in line with an increasing coverage of AZee, for LSF for now, but the methodology could also be applied to other SLs data.

8. Bibliographical References

- Charlotte Baker and Dennis Cokely. 1980. *American sign language. A Teacher's Resource Text on Grammar and Culture*. Silver Spring, MD: TJ Publ.
- Mohamed-El-Fatah Benchiheub, Bastien Berret, and Annelies Braffort. 2016. Collecting and Analysing a Motion-capture Corpus of French Sign Language. In *sign-lang@ LREC 2016*, pages 7–12. European Language Resources Association (ELRA).
- Carlo Cecchetto. 2012. *Sentence types*, page 292–315. Mouton De Gruyter.
- Camille Challant and Michael Filhol. 2022. A First Corpus of AZee Discourse Expressions. In *LREC 2022, 13th Conference on Language Resources and Evaluation, Representation and Processing of Sign Languages*, Marseille, France.
- Jane Coerts. 1990. The analysis of interrogatives and negations in sln. In *Proceedings of the*
the utterance for AF.

- Third European Congress on Sign Language Research. Hamburg*, page 265–277.
- Connie de Vos, Els van der Kooij, and Onno Crasborn. 2009. *Mixed signals: Combining linguistic and affective functions of eyebrows in questions in sign language of the netherlands*. *Language and Speech*, 52(2–3):315–339.
- Colette Dubuisson, Johanne Boulanger, Jules Desrosiers, and Linda Lelièvre. 1991. *Les mouvements de tête dans les interrogatives en langue des signes québécoise*. *Revue québécoise de linguistique*, 20(2):93–121.
- Lou Fant. 1977. *Sign language*. Northridge, CA: Joyce Media Inc.
- Michael Filhol. 2008. *Modèle descriptif des signes pour un traitement automatique des langues des signes*. Ph.D. thesis, Université Paris Sud-Paris XI.
- Michael Filhol. 2021. *Modélisation, traitement automatique et outillage logiciel des langues des signes*. Habilitation à diriger des recherches, Université Paris-Saclay.
- Michael Filhol and John McDonald. 2020. The synthesis of complex shape deployments in sign language. In *Proceedings of the 9th workshop on the Representation and Processing of Sign Languages*.
- Michael Filhol, John McDonald, and Rosalee Wolfe. 2017. Synthesizing sign language by connecting linguistically structured descriptions to a multi-track animation system. In *Universal Access in Human–Computer Interaction. Designing Novel Interactions: 11th International Conference, UAHCI 2017, Held as Part of HCI International 2017, Vancouver, BC, Canada, July 9–14, 2017, Proceedings, Part II 11*, page 27–40. Springer.
- Michael Filhol and John C. McDonald. 2018. Extending the azee-paula shortcuts to enable natural proform synthesis. In *sign-lang@ LREC 2018*, page 45–52. European Language Resources Association (ELRA).
- Mohamed Hadjadj, Michael Filhol, and Annelies Braffort. 2018. Modeling French Sign Language: a proposal for a semantically compositional system. In *Proceedings of the Language Resources and Evaluation Conference*, page 4253–4258, Miyazaki, Japan.
- Thomas Hanke, Lutz König, Sven Wagner, and Silke Matthes. 2010. Dgs corpus dicta-sign: The hamburg studio setup. In *sign-lang@ LREC 2010*, page 106–109. European Language Resources Association (ELRA).
- Annika Herrmann, Sina Proske, and Elisabeth Volk. 2019. *Question-Answer Pairs in Sign Languages*, page 96–131. Brill.
- Ulrika Klomp. 2021. *A descriptive grammar of Sign Language of the Netherlands*. LOT Amsterdam.
- S. Matthes, T. Hanke, J. Storz, Eleni Efthimiou, Athanasia-Lida Dimou, Panagiotis Karioris, Annelies Braffort, Annick Choisier, Julia Pelhate, and Eva Sáfár. 2010. Elicitation tasks and materials designed for dicta-sign’s multi-lingual corpus. In *4th Workshop on the Representation and Processing of Sign Languages: Corpora and Sign Language Technologies*, Malta.
- John McDonald, Rosalee Wolfe, Sarah Johnson, Souad Baowidan, Robyn Moncrief, and Ningshan Guo. 2017. *An Improved Framework for Layering Linguistic Processes in Sign Language Generation: Why There Should Never Be a “Brows” Tier*, volume 10278 of *Lecture Notes in Computer Science*, page 41–54. Springer International Publishing, Cham.
- Bill Moody. 1983. *La langue des signes, Tome 1*, i.v.t. edition. Paris.
- Carol Jan Neidle, Judy Kegl, and Benjamin Bahan. 2000. *The syntax of American Sign Language: Functional categories and hierarchical structure*, cambridge, ma: mit press edition.
- Marloes Oomen and Floris Roelofsen. in prep. Biased polar questions in sign language of the netherlands.
- Sara Canas Pena. 2019. The marking of polar interrogatives in catalan sign language a first attempt to solve the puzzle. *ConSOLE XXVII*, 1:1.
- Karen Petronio and Diane Lillo-Martin. 1997. Wh-movement and the position of spec-cp: Evidence from american sign language. *Language*, 73(1):18–57.
- Marie-Anne Sallandre, Anne Zribi-Hertz, and Marie Perini. 2021. *La langue des signes française (lsf). Projet Langues et Grammaire en Ile-de-France*.
- Rachel Sutton-Spence and Bencie Woll. 1999. *The linguistics of British Sign Language: an introduction*. Cambridge University Press.
- Traci Patricia Weast. 2008. *Questions in American Sign Language: A quantitative analysis of raised and lowered eyebrows*. Ph.D. thesis, University of Texas at Arlington, Arlington.
- Ronnie B. Wilbur. 2012. *Modality and the Structure of Language: Sign Languages Versus Signed Systems*, volume 1 of *The Oxford Handbook of*

Deaf Studies, Language, and Education: Second Edition, page 350–366. Oxford University Press, Oxford.

Ronnie B. Wilbur. 2020. *Non-manual markers: Theoretical and experimental perspectives*, first edition edition, page 36. Routledge, London.

Ulrike Zeshan. 2004. Interrogative constructions in signed languages: Crosslinguistic perspectives. *Language*, 80(1):7–39.

Ninoslava Šarac, Katharina Schalber, Tamara Alibašić, Ronnie Wilbur, Pamela M. Perniss, Roland Pfau, and Markus Steinbach. 2007. *Cross-linguistic comparison of interrogatives in Croatian, Austrian, and American Sign Languages*, page 207–244. Mouton de Gruyter.

9. Language Resource References

LIMSI. 2020. *Dicta-Sign-LSF*. v2, ISLRN 442-418-132-318-7.

LIMSI and CIAMS. 2020. *MOCAP1*. ISLRN 502-958-837-267-9. ORTOLANG (Open Resources and TOols for LANGuage) –www.ortolang.fr.

LIMSI and LISN. 2022. *40 brèves*. v2, ISLRN 988-557-796-786-3. ORTOLANG (Open Resources and TOols for LANGuage) –www.ortolang.fr.