ATLAS Project: Forecast in Italian Sign Language and Annotation of Corpora

Mara Vendrame[1], Gabriele Tiotto[2]
(1) Università degli Studi di Torino, Dipartimento di Psicologia
Via Po 14, 10123 Torino, Italy
E-mail: mara.vendrame@unito.it
(2) Politecnico di Torino, Dipartimento di Automatica e Informatica
Corso Duca degli Abruzzi 24, 10129 Torino, Italy
E-mail: gabriele.tiotto@polito.it

Abstract

The paper presents the preliminary results of a research project focused on the creation and the annotation of one Italian Sign Language corpus concerning the weather forecasts domain. As a result of the annotation process, our annotations of signs sequences showed that the semantics of the signed discourse cannot be grasped just through an annotation of single weather signs which exploits the five parameters *handshape*, *movements*, *directions*, *locations* and *non-manual components*. Rather, from the annotation process appears that, in order to grasp the discourse semantics, it is necessary to consider the extensive use of Highly Iconic Structures in order to specify the iconic properties of the different atmospherics phenomena. In particular, it often occurs that several signs are combined among themselves (see also Cuxac, 2000; Di Renzo, et al, 2006; Pizzuto et al., 2008; Pizzuto, Rossini & Russo, 2006). Thus, respect to single signs, our analysis of complex manual and non-manual units stored in our database suggests the necessity to better explore multidimensional aspects, in order to properly develop and train an automatic translator able to translate from Italian written text to Italian Sign Language.

1 Introduction - ATLAS Project: purposes and characteristics

Our study is part of the Automatic Translation into Sign Languages (ATLAS) Project, targeting the development of several tools to provide signing deaf people full access to broadcast communications. In order to include and let signing deaf people to proactively collaborate in the global community, this project will grant a wide range of services such as the possibility to follow and understand media information delivered in Italian Sign Language.

As the cost of translation services furnished by a human interpreter is very high, the reason for creating an automatic translation system is the economic advantage. In particular, ATLAS focuses on the creation of an automatic translator from written Italian texts to Italian Sign Language through an intermediate translation in a written form of the Italian Sign Language.

Nowadays no Italian Sign Language weather forecast service exists, our study aims at making good of this deficit, to allow signing deaf individuals to access to weather forecast news in their mother tongue.

2 Signing deaf individuals' difficulties with spoken and written verbal languages

Sign language is the visual-spatial language of signing deaf individuals (Emmorey, 2002). Through sign languages deaf individuals become members of the Deaf community which are widespread all over the world. As members of the Deaf community, deaf individuals consider their sign language a crucial aspect of their cultural identity (Padden and Humphries, 1988).

Signing deaf individuals have no problems in understanding their mother tongue (Pizzuto, Caselli & Volterra, 2000; Sacks, 1990). On the contrary, all verbal languages are difficult for deaf individuals to understand. The literature reveals that signing deaf individuals have difficulties with spoken and written language, and this claim holds also for signing deaf Italian individuals (Arfè, 2003; Fabbretti & Tomasuolo, 2006; Pizzuto et al., 2000). Indeed, sign languages differ from spoken languages on several dimensions. All visual-gestural languages possess a rich morphosyntactic structure organized in space, which differs from the sequential ordering of the sentence elements in verbal languages (Bagnara et al., 2008; Russo Cardona & Volterra, 2007; Volterra, 2004).

In particular, the morfosyntactic elements in sign languages are effectively conveyed through facial expressions, body posture and spatial resources, whereas in verbal languages these elements are conveyed through function words like prepositions, articles, conjunctions. As a result, when reading and processing written texts, signing deaf individuals possess scant ability to process basic grammatical morphemes (such as articles, prepositions, conjunctions, pronouns, and verbal auxiliaries), which lead them to a poor exploitation of the semantic and the pragmatic information necessary to reconstruct the meaning of the global message (Radelli, 1998; Vendrame, Cutica & Bucciarelli, 2009; Volterra, Capirci & Caselli, 2001).

3 The weather domain: the creations of news signs

We started to analyze the Italian version of fifty original written weather texts provided by RAI Italian national television. We pointed out some of their peculiar characteristics, such as a formal language with complex sentence structures, the high presence of technical weather related words and frequent references to cardinal points.

The fifty texts were translated into Italian Sign

Language by a sign language interpreter. In particular, the interpreter translated the written Italian texts into the national Italian Sign Language as defined in Radutzky's (2001) dictionary. Thus, for example, we adopted the weather standard signs contained in the Radutzky dictionary for *sun*, *wind*, *snow* and *rain*.

As the Italian Sign Language has no specific signs to describe the atmospherics, a team composed by one hearing interpreter with a group of native deaf signers created a list of new weather signs for those atmospheric events which have not a corresponding sign in the Italian Sign Language. Further, for some standard Radutzky's signs the team created several graduated signs.

For example, the standard Radutzky's sign *rain* was modified in order to express both *misty rain*, *downpour*, and *storm*. The comprehensibility of such new signs was ascertained with other interpreters from different Italian regions. The interpreter was video-recorded while signing each weather sign in a neutral space. As a final step, the interpreter was video-recorded while signing each weather news forecast.

Finally we analyzed the videos of five weather forecasts: our manual and software aided annotation focused on the combination of the five parameters *handshape*, *movements*, *directions*, *locations* and *non-manual components*.

4 Annotation difficulties

Our annotation task posed many problems, due to the fact that respect to verbal languages annotations, sign languages annotations involve a meta-linguistic task in order to grasp the multidimensional aspects of sign languages (Pizzuto et al., 2008). First of all, respect to our previous annotation of single individual signs, annotation of sentences became rapidly a difficult task.
We had to decide what exactly is relevant for producing an accurate annotation, and what we could leave aside. In particular, which aspects of manual and non-manual features had to be considered in order to implement an automatic translator from written Italian language to Italian Sign Language? Indeed, grammatical information in Italian Sign Language are clearly conveyed through spatial modifications of the same sign.

In line with Di Renzo and colleagues (2006), our main difficulty was to describe streams of signs tightly linked to each other as in sign language discourse. In particular, due to co-articulation phenomena, we noted that the beginning of a sign is modified according to the previous sign, and the end of the same sign is modified according to the following sign (see also Pizzuto, 2003; Segouat, 2009).

The signed units annotation revealed two main structural features of the visual-spatial lexicon and grammar of Italian Sign Language for the weather: a high presence of re-locable signs due to spatial cardinality, and interrelated compound signs.

4.1 Multidimensional representations of weather scene

In the Italian weather texts, cardinal points and spatial references are described in a linear manner, whereas in the parallel versions of the Italian Sign Language, they are expressed simultaneously and multidimensionally.

In line with other studies (Pizzuto et al., 2008; Cuxac, 2000), our annotation had to grasp structural features, unique to the sign languages (Pizzuto, 2007; Pizzuto & Pietrandrea, 2001) and represented through manual and non-manual elements arranged in a multidimensional and in multilinear fashion.

Consider, for example, the following sentences: "Local and light cloudiness could take place in the north-eastern sector, then starting from the evening, an increase in cloudiness on the western one".

Cardinal points in sentences were not represented by standard elements, such as through the index finger directed towards the cardinal points, but through complex signs structures dislocated in space with body shift and eye gaze directions towards left or right, up or down. The interconnections of these elements was able to communicate "the whole weather situation" in a simultaneous manner.

4.2 Iconic structures

We found an high presence of non-standard constructions, namely a high presence of highly iconic structures with manual and non-manual features devoted to reproduce the embodied entity (Cuxac, 2000).

In particular, in weather domain, we noted two types of transfer: transfer of form and size, and transfer of situation. Both types are common in signed discourse, in signed poetry and in signed narratives (Pizzuto, 2007; Russo, Giuranna & Pizzuto, 2001). Transfer of form describes objects or persons according to their size or form, transfer of situation involves the shift of a sign referring to either an object or a character relative from a stable locative point of reference (Cuxac, 2000; Pizzuto et al., 2008; Sallandre, 2003). In signed sentences, the presence of iconicity has a crucial role, because it allows the interpreter to describe in a comprehensible way the atmospheric events according to their size or form.
For example, in order to communicate salient differences between "nebula" and "clouds lied around", the interpreter does not use standard signs, but adopts "productive" highly iconic constructions, which describe in a iconic manner the different forms of the clouds.

Consider, for example, the following sentence contained in one text: "Today in southern regions we saw thunderstorms, which gradually weakened, some improvements in the Adriatic area". In order to describe the weather situation, the interpreter utilizes a transfer of situation structure, in which manual and non manual units can be combined among themselves, and they result in a dynamic depiction of the weather situation. Further, the use of situation transfer is accompanied by specific eye-gaze pattern which are oriented towards the hands, and by specific facial expressions (Pizzuto et al, 2008). More in general the weather situation exists as it was observed from a distance (Pizzuto, 2007).

We noted a multilinear organization of information whereby two referents can be simultaneously specified, and also maintained in time and space in a modality that appears to be unique of sign language (Pizzuto et al., 2008). Further, the situation transfer is accompanied by locative point of reference.

As the weather bulletin texts are characterized by geographical coordinate, we remarked an high presence of two manual indexes in order to provide references to cardinal points, accompanied by a gaze pointing in the

same direction.

Thus, in line with previous studies (Di Renzo et al., 2006) we first outline how our annotation have to describe complex sign units that are very frequent in sign languages discourse, and exhibit highly iconic and multilinear features, that have no reference in verbal languages (Pizzuto et al., 2008).

Consider, for example, the following sentences contained in the text: "Ionian sea is very heavy, generally heavy the other seas, bit heavy only the basins to north". In this case the interpreter's translation is characterized by a transfer of situation: some manual and non-manual components are simultaneously arranged in time and space to represent the shift "from heavy seas to a bit heavy seas" (Cuxac, 2000). Further, as we noted previously, non-manual components such as cheek's blow up, left half open eyes and half-mouth are congruent with the process represented.

Analyzing these elements we had the possibility to detect different typologies of signing "styles". They can be classified as:

- Signed Italian
- Polluted Italian Sign Language
- Pure Italian Sign Language

These three typologies are detected and classified with respect to the amount of iconic, incorporation and multidimensional elements in the signing act.

Signed Italian is poor of iconic structures and the use of multidimensional representation is limited. In this case use of the facial expressions and incorporation is limited. "Polluted Italian Sign Language" can be seen as a signed Italian in which there is a frequent use of iconicity and multidimensionality but is in some way polluted by elements proper of Signed Italian. Facial expression is used but we detected a low use of incorporation. Pure Italian Sign Language is the preferred communication modality of deaf people and is rich in iconicity, incorporation and for this reason is extremely dynamic (i.e. a single sign can be signed in different ways).

These considerations make relevant to choose the right tradeoff between quality of the representation and complexity in annotation. In order to provide the best translation possible, we decided to create and annotate the movies in Pure Italian Sign Language.

This in line with the ATLAS project objectives that tries to provide a complete translation resorting to the Italian Sign Language grammar.

5 The annotation of video content in the weather forecast domain

A study on previous project targeting sign language annotation had been performed in order to derive guidelines for the annotation of our weather forecast content.

The automatic translation purpose makes relevant to provide the statistical translator all the needed information for the parameterization of the signs. Since they present modification within utterances with respect of their basic lexical form these information have to be notated. Iconicity, co-articulation and the relationship between the signed entities are part of the semantics of the signed discourse and have to be described during annotation.

After several studies we created a formalism that can be considered an annotation schema. We have not to neglect that this formalism conveys also visualization information that can be provided to the system modules devoted to convert linguistic content to character animation movements.

A detailed description of this formalism is out of the scope of this paper but it worth to point out that the advantages of applying this formalism to annotation are that the annotator is in some way guided to annotate just the necessary information for the automatic translation and for a complete description of the signs. On the other side it is rich enough to provide the basis for the development of a complete knowledgebase.

The annotation is performed using a custom built annotation tool that is based on our formalism. This is able to store the information in a database that includes the Radutzky Italian Sign Language dictionary, the ATLAS dictionary with signs within the weather forecast domains and other non standard signs. This provides a knowledgebase for the creation of the Italian Sign Language corpus.

6 Conclusions

Even if our study is still ongoing, our annotation revealed that, as in face to face sign language modality, also in weather domain high spatial arrangement, facial expressions and iconic structures, are the most peculiar components.

Thus, with respect to standard signs listed in Radutzky Italian Sign Language dictionary, and isolated new weather signs, our annotation have to properly consider complex sign constructions with complex meaning that are very frequent in signed discourse, and grammar as part of the non-standard or productive lexicon (Cuxac, 2000; Di Renzo et al., 2006; Pizzuto et al., 2008). The attempt to create the first Italian Sign Language corpus in Italia made relevant the considerations pointed by previous studies.

The creation of new signs required the definition of a roadmap in order to consider the linguistic and cognitive issues, in a non standard domain in Italian Sign Language. The roadmap to the creation affected also the procedures for annotation, since new issues enriched the formalism that supports the representation of a written form of Italian Sign Language and the development of the annotation tool.

7 Acknowledgements

The work presented in the present paper has been developed within the ATLAS (Automatic Translation into sign LAnguageS) Project (ID 44), co-funded by Regione Piemonte within the "Converging Technologies - CIPE 2007" framework (Research Sector: Cognitive Science and ICT).

8 References

Arfè, B. (2003). La produzione del testo in persone sorde: aspetti linguistici e cognitivi del processo di scrittura. *Psicologia Clinica dello Sviluppo,* 1, pp. 7-28.

Bagnara, C., Corazza, S., Fontana, S., & Zuccalà, A. (2008). *I segni parlano. Prospettive di ricerca sulla Lingua dei Segni Italiana.* Milano: Franco Angeli.

Cuxac, C. (2000). *La Langue des Signes Francaise (LSF).*

Les voies de l'iconocité. Faits de Langues, n. 15-16. Paris: Ophrys.

Di Renzo, A., Lamano, L., Lucioli, T., Pennacchi, B., & Ponzo, L. (2006). Italian Sign Language: Can we write it and transcribe it with Sign Writing? in C. Vettori (ed.), *Proceedings of the Second Workshop on the Representation and Processing of Sign Languages, International Conference on Language Resources and Evaluation*, LREC, Genoa, May 28th 2006. Pisa: ILC-CNR, pp. 11-16.

Emmorey, K. (2002). *Language, cognition, and the brain: Insight from sign language research.* Mahwah, N.Y: Erlbaum.

Fabbretti, D., & Tomasuolo, E. (2006). *Scrittura e sordità.* Roma: Carocci.

Padden, C., & Humphries, T. (1988). *Deaf in America: Voices from a Culture.* Cambridge: Harvard University Press.

Pizzuto, E. (2003). Coarticolazione e multimodalità nelle lingue dei segni: dati e prospettive di ricerca dallo studio della Lingua dei Segni Italiana (LIS). In Marotta G., Gnocchi N. (a cura di), *La coarticolazione - Atti delle XIII Giornate GFS,* Pisa, Edizioni ETS, pp. 59-77.

Pizzuto, E. (2007). Deixis, anaphora and person reference in signed languages. In E. Pizzuto, P. Pietrandrea & R. Simone (eds.), *Verbal and Signed Languages - Comparing structures, constructs and methodologies.* Berlin/ New York: Mouton De Gruyter, pp. 275-308.

Pizzuto, E., Caselli, M.C., & Volterra, V. (2000). Language, Cognition and Deafness. *Proceedings from Newborn Hearing Systems, Seminars in Hearing,* 21, pp. 343-358.

Pizzuto, E., Pietrandrea, P. (2001). The notation of signed texts: open questions and indications for further research. *Sign Language and Linguistics, (Special Issue on Sign Transcription and Database Storage of Sign Information),* 4: 1/2, pp. 29-43.

Pizzuto, E., Rossini, P., & Russo, T. (2006). Representing signed languages in written form: questions that need to be posed. In *C. Vettori (ed.), Proceedings of the "Second Workshop on the Representation and Processing of Sign Languages "- LREC 2006 – 5 th International Conference on Language Resources and Evaluation.* Genoa, May 28 th 2006, Paris: ELRA2006, pp. 1-6.

Pizzuto, E., Rossini, P., Sallandre, M.A., & Wilkinson E. (2008). Deixis, anaphora and Highly Iconic Structures: Cross-linguistic evidence on American (ASL), French (LSF) and Italian (LIS) Signed Languages. In R. Müller de Quadros (Ed.), *Sign Languages: spinning and unraveling the past, present and future. TISLR9, forty five papers and three posters from the 9th Theoretical Issues in Sign Language Research Conference* (pp. 475-495). Petrópolis/RJ, Brazil: Editora Arara Azul.

Radelli, B. (1998). Nicola vuole le virgole. Introduzione alla logogenia. Padova, Decibel.

Radutzky, E. (a cura di) (2001). *Dizionario bilingue elementare della Lingua Italiana dei Segni.* Edizioni Kappa, Roma.

Russo Cardona, T., & Volterra, V. (2007). *Le lingue dei segni. Storia e semiotica.* Roma, Carocci Editore.

Russo, T., Giuranna, R., & Pizzuto, E. (2001). Italian Sign Language (LIS) poetry: iconic properties and structural regularities. *Sign Languages Studies,* Vol.2., 1, Fall 2001, pp. 84-112.

Sacks, O. (1990). *Vedere voci. Un viaggio nel mondo dei sordi.* Milano, Adelphi.

Sallandre, M-A. (2003). Les unités du discours en Langue des Signes Francaise. Tentative de categorization dans le cadre d'une grammaire de l'iconicité. Ph.D. Dissertation, Paris, Université Paris 8.

Segouat, J. (2009). A study of Sign Language coarticulation. *Sigaccess Newsletter,* 93, pp. 31-38.

Stokoe, W. (1960). Sign language structure: An outline of the visual communication systems of the American deaf. *Studies in Linguistics, Occasional Paper* (8) (2nd printing 1993, Burtonsville, MD: Linstok Press).

Vendrame, M., Cutica, I., & Bucciarelli, M. (2009). Learning by models from texts and from videos: where deafs differ from hearings. *Proceedings of the British Psychological Society, Annual Conference, Cognitive Psychology Section.* Hatfield, England, 1-3 September 2009, p. 71.

Volterra, V. (a cura di) (2004). *La lingua italiana dei segni*. Bologna: Il Mulino.

Volterra, V., Capirci, O., & Caselli, C. (2001). What atypical populations can reveal about language development: The contrast between deafness and Williams syndrome. *Language and Cognitive Processes,* 16, pp. 219-239.