Elicitation and corpus of spontaneous Sign Language discourse representation diagrams

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Abstract

While Sign Languages have no standard written form, many signers do capture their language in some form of spontaneous graphical form. We list a few use cases (discourse preparation, deverbalising for translation, etc.) and give examples of diagrams. After hypothesising that they contain regular patterns of significant value, we propose to build a corpus of such productions. The main contribution of this paper is the specification of the elicitation protocol, explaining the variables that are likely to affect the diagrams collected. We conclude with a report on the current state of a collection following this protocol, and a few observations on the collected contents. A first prospect is the standardisation of a scheme to represent SL discourse in a way that would make them sharable. A subsequent longer-term prospect is for this scheme to be owned by users and with time be shaped into a script for their language.

Keywords: Sign Language, Spontaneous representation, Writing system

1. Introduction

Sign Languages (SLs) are gestural oral languages, with no written form (Pizzuto and Pietrandrea, 2001). A few systems have been proposed to equip Sign with a standard script, some for a particular SL, others claimed for any SL (Grushkin, 2017; Kato, 2008; McCarty, 2004; Lessa-de Oliveira, 2012; Barros, 2008). SignWriting (Sutton, 2014) is the most well known, and has been at the heart of a few research projects, e.g. to test its use in educational environments, or to equip it with a software editor. HamNoSys (Prillwitz et al., 1989; Hanke, 2004) is the most notoriously known in the computer science domain because it has successfully been processed as input to synthesise signs with a virtual signer (3d avatar) (Elliott et al., 2004; Elliott et al., 2008).

However, none has come at all close to being shared and practiced by large numbers of users with ease, nor does any seem to be currently gaining momentum. Whatever the status of those systems at this point, it remains that Sign Languages have no accepted writing system. But this does not mean that it is impossible to note, draw, graph, or sketch out anything that represents discourse in SL. Indeed, SL users come up with solutions when they need a functional equivalent to writing. The goal of this paper is to study them.

Of course, many simply write text in an official or locally dominant language they happen to know. But this means using the writing system of a different, "foreign" language, in other words translating into a separate one entirely, which falls out of our scope. Instead of proper verbal sentences, articles may otherwise be dropped, arrows used between two written clauses, or pictograms drawn instead of spelling out words. Comparable to shorthand note taking, these techniques do part from the full set of syntactic constraints. However, they remain tied to the written language, constrained by its vocabulary and inspired by its canonical linear order, e.g. subject-verb-object.

In the past years, we encountered a variety of different hand-scripted productions aimed at capturing SL on paper in order to be read later, without or with negligible support from a different written language. Each language user producing their own personal approach that was neither learnt nor theorised as a system, we call those "spontaneous" representations of the SL discourse represented in their contents.

In the next section (§2.), we present a variety of cases and examples of such productions. After explaining their potential scientific value, section 3. defines an elicitation protocol to collect a corpus of similar data, enabling statistical analyses. Section 4. reports on the current state and amount of collected data, and lists a few observations we were able to draw from it.

2. Spontaneous Sign Language representation

We found three different types of situations where SL was spontaneaously captured in representations on paper by language users.

First, many SL users **preparing signed speeches** have been found to use graphic support to represent the discourse to be delivered. What is more, long discourse has more than once been seen drawn on a paper feed, used as a teleprompter at the time of signing, e.g. in front of a camera. This was done either by scrolling the paper down as the speech was delivered, or by playing a video of the paper feed, itself filmed beforehand in a slow camera travel down from the top. To these users, graphical schemes could always be found sufficient to express the whole of the production, and are naturally preferable to text because they are in direct relationship with the signing space, though with one fewer spatial dimension. An example of hand-drawn teleprompter scroll is given in fig. 1.

The second case of spontaneous diagrams we wish to report on comes from an interesting position at the *Institut*

Figure 1: Diagram feed for a "teleprompter" scroll

National des Jeunes Sourds[1] (INJS) in Paris, a historic deaf school where teachers teach classes in LSF[2] today. At INJS, we met teachers upholding that SL natives should be able to write and turn in homework in a written form in their language, i.e. the one they think and organise ideas in. This implies not to film themselves but produce handwritten work on paper, and not to require written French but make SL the represented language. Since there is no full writing system for SL, these teachers ask their students to draw SL the way they feel it should, provided they can understand the signing that motivated the drawing as they read it. The school has kindly agreed to share a few of those

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[1]National institute for deaf youth.

[2]*Langue des signes française* = French Sign Language.

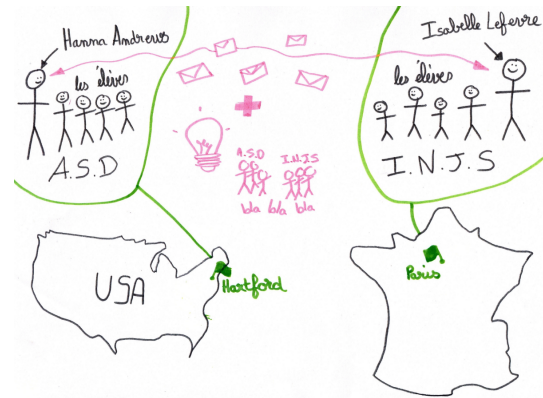productions with us. Figure 2 shows one of the pages of a piece of homework.

Figure 2: Diagram produced by an INJS pupil

The third use case can be observed in the domain of text-to-Sign translation. Professionals draw "deverbalising diagrams" of the source text in a first stage of their process, to represent its full meaning in a graphical form (Seleskovitch and Lederer, 1985; Athané, 2015). It enables them to work further from the diagrams alone, leaving the source texts aside and avoiding the translation bias they could induce (e.g. sentence order or lexical choices). Figure 3 is an example of a deverbalising diagram, representing a source text of 99 words.
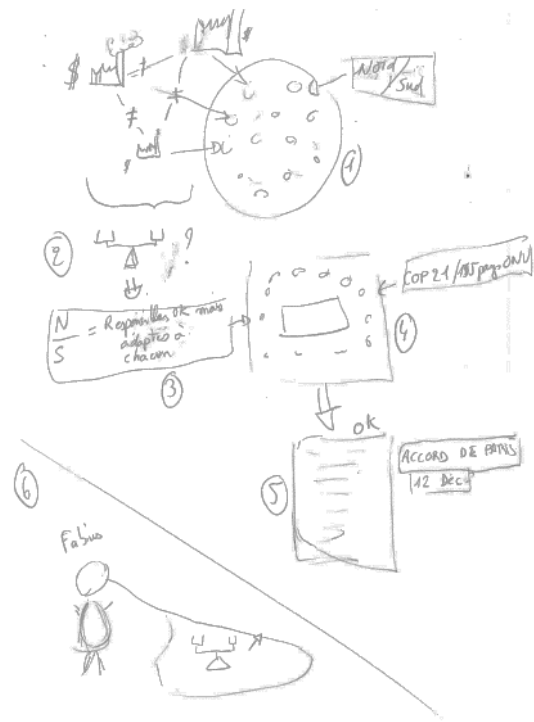

Figure 3: Deverbalising diagram produced in a text-to-SL

After a few such diagrams shared with us, some drawn symbols or higher-level graphical layouts appeared strikingly consistent:

- in meaning, e.g. specific style of arrows for displacements;

- or in the forms produced to read them, e.g. relative positions in signing space similar to those in the diagrams.

Moreover, these consistent choices could be seen not only in the diagrams of every person, but also in the whole set of diagrams, across authors. This indicated that even without a designed system, SL users produce spontaneously similar diagrams to some extent.

Unfortunately, these are usually productions discarded after use, considered as private intermediate steps not worth keeping. Because it is the only intended result, authors would rather keep a video recording of the final speech produced than personal drawings which only they at best would make sense of afterwards. But to us, the regularities found in those spontaneous productions constitute a window on the way authors internally work the cogs of their own language, more or less consciously separating them out and linking them together in diagrams.

We hypothesise that patterns can be found in these diagrams, and formalised, and that a lot can be learnt from them. To test this, we decided to build a corpus of such productions to enable their analysis. The next section justifies and explains the protocol we designed to elicit and collect diagrams of the kind spontaneously drawn by SL users representing SL discourse.

3. Corpus elicitation

3.1. Elicitation protocol

Before asking participants to produce data, a formal specification of the tasks and selection of the elicitation material was required to maximise useful contents. However, the point was to elicit spontaneous drawings in order to observe the regularities emerging from language users with as little bias as possible in the productions. So we had to avoid making the informants self-conscious about any lack or consistency of an underlying system in their own diagrams. In other words, in the design of the elicitation task and material, we wanted to control variables observed or likely to impact the drawings, but not to affect how the informants approach composing the drawings themselves.

This to us implied asking the participating subjects to **draw for themselves**, and not for an unknown third party to read. The reason is that since there is no standard, existing system for the diagrams, nothing too specific can be encoded in a diagram and assumed to be fully understood from the diagram alone. Drawing for anybody else at this time forces to use more generic conventions and icons not to turn the productions into a form of guessing game. But on the contrary, we wish to collect as many examples as we can of these personal, possibly creative graphics, letting the authors mirror their (more or less conscious) idea of the internal workings of their language.

Secondly though, if we allow for personal encodings of specific constructs, meanings or gestures, there is a chance we might not understand what they stand for. So if we eventually want to be able to interpret everything of the diagrams

and compare them to how they were intended to be read, we must also ask the authors to **deliver the signed version** of what they captured in their drawn productions. With this, any part of the diagram should be interpretable with the help of the signed counterpart.

A third concern then is that if one draws to produce the signed version immediately afterwards, one can easily use short term memory and reduce the information load in the diagram, expanding it as they sign the final discourse. In a written/vocal language, this is analogous to a debater jotting down talking points before developing a rebuttal. Short-term memory stores the contents of the intended speech instead of the writing, which only serves to cue the reader. To enforce the full content of the discourse in the diagram, participants should be drawing with the thought that they will have to **read them later**. Trading off between draw–read separation time and participant time commitment, we told them that they would have to produce a signed read-out of their diagrams two weeks after drawing them.

This in turn raises the new concern of participants not being able to read from their diagrams or, if proactive about it, overloading the diagrams with excessive detail or written language. We compensated this with two further decisions for the protocol. The first one is to allow participants to work on the signed productions immediately they turn their diagrams in (but without telling them in the first place). This way, anything included in the drawings that would have been unclear later can be delivered relying on short-term memory. As long as they do not expect it while they are composing the diagrams, this is acceptable since we are not testing the SL production but only using it to help in later diagram interpretation and analyses. The second decision is to tell them from the start that they will have to read from their diagrams only, but that they will be allowed to fall back on source elicitation documents if they are missing elements to complete the discourse, provided they report those cases.

To summarise, we tell the participants in the beginning that: (1) they are drawing for themselves; (2) they will deliver diagrams first, and a signed version reading off of them two weeks later; (3) should they not understand their diagram, they will be allowed to go back to the source elicitaion material. When they deliver the diagrams, they are told that they may work on the signed version straight away.

Lastly, we decided to allow people to download the elicitation material and work from home, organising the time spent on drawing as they pleased. This was to facilitate the experiment in terms of logistics and comfort for the participants. Besides, a controlled environment would not necessarily add more reliability to the data than it would distance the productions from what they normally shape into. For example, people might need to look up information online, or to take breaks between tasks for better attention and results (no expediting drawings only to finish in an artifical time frame).

3.2. Controlled variables

Many parameters are likely to impact such drawings, which makes it difficult to control the variables entirely. However,

we have listed a few major ones, likely or observed to create different styles, approches or choices in the collected diagrams, and for which a control is possible. We present them in the subsections below.

Form/meaning source

A language is a communication system associating forms (observed or produced) to meaning (interpreted or intended, repectively). A writing system usually captures elements of either form or meaning for a most part, although always of both, in imbalanced proportions. For example in the Spanish writing system, the letter "M" captures the production of the (phonological) form /m/, while the "¿ ... ?" character pair captures both the meaning of interrogation and the form of changing the pitch when pronouncing the enclosed contents. The scripting strategy capturing form is called phonography; the one capturing meaningful units is called logography.

In a spontaneous diagram task, i.e. without an existing system constraining the drawn production, it is likely that the productions will depend on what the user is exposed to or has knowledge of before drawing. For example, a person taking notes of a delivered lecture is exposed to already formed articulations, before even interpreting its meaning, though both can be considered out of her control. On the opposite end, a speaker authoring content from scratch is exposed to neither before drawing. The case of translation presented above is interesting to consider here, as its essence is to put together a non-given target form, while preserving a given source meaning. It is therefore an intermediate case. These three cases are summarised and labelled in table 1, in decreasing order of form/meaning exposure before drawing.

	form given	meaning given
stenographer	yes	yes
translator	no	yes
author	no	no

Table 1: Form/meaning exposure profiles

Without a standard drawing system, these differences in exposure before drawing will potentially inflict on the drawn productions, in ways and to measures still unknown. We therefore wanted to elicit diagrams in each of those situations. One of the first questions after the collection would be to situate the spontaneous diagrams with respect to the phonography–logography distinction, perhaps depending on the situation. We will be eliciting diagrams from three types of material: **videos** of SL discourse to note down for the stenographer situation, **texts** in written French to translate to SL for the translator situation, and **topics** to talk about in SL speeches for the author situation.

Discourse genre

An essential property of SL is iconicity, i.e. a resemblance between the form of the performed signs and their meaning. For example, the form of the sign meaning "cat" in LSF is an outward gesture on both sides of the mouth depicting a cat's whiskers. Iconicity can be observed in an even broader sense. SL making a relevant use of the signing space, relative topological and geographical relationships between entities are expressed via a direct projection of the relationship inside it. Actions of agents targeted at their objects/patients also map the agent–patient direction directly into space, between the two entities involved, previously anchored as points in the signing space.

The highest use of the feature, often called "role shift", is where all the articulations produced by the signer become potentially relevant, conveying most of the meaning in a directly iconic way. In its most extreme form, it borders the effect of miming. The frequency of this feature is high in story telling for example, a genre keen on visual effects and contrasts, involving a lot of enacted situations. On the contrary, neutral statements about timeless facts or involving non-animated entities engage fewer instances of role shifts. The graphical nature of the diagrams allows to transcribe a lot of those spatial arrangements and visual effects. It is therefore important that we collect instances of either end of that continuum if we want to characterise how they are transcribed when they are present, and what subtitutes for them when they are not. We decided to elicit discourses of three genres: **stories** and fables for discourses where iconicity and body engagement is preferred, and general **definitions** for examples reducing the use of role shifts and increasing that of neutral forms. We also included **news items** as an intermediate genre, journalists delivering neutral, disengaged discourse by construction but still involving many animated agents in time-anchored sequences of events.

A short-sized text example is given below for each genre:

> Story: "*Once upon a time, in the mountains, there was a caterpillar named Zoé who was green with large yellow spots. She was very pretty and very tender, but also very sad as she thought of her parents. They had become butterflies, and left her alone on the ground.*"

> Definition: "*The heart is a body organ located inside the rib cage and ensuring the blood flow. It is necessary to sustain life. Its stop causes death. Its inverted cone shape and red colour due to the presence of blood formed a well-known symbol for life and love.*"

> News item: "*At least 525 people have been killed in Indonesia by a tsunami caused by an underwater earthquake on Monday, according to a new count published by the government on Wednesday.*"

Discourse length

A lot of information can fit in a connected diagram. However, the longer the discourse captured by a diagram, the more separations will likely be observed, if only to allow for turning pages. The ways and reasons for diagram splits are yet to be studied, but we can expect differences attributable to the discourse length. Besides, longer SL utterances tend to introduce more of the context, set and agents

first before developing the actions taking place in the established scene. And the way diagrams organise these features as discourse length grows is also of interest. We therefore wanted some control and distribution on the discourse length.

For a first corpus with limited means, it was not possible to reach hour-long productions, and we decided to limit tasks to a couple of minutes. Besides, we have observed in earlier work that the average duration for a SL piece of discourse by heart limiting disfluencies (e.g. backtracking or insertions of filler gestures) was less than 1 min (Filhol and Hadjadj, 2018), which suggests that a comfortable memory buffer for delivering speech without reading notes is beneath this value. So we chose to collect examples on either side of this relevant boundary: those resulting in signed productions of less than 30 s (**short**), and those exceeding 1.5 min (**long**). We also left open a category for **isolated** clauses, e.g. *"I take my child to the swimming pool every other Wednesday."*. This is to allow testing particular language constructs in isolation which we could be curious about, although only a few were included since out-of-context elicitation is not representative of concrete use cases.

Discourse entities

Diagrams often depict agents and discourse entities as symbols (icons, written words, etc.) in certain positions, linked with arrows or other connecting graphics. Depending on their number, the graph can grow in complexity, or find other strategies if it becomes too densely connected. To enable such analysis, we chose to collect a set of productions in which the **number of participating entities** by task would be more or less evenly distributed across the tasks. Short lengths of natural discourse typically do not exhibit high counts of acting entities, but including examples of single agents as well as two-, three- and multiple-character scenes should enable first comparisons.

Note that this can be done only when providing texts or videos for elicitation. In the case of a topic assignment, because the discourse content is left up to the author, the entity count will not be controlled (but if relevant, it can be counted afterwards).

Placements and displacements

Relative movements and geographic and topological relationships play a special part in SL, inducing a heavy use of the signing space. In a similar way to what we did for discourse entities, we therefore wanted to ensure a variety of cases in terms of **number of placements and movements** in the discourse. In video elicitations, they refer to classifier placements, relocations, etc. In text elicitations, they refer to semantic equivalent, e.g. clauses like *"the rat rushed to the lion"* counted as a movement.

3.3. Task distribution and elicitation material

At this point we wanted to build a set of tasks that covered all possible genres, lengths, etc. We also wanted to limit the time each participant would spend on diagrams and signing the result. A total time spent of 4 hours being already enough to ask for, we decided to keep the time load under this value, using an indicative duration of 15 min for a short task, 45 min for a long one, 5 min for an isolated clause (which they will only be asked once at most), and a 2 min overhead time per task.

Furthermore, we needed to include various language user profiles. Translators and language professionals (teachers, linguists, etc.) as well as more naïve but native users, deaf and hearing provided they all qualified as fluent signers should be included and separated across task sets as appropriate. For example, participants with insecure understanding of written text should be assigned stenographer and author tasks, not translations. We constituted five sets of tasks allowing for such distribution: A and B, reserved for participants fluent in both written and signed language like interpreters or children of deaf adults, C and D, to be assigned mostly to deaf participants with SL as primary language (no text to read), and E, composed with professional deaf translators in mind (quite a unique profile in France) to compensate for the lack of text-elicited deaf productions.

Besides, we were interested in eliciting a few tasks in more than one set, in parallel:

- using the same elicitation material between different participant profiles;

- using the same contents in different modalities, i.e. translated beforehand, one in text and the other in video.

However, only a few could be done not to reduce the variety of the elicitation tasks too much. We summarise the chosen distribution in table 2, w.r.t. elicitation type (video, text, topic), length (short, long, isolated), and genre (story, news item, definition). Isolated clauses were chosen separately, to elicit specific semantic/language constructs and were not classified with a genre.

With the distribution in table 2, we ensure that with as few as 3 informants on each task set, we would collect 138 diagrams in total, including:

- 51 representing stories, 45 news items, and 30 definitions;

- 57 elicited by video (stenography), 66 by text (translations), and 15 by topic (free productions);

- 90 representing short discourse, 36 long discourse, and 12 isolated clauses

- two disjoint comparable subsets of 12 diagrams each, created through translation and stenography in parallel, half of them short and the other half long.

To choose the elicitation material for each task, we selected a dozen of texts for each length–genre pair, with length being either short or long, and genre being story, news item or definition. In the set were included translations of SL videos that were already available to us[3], and that could fit

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[3]For example, we included the story available on the regional language LIMSI atlas, which we had in French (`https://atlas.limsi.fr/?tab=Hexagone`; select "Paris" to see the text) and in LSF (`https://atlas.limsi.fr/?tab=LNT`; select "LSF" to view the video) in parallel.

Task set	SL video (stenography)			Text to translate			Free topic		Est. time
	Short	Long	Isol.	Short	Long	Isol.	Short	Long	
A	1(a), 1, 0			3(b), 3, 1	0, 1, 0	1			207 min
B	0, 1, 1			2, 1, 0	1, 1, 1				226 min
C	1, 1, 1	1(d), 1, 1(e)	1				0, 0, 1		216 min
D	3(ab), 2(c), 1	1, 0, 0	1				1, 1, 0	0, 0, 1	237 min
E				1, 1(c), 1	1(d), 1, 1(e)	1	1, 0, 0		216 min

Triplet counts, in order: stories, news items, definitions.
Letters in parentheses: parallel elicitations (each refers to one content, appearing twice in the table).

Table 2: Elicitation task distribution

in either of the six sets. For each we counted the number of discourse acting entities, placements and movements. Then we distributed them evenly in the table until we approached the time load limit, making sure SL material was first put in the stenography cells, and that at least one entry for each of the count variables was put in the table. This ensures a variety of entity, placement and movement counts in the discourse contents across the whole set (though not per other variable combination, which would increase the combinatorics too much).

4. Data collection

We have begun following the protocol specified in the section above with a first set of participants. At this point we have collected the diagrams of 12 participants, assigned to the following task sets: 4 to set A, 4 to set B, 1 to set D, 3 to set E. This means that we already have a corpus of over 100 diagrams with their SL video counterpart, including:

- 42 stories, 41 news items, and 20 definitions;

- 21 elicited by video, 84 by text, and 6 by free topic;

- 76 short entries, 27 long, and 8 isolated clauses.

Figures 4, 5 and 6 give examples of collected diagrams, the last one being elicited with the "heart" definition exemplified at the end of §3.2.. We will keep enroling more participants as volunteers will manifest. Especially, we are reaching out to deaf groups so that we can better balance the elicitation profiles (grow the numbers on task sets C and D in particular). We then intend to deposit the corpus online, for example on the Ortolang platform well suited for this purpose[4], a year after we reach the 300 diagram threshold. Meanwhile, we can already observe that they all made extensive use of 2d graphics, though still dotted with written words, especially proper names (the top three in fig. 5). Words that are not proper names come in variable proportions (from 0 to 29 in a full A4 page, with a very uneven distribution). Also, we notice what would qualify as a preference for logographic symbols, capturing meaning instead of form. For example, the sun was always drawn as an icon representing a sun, not what the body/hands should do to sign sun. Incidentally, this is an opposite property to every proposed writing system for SL, and may explain the difficulty for those to catch on.
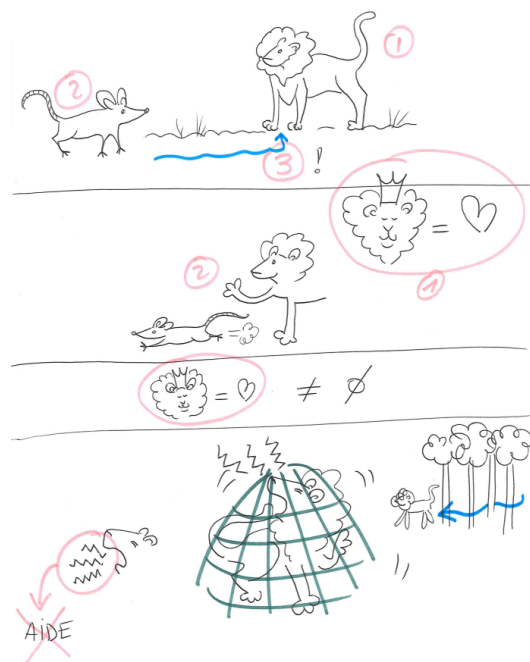
Figure 4: Diagram collected for a story

More specific patterns also appear to consistently link a graphical form and a meaning. These include:

- colour change (when available) for a focused event in a set up context, e.g. the blue arrows in fig. 4 denoting a path in an established scene;

- separation bars for the same reason, when the context is more abstract (an example was visible in fig. 3);

- the projection of topological constructions in the signing space onto the 2d plane, a feature already observed by Guitteny (2007) who studied SL discourse supported by educational (explanatory) diagrams;

- equal and comparison signs, as in figures 5 and 4;

- symbol repetition in enclosed shapes to mean sets of identical objects like in figure 5

More recurrent features can yet be found in the diagrams, the list above only being a sample. We explain these in an article to be published (Filhol, 2020), giving examples for
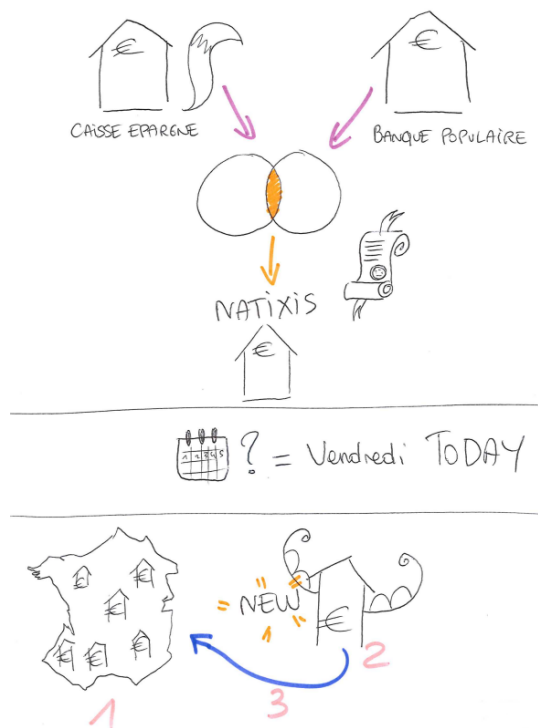
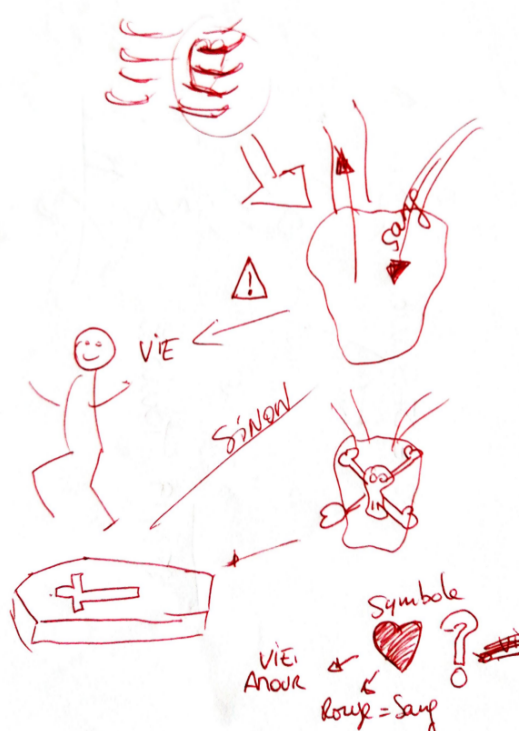Figure 5: Diagram collected for a short news item

Figure 6: Diagram collected for a definition

each, and compare the general properties observed in the diagrams to those of writing systems and representations of SL.

5. Conclusion and prospects

After observing a few spontaneous SL representations by signers and having found that they exhibited recurrent features, we put forward that if patterns are found and studied in the productions, we would gain insight on the signers' approach to encoding their language. We then specified and applied an elicitation protocol to collect a corpus of such diagrams, in which major variables likely to impact their contents were balanced. We have begun data collection following the protocol and presented regularities which indicate that some underlying principles naturally come to the signers.

We propose that such regularities should not be ignored if so spontaneously produced by native and professional speakers of the language. They should instead seriously be investigated further as they may inspire some standardisation of SL representation that would be accepted by language users. Standardisation of such diagrams, if aimed at making them sharable and readable by other people than oneself to an arbitrary level of precision, may put the signing community on the track of shaping a new kind of writing system.

Acknowledgement

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