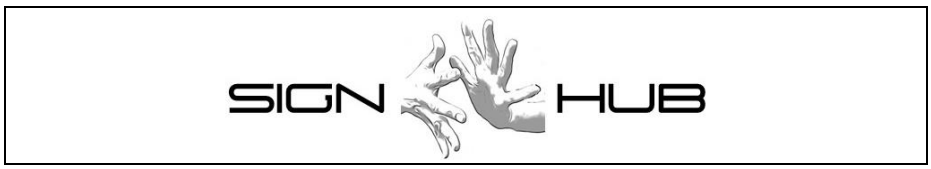

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D2.22 Guidelines for assessment in sign language and recommendations stemming from the results of assessment

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Scope of the document

This deliverable draws from the results of SIGN-HUB a list of guidelines and recommendations on early sign language exposure and testing tools which may be helpful for researchers, professionals who work with Deaf signers – speech-language pathologists, teachers, kindergarten teachers, medical professionals, and learning disability diagnosticians. It is also relevant for language policy makers, and for parents of deaf children.

It is articulated into two parts. The first part contains general recommendations. The second part lists some more specific guidelines on 1) how to turn the assessment tools into clinical tests and 2) how to reproduce these tools in other sign languages.

Part 1: Recommendations and conclusions

Within the framework of SIGN-HUB, the assessment work group focused on the conception, design, creation, administration, and analysis of syntactic and lexical tests in five sign languages.

For some of the languages, these were the very first assessment tools ever developed to allow the assessment of language impairments in children and adults, and the empirical examination of differences between early and late signers.

Here, we summarize a list of the main outcomes of this endeavor, which may be helpful for professionals who work with Deaf signers – speech-language pathologists, teachers, kindergarten teachers, medical professionals, and learning disability diagnosticians. It is also relevant for language policy makers, and for parents of deaf children.

We shall dwell in particular on four main issues, listed below:

A. For the assessment of language impairments, we recommend a procedure in which the properties that are known to be specific markers of language impairment are identified in **the local sign language**, as the basis for the development of sensitive tests for the diagnosis of language deficits, both acquired and developmental.
B. For the assessment of language impairments in signers with a concern about language difficulties, either following brain damage or with a developmental difficulty, we **recommend the diagnosis in the native language. If the person is signing from birth it is essential to diagnose their sign language**. **As for signers who were exposed to sign language at a later stage, we recommend they are diagnosed in their sign language as well, with their performance crucially compared to that of the matching population (i.e., early signers or late signers).** This can be complemented with diagnosis of the spoken language, but no conclusion regarding the status of language impairment should be drawn exclusively on this.
C. A very clear result from the tests our working group ran in the various languages is the differences in language abilities between early and late signers, and the syntactic difficulties of deaf children and adults who were not exposed to sufficient language input during the critical period for first language acquisition. We present below the first recommendation: Whether implanted or not, in order to guarantee unhindered language acquisition, **deaf children should be exposed to sign language as early as possible, ideally from birth.**
D. Another result relates to the use of contact manually coded languages, in which some form of hybrid communication system is used, mainly in educational settings, whereby lexical signs are organized according to spoken language syntax, together

with fingerspelled functional elements from the spoken language. Our results indicate that the use of manually coded language, which is not a natural language, instead of a sign language, which has its own syntax and morphology, **is less effective for language development than a natural sign language. We recommend the use of a natural sign language, and the explicit distinction between the sign language and the manually coded one**.

In what follows we briefly detail these four points.

A. Guidelines for the assessment of language impairments

One of our major tasks in the assessment working group of SIGN-HUB was to be able to assess various types of language impairments. Currently, in many countries, when a deaf signing person comes to diagnosis with language difficulties, there are no available tools to examine their language and to provide a specific assessment that can later lead targeted efficient treatment.

Language impairments can result from brain damage – following stroke, head trauma, tumor or removal of tumor, or other reasons. It can also result from certain types of dementia. Other language impairments are present from birth. In all these cases – of acquired language impairments (aphasia), progressive language impairments (dementia), or developmental language impairments (SLI or DLD), various components of language can be selectively impaired (Bishop, 2006; Conti-Ramsden & Botting, 1999, 2006; Conti-Ramsden, Crutchley, & Botting, 1997; Conti-Ramsden et al., 2001; Dockrell, Messer, & Murphy, 2005; Friedmann & Novogrodsky, 2007, 2011; Korkman & Hakkinen-Rihu, 1994; Rapin & Allen, 1983; van Daal, Verhoeven, & van Balkom, 2004; van der Lely, 2005).

Because syntax, phonology, pragmatics, semantics, and the various lexica are distinct modules in the language system, they can be selectively impaired, creating different types of specific language impairments, in both acquired and developmental cases.
In the case of aphasia and developmental impairments in spoken languages, different impairments have been identified: in the area of lexical retrieval, five types of anomia, lexical retrieval impairments are described (Friedmann, Biran, & Dotan, 2013), each affecting a different lexicon or connections between these lexica. Each of these impairments involves different types of errors and different types of stimuli that are sensitive to it.

In the area of syntactic impairments in spoken languages, we know of two structures that are highly sensitive to impairments and are widely attested cross-linguistically: syntactic movement and the high nodes of the syntactic tree (Grodzinsky, 2000; Friedmann & Grodzinsky,

1997; Friedmann, 2001, 2004; Friedmann & Novogrodsky, 2011). Other structures, like cliticization, are also highly sensitive but are more specific to certain classes of languages and the morphosyntactic properties of clitics in each of them.

Therefore, our rationale in creating the tasks that would allow for the identification of such impairments also in sign languages was to search for the clinical markers that are most sensitive, and identify in each of the sign languages we tested the structures involving those clinical markers. In the area of anomia, we know from spoken languages that certain anomias result in phonological errors, others in semantic errors, and yet others in category-specific errors. This guided us to develop tests that would be sensitive to the various errors that the participants can make. The rationale was that once we are able to identify the different types of errors in signers, we will be able to diagnose the exact locus of impairment for each of them, and recommend treatment that is targeted at the impaired component.

A similar rationale held for the syntactic assessment, in syntactic SLI (specific language impairment that affects syntax, also called syntactic developmental language disorder, DLD) in spoken languages. A robust clinical marker for syntactic SLI is a deficit in sentences containing long distance dependencies in which the nominal that undergoes movement crosses over another nominal which is structurally similar, such as in object relatives and object *which*-questions (e.g., Delage et al., 2008; Friedmann & Novogrodsky, 2004, 2007, 2011; Håkansson, & Hansson, 2000; Levy & Friedmann, 2009; Marinellie, 2004; Novogrodsky & Friedmann, 2006; Stavrakaki, 2001; van der Lely, 1997). Whereas some studies have already explored SLI in sign language (e.g., Marshall et al., 2006, 2013, 2015; Mason et al., 2010; Morgan et al., 2007; Woll & Morgan, 2012), they did not diagnose specific impairments in syntax, and specifically in long distance dependencies. Therefore, we first searched, within each of the sign languages we tested, for sentence structures that involve this type of syntactic dependency. Then, we developed syntactic tests for the assessment of the comprehension and in some cases production of syntactic structures that involve long distance dependencies, in comparison with structures without.

In addition to this, we identified syntactic structures that are sign-language specific, notably those involving the grammatical use of space (including role shift and agreeing verbs). For those structures we had to undertake the constructions of tests mostly from scratch.

This methodology, in each domain we assessed, yielded the results we were aiming at: we were able to detect effects of age of exposure to sign language on syntactic competence, as well as specific syntactic and lexical retrieval deficits in signers.

Therefore, our recommendation for the development of tests that are aimed at detecting specific types of language impairment is the following: **combine in-depth knowledge of the properties of well-studied types of language impairments in spoken languages, with in-depth knowledge of the properties of the target sign language**. Identifying the stimuli in the target sign

language that are most sensitive to each type of language impairment and developing comprehension and production tests that assess them will lead to fine-grained identification of the source of language impairment of the assessed person, later allowing for more targeted and efficient treatment. In addition, we recommend to build tests that specifically target the constructions that make a grammatical use of space, as these constructions are also sensitive to age of acquisition and are likely to be affected in case of language impairment.

B. The importance of testing deaf children in their first language

Whereas some of the deaf native signing children tested in the spoken language showed good performance in both structures with and without crossing movement, others showed relatively low performance across structures, with no difference between structures with and without syntactic complexity (Pe'er Strugo et al., 2020).

This pattern of performance is typical for children who are tested in their second language, and indeed for some of them the sentences they produced in the spoken language were affected by morphosyntactic properties of the sign language.

Whereas they did not show a pattern of difficulty typical of syntactic impairments, their performance in the spoken language tests was overall low. Therefore, had these children been assessed only in the spoken language, their second language, their low performance might have been taken as an indication of syntactic difficulty, contrary to fact. We know that they are actually not syntactically impaired because we also tested their complex syntax in their native language – sign language, where they performed very well on all complex syntactic structures.

Our conclusion is that **in order to assess the syntactic abilities of deaf children (and adults) appropriately, they should be assessed in their primary language, sign language.** Testing deaf signers in their second language does not allow them to show their real language abilities, and may lead to the false conclusion that deaf individuals who have good syntactic abilities in their first language have language impairments.

B2. This conclusion holds both for native signers and for signers that were exposed to sign language in their first years: both should be assessed in their first language, the sign language. Since the syntactic abilities of native and early signers are not identical, individuals belonging to these two populations should be assessed in comparison to two separate baselines. As for signers that were first exposed to sign language later in life, they should also be tested in sign language, but again only in comparison with thresholds relevant for their specific population.

B3. A related issue is the language that the assessor uses. Participants tended to use the manually coded language if the experimenters exchanged in spoken language with each other. Once the experimenters only communicated in sign language, also among themselves, the spontaneous production went back to be natural and in sign language. We strongly recommend **the exclusive use of sign language when administering the tests, and if possible, testing in a context in which the participant spontaneously uses a natural sign language** (i.e., not in school, where spoken language or manually coded language can be used).

C. The importance of early exposure to a sign language

Empirical data regarding the crucial role of language input during a critical period for first language acquisition comes from deaf and hard-of-hearing children. Hard-of-hearing children who communicate only in spoken language show consistent difficulties in the comprehension and production of complex syntax (Berent, 1988; 1996; de Villiers, 1988; Delage & Tuller, 2007; D'Ortenzio, 2015, 2019; Friedmann & Haddad-Hanna, 2014; Friedmann & Szterman, 2006, 2011; Friedmann, Szterman, & Haddad-Hanna, 2010; Haddad-Hanna & Friedmann, 2009; Quigley, Smith, & Wilbur, 1974; Quigley, Wilbur, & Montanelli, 1974; Ruigendijk & Friedmann, 2017; Szterman & Friedmann, 2014a,b; 2015; Turner & Rommetveit, 1967; Volpato & Adani, 2009). These difficulties were found to be related to insufficient exposure to language input during the first year of life (Friedmann & Rusou, 2015; Friedmann & Szterman, 2006).

For hard-of hearing children who communicate only orally, this is related to the fact that they are not exposed to a natural and accessible language during the first year of life (because they do not receive hearing devices or the devices provided do not lead to typical development) and miss the critical period for the acquisition of syntax in their first language.

Crucially, in the framework of SIGN-HUB syntactic testing, we examined whether early exposure to sign language (during the first years of life) provides the sufficient input required for the normal development of complex syntax. The results were clear: deaf signing children who were exposed to sign language during the critical period for syntax acquisition did not show any difficulty in the comprehension and production of complex syntactic structures in their native language. Their performance was high on all structures, and they were able to comprehend and produce structures involving complex syntactic dependencies similarly to structures without them.

This shows that in contrast to deaf children who are not exposed to a language during their first years of life, early exposed signing children do not have a difficulty with syntactic movement in their language (Pe'er Strugo et al., 2020), and they develop good syntactic abilities.

The early exposure to sign language also has a positive effect on the later acquisition of spoken language. In SIGN-HUB we assessed the syntactic abilities of native signing children not only in their native sign language, ISL, but also in Hebrew, their second language (Pe'er Strugo et al., 2020). They were tested in the comprehension and production of various syntactically complex sentence structures, including relative clauses, *wh*-questions, and topicalization structures. The results indicated that not only is early sign language exposure crucial for the acquisition of complex syntax in sign language, but it also contributes to the typical acquisition of syntax in spoken language. In sharp contrast to orally-trained hard-of-hearing who use hearing aids / cochlear implants and who received (spoken) language input after the critical period for syntax, the native signing children did not show a specific deficit in movement-derived sentences.

Thus, to allow the development of typical syntactic abilities, it is crucial to expose deaf children to a natural language as early as possible, ideally from birth. This can be done by exposing them to sign language. Cochlear implants that are provided during the first year of life, and that are coupled with speech therapy, may also allow children to benefit from input in a spoken language during the first year of life and lead to good syntactic development. However, it should be stressed that the early fitting of hearing devices is crucial, and studies found that implanting later than 12 months may be too late for typical language development. Additionally, not all children who receive hearing devices early can in fact benefit from these devices, as the devices do not always provide the necessary input (cf. Friedmann & Rusou, 2015; Friedmann & Szterman, 2006; Guasti et al., 2014 a.o.). Therefore, we suggest that a way to avoid any risk of leaving deaf children with cochlear implants / hearing aids without early exposure to language is by exposing them to sign language as well, as early as possible. This leads to early bimodal bilingualism (cf. Davidson, Lillo-Martin & Chen Pichler 2014 for the claim that bilingual Deaf children with cochlear implants on a variety of standardized tests have comparable English scores to hearing children of deaf parents; and see Moiseyev & Sandler, 2014, for bimodal bilingual education). The bimodal bilingualism perspective is supported by findings that replicate the familiar advantage of bilinguals in higher order attention task for the specific population of bimodal bilinguals (cf. Kushalnagar, Hannay & Hernandez, 2010).

D. The importance of consistent exposure to a natural language

In some educational settings involving deaf children there is use of manually coded languages (e.g., "signed Hebrew" in Israel), whereby lexical signs are put into the spoken

language syntax, together with fingerspelled functional elements from the spoken language. This results in an unnatural language which makes inconsistent use of functional elements of the spoken language, neglecting grammatical devices of the actual sign language such as facial expressions and spatial relations.

Our results indicate that the use of a manually coded language instead of a natural sign language creates an inconsistent exposure of the deaf children both to the spoken and to the natural sign language (Pe'er-Strugo, 2019): on the one hand, they are not exposed consistently to the spoken language due to their deafness, and on the other hand – they are exposed to a mix of lexical signs of their native language with the syntax of the spoken language in the educational settings. The use of manually coded languages disrupts the performance of deaf children both in the spoken language and in the sign language: it creates syntactic confusion between the two languages and interferes with production in both languages, such that productions of sign language structures are influenced by the morpho-syntactic features of the spoken language, and vice versa. It is therefore **crucial to expose deaf children consistently to each of the natural languages – both to the spoken language and to the sign language**, rather than creating a hybrid of the two.

Moreover, SIGN-HUB results suggest that children would benefit from meta-linguistic knowledge about the differences between their two languages. Raising their awareness about the syntactic and morphological structures unique to each language and explicitly emphasizing them when teaching structures in the spoken language may help the deaf native signers to learn their second language. **We therefore recommend emphasizing the differences between structures in the spoken language and the sign language in order to facilitate learning structures that differ between the languages**.

Part 2: Turning the tests into clinical tests and applying their logic to other sign languages

1. What is needed to turn these tests into clinical tests

The tests that are available on the SIGN-HUB platform, plus others that can be requested to the Israeli team for ISL, were built to be able to distinguish between low performance due to late language exposure and low performance due to language disorders. Clinicians may want to use the assessment tools to this end. However, these tests are NOT clinical tests, for a number of reasons, and should thus not be used by speech therapists or clinicians as such. They have not yet been **normalized** (i.e. they do not come with baseline(s) against which to assess the performance of any given individual); some of them are **too long** and thus need to be reduced, and some are **too complex** and thus need to be discarded as assessment tools for special populations.

In addition, some of them contain some items that did not work for technical reasons.

For example, the relative clause and the constituent question tests rely on clickable areas on the pictures that were not perfectly implemented in some cases, thus obscuring the results of those items. This needs to be fixed.

As another example, the LSF picture naming task, which is very long, contained some pictures that prove not to be successful in unambiguously eliciting the target signs, although they were not identified as ambiguous in the pilots we ran. These items will have to be eliminated.

For each test, the platform provides automatically an output file reporting all the correct/wrong answers of the participant. This output file now comes in a very opaque and difficult format, that can only be read by a researcher. We need to simplify this output file in order to make it interpretable by a clinician. In order to do so, the file should contain clear results and provide also the relevant thresholds in the general population.

After all the technical issues are solved, we shall work in tandem with clinicians and

- verify test retest reliability
- select the tests that are best suited to become clinical tests.
- It could indeed be the case that some tests only work for a given signing population and not with others. For example, all LSF signers are very good with subject relatives comprehension, but late learners have a very poor performance with object relatives (mean accuracy around 50%). Using object relative clauses in a clinical test with Late learners does not seem a good idea because 1) it could be discouraging to have such

difficult items 2) it is not informative for the clinicians. The difficulty of the final version of test on relative clauses should be balanced according to the language group.

In addition to these general issues, in what follows we propose a survey of all the tests with a to-do-list of measures to be implemented in order to turn them into clinical tools.

Notice that even after all these corrections and simplifications are done, the interpretation of the results of each test will only be possible to clinicians with some knowledge of the sign language tested or in collaboration with an interpreter or a researcher who works on the sign language tested.

1.1. Lexical tests

1.1.1. Lexical comprehension with phonological distractors task

Administration
Since it is a comprehension test, and it comes with sign language instructions that are very detailed, a clinician alone might be able to administer it. Nevertheless, the presence of a sign language expert is highly recommended (either Deaf or interpreter).
Advantages
It is easy and fast to administer.
Disadvantages
In the testing campaign that we performed, no difference in accuracy was found across the three groups of participants we tested (native, early and late learners).
How close is it to become a clinical test?
It can already be used as a clinical test with the appropriate baselines (see the introduction for important caveats)
What needs to be done
- We should verify whether an error analysis reveals differences across the populations. - We could not rely on frequency to construct and balance the tests, because data about lexical frequency are not available for sign languages. This information should be obtained through a frequency validation and added as a covariate to the analysis.
Risks
Lexical variation might be a problem. Although we tried to select signs that are nationally recognized, a participant might not be familiar with the sign variant used as a target.
Issues specific to a given sign language
Lexical variation might be especially important in LIS.

1.1.2. Lexical comprehension with semantic distractors task

Administration
Since it is a comprehension test, and it comes with sign language instructions that are very detailed, a clinician alone might be able to administer it. Nevertheless, the presence of a sign language expert is highly recommended (either Deaf or interpreter).
Advantages
It is easy and fast to administer. Materials are almost the same in LIS, LSC, LSE and LSF, therefore it can be used in bilingual individuals who are native signers of two sign languages among LIS, LSC, LSE, LSF.
Disadvantages
In the testing campaign that we performed, no difference in accuracy was found across the three groups of participants we tested (native, early and late learners).
How close is it to become a clinical test?
It can already be used as a clinical test with the appropriate baselines (see the introduction for important caveats)
What needs to be done
- We should verify whether an error analysis reveals differences across the populations. - We could not rely on frequency to construct and balance the tests, because data about lexical frequency are not available for sign languages. This information should be obtained through a frequency validation and added as a covariate to the analysis.
Risks
Lexical variation might be a problem. Although we tried to select signs that are nationally recognized, a participant might not be familiar with the sign variant used as a target.
Issues specific to a given sign language
Lexical variation might be especially important in LIS.

1.1.3. Picture naming task

Administration
The **administration** of the test needs to be done in collaboration with a Deaf consultant or an interpreter if the clinician has no knowledge of the sign language tested.
Advantages
It is easy and fast to administer. Materials are almost the same in LIS, LSC, LSE and LSF, therefore it can be used in bilingual individuals who are native signers of two sign languages among LIS, LSC, LSE, LSF.
Disadvantages

The interpretation of the results is time consuming and needs to be done by a person who is proficient in the sign language tested.
How close is it to become a clinical test?
It is close to be usable as a clinical test with the appropriate baselines (see the introduction for important caveats)
What needs to be done
- Some pictures which did not work well have to be removed. In general, pictures containing too much visual information were problematic. - A catalogue of the variants that were produced during the testing sessions should be realized - A transcription manual, explaining how to code the productions, should be provided, as well as specific criteria for evaluation of the performance. - We could not rely on frequency to construct and balance the tests, because data about lexical frequency are not available for sign languages. This information should be obtained through a frequency validation and added as a covariate to the analysis.
Risks
-Lexical variation might be a problem. Although we tried to select target signs that are nationally recognized, a participant might produce a variant that was not taken into account for the evaluation. -Some pictures might not be univocal enough, and the participant to the test might not produce the sign expected due to misinterpretation of the picture.
Issues specific to a given sign language
-Due to the problem of lexical variation, the LIS test has a sufficient, but not large, number of items. - In ISL 3 items needed to be removed due to name disagreement -In LSF, the signs recorded by the informant and taken to be targets were sometimes non-standard: the hand configuration or the entire sign were not those produced by the majority of the participants. This complicates the interpretation of the results.

1.1.4. Opposites lexical task

Administration
The **administration** of the test needs to be done in collaboration with a Deaf consultant or an interpreter if the clinician has no knowledge of the sign language tested.
Advantages
It is easy and fast to administer. Materials are almost the same in LIS, LSC, LSE and LSF, therefore it can be used in bilingual individuals who are native signers of two sign languages among LIS, LSC, LSE, LSF.

Disadvantages
The interpretation of the results is time consuming and needs to be done by a person who is proficient in the sign language tested.
How close is it to become a clinical test?
It is close to be usable as a clinical test with the appropriate baselines (see the introduction for important caveats).
What needs to be done
- A transcription manual, explaining how to code the productions should be provided, as well as specific criteria for evaluation of the performance. - We could not rely on frequency to construct and balance the tests, because data about lexical frequency are not available for sign languages. This information should be obtained through a frequency validation and added as a covariate to the analysis
Risks
Lexical variation might be a problem. Although we tried to select target signs that are nationally recognized, a participant might produce a variant that was not taken into account for the evaluation.
Issues specific to a given sign language
—

1.2. Syntactic tests

1.2.1. Role shift comprehension

Administration
Since it is a comprehension test, and it comes with sign language instructions that are very detailed, a clinician alone might be able to administer it. Nevertheless, the presence of a sign language expert is highly recommended (either Deaf or interpreter).
Advantages
It is sensitive enough to detect differences in language competence across individuals wrt role-shift marking.
Disadvantages
It is a long test and it is quite difficult.
How close is it to become a clinical test?
It is close to be usable as a clinical test with the appropriate baselines (see the introduction for important caveats)
What needs to be done
The test needs to be shortened and some items need to be removed.

Risks
The test could be too difficult for individuals with language impairment or cognitive decay.
Issues specific to a given sign language
—

1.2.2. Agreement comprehension

Administration
Since it is a comprehension test, and it comes with sign language instructions that are very detailed, a clinician alone might be able to administer it. Nevertheless, the presence of a sign language expert is highly recommended (either Deaf or interpreter). In contrast, the ISL task involves three experimenters.
Advantages
It is easy. It is sensitive enough to detect differences in language competence across individuals. The ISL task is also reported to be natural and even fun.
Disadvantages
It now comes in two blocks to be administered in two separate moments The ISL version requires 3 experimenters.
How close is it to become a clinical test?
It is very close to be usable as a clinical test with the appropriate baselines (see the introduction for important caveats)
What needs to be done
Some items need to be removed. The test should be shortened considerably by reducing it to one block
Risks
—
Issues specific to a given sign language
—

1.2.3. Constituent question comprehension

Administration

Since it is a comprehension test, and it comes with sign language instructions that are very detailed, a clinician alone might be able to administer it. Nevertheless, the presence of a sign language expert is highly recommended (either Deaf or interpreter).
Advantages
It is sensitive enough to detect differences in language competence across individuals. An individual with SLI has already been identified with it (in ISL).
Disadvantages
It now comes in two blocks to be administered in two separate moments.
How close is it to become a clinical test?
It is close to be usable as a clinical test with the appropriate baselines (see the introduction for important caveats) in most sign languages, except for LIS.
What needs to be done
Some items need to be removed. Some technical problems with clickable areas need to be solved The test should be shortened considerably by reducing it to one block
Risks
The test could be too difficult for individuals with language impairment or cognitive decay.
Issues specific to a given sign language
LIS: for subject questions, we used marked structures that could not be processed by most of the signers. In LIS we used only WHICH question assuming that WHO question could not be used with animals. This turned out to be false, so probably in LIS we should add WHO questions, and find another strategy for non-ambiguous subject questions.

1.2.4. Relative clause comprehension

Administration
Since it is a comprehension test, and it comes with sign language instructions that are very detailed, a clinician alone might be able to administer it. Nevertheless, the presence of a sign language expert is highly recommended (either Deaf or interpreter).
Advantages
It is sensitive enough to detect differences in language competence across individuals
Disadvantages
It now comes in two blocks to be administered in two separate moments.
How close is it to become a clinical test?
It is close to be usable as a clinical test with the appropriate baselines (see the introduction for important caveats) in LSF, but still far for the other sign languages.

What needs to be done
Some items need to be removed. Some technical problems with clickable areas need to be solved The test should be shortened considerably by reducing it to one block
Risks
The test could be too difficult for individuals with language impairment or cognitive decay.
Issues specific to a given sign language
In LIS the accuracy is quite low even for natives (75%). This might be due to the fact that in the LIS test all relatives start with the same noun, no matter if they are subject or object relatives. The sentences obtained were quite hard even for the consultant, who sometimes looks hesitant in the videos.

1.2.5. Pseudo-Cleft comprehension

Administration
Since it is a comprehension test, and it comes with sign language instructions that are very detailed, a clinician alone might be able to administer it. Nevertheless, the presence of a sign language expert is highly recommended (either Deaf or interpreter).
Advantages
It is sensitive enough to detect differences in language competence across individuals. An individual with SLI has already been identified with it (in ISL).
Disadvantages
-
How close is it to become a clinical test?
It is close to be usable as a clinical test with the appropriate baselines (see the introduction for important caveats) in ISL, but still far for the other sign languages.
What needs to be done
Subject Pseudocleft structures without role shift in ISL need to be removed as they have yielded an opposite response in the adult native signers group. Some technical problems with clickable areas need to be solved. The test should be shortened considerably by reducing it to one block.
Risks
The test could be too difficult for individuals with language impairment or cognitive decay.
Issues specific to a given sign language

2. What is needed to reproduce the same kind of test in a new sign language

The tests that are available on the SIGN-HUB platform can also serve as models for the development of similar assessment tests in other sign languages.

A very important aspect of each test is **Instructions**: each test should come with clear and complete instructions in the relevant sign language. The more complete and intelligible are the instructions, the easier it is to administer the test.

An important caveat concerns Reaction times, which might be worth recording especially for the syntactic tests. The platform is able to record them, but great caution needs to be made to the exact timing of the video clips used. Also, if reaction times are recorded, the instructions should contain an explicit reference to time constraints.

A final notice concerns validation: the most delicate phase of the building of a test concerns validation, both of the linguistic and visual material, as well as of the global design, of each test.

In what follows we give some specific recommendations on how to replicate each test in a new sign language. Most of these suggestions correspond to what we did to prepare our tests (in particular concerning pretest linguistic research and pretest validation: see the appendix for some more details), while some of them are based on what we have learned.

2.1. Lexical tests

2.1.1. Lexical comprehension with phonological distractors task

Preliminary knowledge necessary
- Advanced knowledge of the sign language phonology (phonological awareness skills are needed to select the phonological distractors) - Advanced knowledge of the sign language vocabulary
Linguistic risks

- *Risks regarding the target*
  - Handling and instrument classifiers should be avoided because a correct answer might be given by a non-signer as well.
  - Predicate classifiers should be avoided because a correct answer might be given by a non-signer as well.

- Proper names should be avoided
- Compounds should be avoided
- Signs with low frequency should be avoided
- Lexical variations: Signs with at most 3-4 variants recognized by the whole community are accepted
- Transparent target signs should be avoided → a transparency agreement validation task is needed (a non-signer sees the sign and write its meaning).

- *Risks regarding the distractors*
  - Semantic relation between the target and the distractors should be avoided
  - Specific criteria to select the minimal pairs need to be followed

Experimental risks

The pictures might not necessarily elicit the concept targeted → A matching agreement validation is needed.

Recommendations

- The targets and distractors need to be depictable: it is necessary to be able to represent each sign with a picture/drawing (avoid abstract concepts).
- A number of items validation are needed before administering the test (transparency agreement validation; matching agreement validation; frequency validation; iconicity validation).
- Overlapping of targets across different tasks should be avoided. Before recording the videos and selecting the pictures for the tasks, prepare the list of targets and distractors to check if there are signs used as targets in different tasks.

2.1.2. Lexical comprehension with semantic distractors task

Preliminary knowledge necessary

- Advanced knowledge of the sign language vocabulary
- Some phonology of the sign language is also necessary in order to avoid phonologically related signs

Linguistic risks

- *Risks regarding the target*
  - Handling and instrument classifiers should be avoided because a correct answer might be given by a non-signer as well.
  - Predicate classifiers should be avoided because a correct answer might be given by a non-signer as well.
  - Proper names should be avoided
  - Compounds should be avoided
  - Signs with low frequency should be avoided

- Lexical variations: Signs with at most 3-4 variants recognized by the whole community are accepted
- Transparent signs should be avoided → a transparency agreement validation task is needed (a non-signer sees the sign and write its meaning).

- *Risks regarding the distractors*
  - Phonological relation between the target and the distractors should be avoided

→ A phonological relation is considered to occur when the target and the distractor share more than two parameters (considering location, handshape, movement and orientation).

- Specific criteria in the selection of the semantic category of the distractors need to be followed.

Experimental risks

The pictures might not necessarily elicit the concept targeted → A matching agreement validation is needed.

Recommendations

- The targets and distractors need to be depictable: it is necessary to be able to represent each sign with a picture/drawing (avoid abstract concepts).
- A number of items validation are needed before administering the test (transparency agreement validation; matching agreement validation; frequency validation; iconicity validation).
- Overlapping of targets across different tasks should be avoided. Before recording the videos and selecting the pictures for the tasks, prepare the list of targets and distractors to check if there are signs used as targets in different tasks.

2.1.3. Picture naming task

Preliminary knowledge necessary

- Little knowledge of the sign language grammar is needed to produce the test. Using the same pictures, one has to elicit signs from a native informant. The signs produced will then function as targets.
- For the evaluation of the results of the test, is it necessary to know the complexity and the frequency of the target signs (see recommendations)

Linguistic risks

Handling and instrument classifiers should be avoided because a correct answer might be given by a non-signer as well.

Predicate classifiers should be avoided because a correct answer might be given by a non-signer as well.

Proper names should be avoided

Compounds should be avoided

It is recommended to select only common nouns. Signs with low frequency should be avoided Lexical variations: Signs with at most 3-4 variants recognized.by the whole community are accepted Transparent signs need to be avoided. Language variation might be an issue: the participant might produce a sign that is a variant of the target sign. This might complicate the interpretation of the results.
Experimental risks
The picture might not necessarily elicit the concept targeted → A matching agreement validation task is needed. Pictures in general should not contain too much visual information. The instructions should make very clear that participants are expected to produce **one sign** and not a description. The training phase is essential to make this point very clear.
Recommendations
- A number of steps need to be taken before administering the test: articulatory complexity agreement validation; transparency agreement validation; matching agreement validation; frequency validation; iconicity validation. - Overlapping of targets across different tasks should be avoided. Before recording the videos and selecting the pictures for the tasks, prepare the list of targets and distractors to check if there are signs used as targets in different tasks.

2.1.4. Opposites lexical task

Preliminary knowledge necessary
Basic sign language knowledge is needed and it is possible to reproduce the test if there is a collaboration with a Deaf native signer. Using the list that was used in the available tests, a sign language informant should produce pairs of opposite concepts. For the evaluation of the results of the test, is it necessary to know the complexity and the frequency of the target signs (see recommendations)
Linguistic risks
Risks regarding the input sign Handling and instrument classifiers should be avoided because the input sign might be comprehended by a non-signer as well. Predicate classifiers should be avoided because the input sign might be comprehended by a non-signer as well. Proper names should be avoided Compounds should be avoided Signs with low frequency should be avoided

Lexical variations: Signs with at most 3-4 variants recognized by the whole community are accepted Transparent signs need to be avoided Targets that might have more than one opposite should be avoided. *Risks regarding the opposite sign to be produced* Phonological relation between the target and the opposite should be avoided → A phonological relation is considered to occur when the target and the opposite share more than two parameters. Language variation might be an issue: the participant might produce a sign that is a variant of the target sign. This might complicate the interpretation of the results.
Experimental risks
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Recommendations
- A number of items validations with hearing non-signers are needed before administering the test: articulatory complexity agreement validation; transparency checking validation; matching agreement validation; frequency validation; iconicity validation . - Overlapping of targets across different tasks should be avoided. Before recording the videos and selecting the pictures for the tasks, prepare the list of targets and distractors to check if there are signs used as targets in different tasks

2.2. Syntactic tests

2.2.1. Role shift comprehension

Preliminary knowledge necessary
- Advanced knowledge of the role shift marking system of the language - Advanced knowledge of the pronominal system of the language - Advanced knowledge of verbs classes (agreeing vs non agreeing verbs)
Linguistic risks **---**
Experimental risks
1) Some pictures that are related with the target sentence could not recognized. The content of the reported sentence needs to be easily representable so that the participant can easily make the link with the correct picture.

2) The test involves 2 or three characters (the signer and one or two other characters). It is better to involve actors of different gender in order to avoid a possible confusion.
Recommendations
To build a test great attention should be payed to: 1. Prepare target sentences that are easily representable with pictures 2. Check if the selected pictures are adequate by validating the material in two phases, i.e. with: a) hearing speakers (with the target sentences in the spoken language); b) deaf signers

2.2.2. Agreement comprehension

Preliminary knowledge necessary
- Advanced knowledge of verbs classes (agreeing vs non-agreeing verbs; backwards agreeing vs forward agreeing verbs)
Linguistic risks
-
Experimental risks
1) Not all verbs correspond to actions/events that are easy to mimic in a non-linguistic scene. The verbs should be selected cautiously with this criterion mind (and the selection should be validated through pilots: see recommendations) 2) The input scene should contain no linguistic features and possibly no gestures. 3) It is better to involve actors of different gender in order to avoid a possible confusion when recording the sentence (1st and 2nd person should be a man and a woman or vice versa)
Recommendations
To build the test great attention should be payed to: - select verbs that are easily representable with non-linguistic mimic scenes - check if the scenes selected work by validating the material in two phases, i.e. with: a) hearing speakers (with the target sentences in the spoken language) b) deaf signers

2.2.3. Constituent question comprehension

Preliminary knowledge necessary
- Advanced knowledge of the syntax of constituent questions in the sign language

- Determination of effective strategies for disambiguating subject and object questions in the sign language
Linguistic risks The strategy selected for disambiguating subject and object questions might be a marked strategy, adding an unwanted amount of complexity to one of the two conditions.
Experimental risks
Picture selection in syntactic tasks can be tricky. → If you present the question and the pictures at the same time, participants might get distracted or go for an overlap between the grammatical use of space in the sentence, and the way characters are distributed in space in the picture → if the picture is shown after the question, working memory is more involved and this might interfere with the linguistic results. → In case the question is presented first, it should be introduced adequately.
Recommendations
Validate the test with a small group of Deaf signers and try different procedures (see experimental risks) and different disambiguating strategies (see linguistic risks).

2.2.4. Relative clause comprehension

Preliminary knowledge necessary
Advanced knowledge of the syntax of relativization in the sign language.
Linguistic risks —
Experimental risks
Picture selection in syntactic tasks can be tricky. → If you present the relative and the picture at the same time, participants might get distracted or go for an overlap between the grammatical use of space in the sentence, and the way characters are distributed in space in the picture → If the picture is shown after the relative, working memory is more involved and this might interfere with the linguistic results. → In case the relative is presented first, it should be introduced adequately.
Recommendations
Validate the test with a small group of Deaf signers and try different procedures (see experimental risks) and different disambiguating strategies (see linguistic risks)

Appendix: pretest validations

Here we briefly describe the different validation phases of linguistic and visual material that we recommend in the guidelines before the test is piloted with Deaf participants. These were the validation phases that we went through in order to develop the assessment tools.

1. Lexical tests

1.1. Matching agreement (pictures)

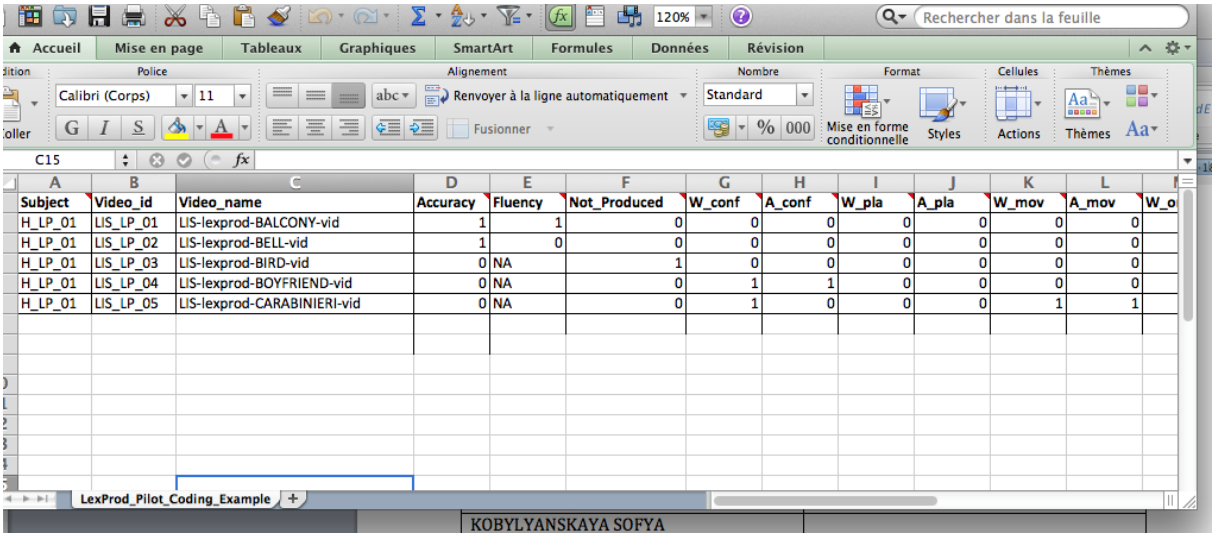
The aim is to verify whether the selected images are able to elicit the target concepts. Non-signing hearing participants belonging to different age groups and acquainted with the visual culture of the relevant country can be involved.

1.2. Transparency agreement (signs)

This involves controlling whether the target sign can be recognized by a hearing non-signer. Non-signing hearing participants belonging to different age groups and acquainted with the visual culture of the relevant country can be involved. The goal is *not* to avoid signs with iconic components but identifying signs that can be recognized and or produced by a hearing non-signer (namely signs that are gestures in the mainstream hearing culture).

1.3. Articulatory complexity agreement

The aim is to measure the perceptual/articulatory complexity of the target signs. Non-signing hearing participants belonging to different age groups and acquainted with the visual culture of the relevant country can be involved. They are asked to watch and repeat all the target signs, without having access to their meaning.
All the obtained productions are then coded according to a grid in order to establish a ranking in articulatory complexity as measured by difficulty of repetition by a non-signer.
An example of the coding sheet is given below.



Subject	Video_id	Video_name	Accuracy	Fluency	Not_Produced	W_conf	A_conf	W_pla	A_pla	W_mov	A_mov	W_o
H_LP_01	LIS_LP_01	LIS-lexprod-BALCONY-vid	1	1	0	0	0	0	0	0	0	
H_LP_01	LIS_LP_02	LIS-lexprod-BELL-vid	1	0	0	0	0	0	0	0	0	
H_LP_01	LIS_LP_03	LIS-lexprod-BIRD-vid	0	NA	1	0	0	0	0	0	0	
H_LP_01	LIS_LP_04	LIS-lexprod-BOYFRIEND-vid	0	NA	0	1	1	0	0	0	0	
H_LP_01	LIS_LP_05	LIS-lexprod-CARABINIERI-vid	0	NA	0	1	0	0	0	1	1	

1.4. Frequency validation

Deaf signers should be involved. After seeing each video, participants have to rate the frequency of the sign on a scale from 1 (low frequency) to 7 (high frequency).

1.5. Iconicity validation

Deaf signers should be involved. After seeing each video, participants have to rate the iconicity of the sign on a scale from 1 (low iconicity) to 7 (high iconicity).

2. Syntactic tests

The relative clause and the constituent question tests exploit the visual material of a test that has been largely used by the Israel team on a number of different populations, which thus needed no further validation.

For the other syntactic tests, a parallel test using the same visual material but functionally equivalent structures in the corresponding spoken language can be used to validate this visual material. Non-signing hearing participants belonging to different age groups and acquainted with the visual culture of the relevant country can be involved. The aim is to verify that the visuals (such as the pictures given below) can be effectively used to test the comprehension of the relevant structures.

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