ISL-LEX v.1: An Online Lexical Resource of Israeli Sign Language

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Abstract

This paper describes a new online lexical resource and interactive tool for Israeli Sign Language, *ISL-LEX v.1*. The dataset contains 961 non-compound ISL signs with the following information: subjective frequency ratings from native signers, iconicity ratings from native and non-native signers (presented separately), and phonological properties in six domains. The selection of signs was also designed to reflect a broad distinction between those signs acquired early in childhood and those acquired later. ISL-LEX is an online interface built using the SIGN-LEX visualization (Caselli et al. 2022), and is intended for use by researchers, educators, and students. It is therefore offered in two text-based versions, English and Hebrew, with video instructions in ISL.

Keywords: Israeli Sign Language, ISL, lexical database, lexicon, lexical network, phonological coding, ISL-LEX, SIGN-LEX

1. Introduction

While linguistics research on Israeli Sign Language (ISL) has been active and productive for many years (Meir and Sandler 2004; Nespor and Sandler 1999; Meir 2001; Meir and Sandler 2007; Lepic et al. 2016; Dachovsky et al. 2018; Sandler 2018; Fuks 2021, etc.), efforts to produce ISL language resources and make them publicly available have only recently gotten underway. This is in part due to a shift in focus by the global academic community toward greater open access and publicly available datasets. In alignment with this goal, we report here on a new lexical resource of Israeli Sign Language, *ISL-LEX v.1*.

Lexical databases have many important uses. They are crucial for testing hypotheses and controlling variables in psycholinguistic studies regarding language processing and acquisition, and for pedagogical applications, such as curriculum development and assessment. They also can be used to support dictionary making, contain information to facilitate different types of linguistic analysis, and track ID-glosses in corpus annotation.

ISL-LEX is an online interface and search tool associated with a lexical database of ISL. This interface portrays 961 lexical signs of Israeli Sign Language in a visual network of phonological relations; that is, signs are grouped and colored by the degree of similarity to other signs (**Figure 1**). ISL-LEX also contains a video of each sign, detailed phonological information, and ratings for sign frequency and iconicity. The content data was created for projects at University of Haifa in Israel, while the online interface is part of the SIGN-LEX interactive web-based platform (Caselli et al. 2022). This platform has a unique visualization, search features, and scatterplot views to aid language research, language learning, and teaching.

This is one of the few quantitative datasets of ISL in general, and the first to be made available to the public. It is accessible in English and Hebrew through parallel versions of the interactive online platform, as well as in standalone datasets for download (see §3). This paper provides a description of ISL-LEX v.1, including the digital resources associated with it, a description of the interface, its versions in English and Hebrew, details about the contents, the raw data in OSF (Open Science Framework), and future plans.

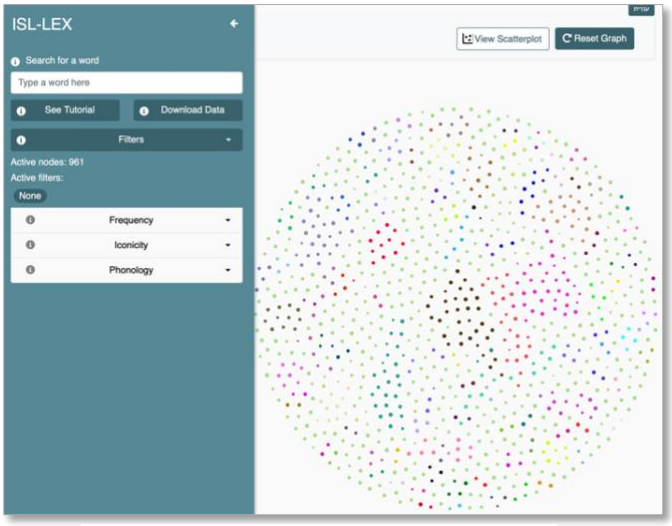

Figure 1: The ISL-LEX interface

2. Digital Resources Associated with ISL-LEX

There are four independent but associated sources of data related to ISL-LEX: (i) the 'landing page' website, (ii) the interface itself, (iii) the raw downloadable data, and (iv) associated articles about the content.

The first is the **landing page website** at https://sites.google.com/view/isl-lex. This site provides attribution, instructions, permissions, and contact information for the project. It is also the "front door" entry point to ISL-LEX. The second and main resource, **ISL-LEX** itself, is a web-based interface using the SIGN-LEX platform, located at this URL (but customarily accessed via the landing page): https://asl-lex.github.io/isl-lex/index.html. The third source of data is the **raw data** in comma-separated values (CSV) format in two files, one for English and one for Hebrew. This data is available on OSF: https://osf.io/jmwyx/. The fourth type of resource are **publications** that describe the data in greater depth; that is, the methods used to collect the data and detail about the coding in Novogrodsky and Meir (2020) and in Morgan et al. (in prep).

3. A Multilingual Resource

In keeping with the theme of the LREC 2022 workshop, ISL-LEX is notable for being available in two written languages, English and Hebrew, as well as in ISL in informational videos. The online interface can toggle between English and Hebrew by clicking the button in the upper-right hand corner of the main interface (Fig. 2). Also, the raw data is available in both languages.

Figure 2: Toggle between English and Hebrew

This satisfies a goal for ISL-LEX to be a resource for both international researchers and for various audiences within Israel, including linguists, teachers and students of ISL, parents of deaf children, and others (uses for linguists and teachers focusing on acquisition questions are addressed further in Novogrodsky and Meir, 2020). It is important to point out that the translations used to label signs in both English and Hebrew in ISL-LEX should be treated with some caution. While deaf signers were involved in assigning them, translations between any two languages can be fraught and may fail to convey the exact semantic scope and patterns of use specific to each language. For example, in ISL two different signs are translated to "love" in Hebrew and English. One sign denotes love for inanimate objects and the other sign denotes love for animate beings. The glossing conventions address this to some extent by using numbers for signs with one gloss translation in the written language but different meanings in ISL; e.g. LOVE1, LOVE2 (see Novogrodsky and Meir 2020 for more details). A new corpus project for ISL, the *ISL Corpus Project* (ISLCP; Stamp 2022), will help to clarify the usage of ISL signs and assign ID-glosses to the lexicon for corpus annotation. See §7 for future plans with this resource.

4. Description of the ISL-LEX Interface

ISL-LEX is one of the SIGN-LEX web-based interfaces (Caselli et al. 2022; see also Acknowledgements). This interface has three main components: (1) a **visualization** of all the signs; (2) a **filter** component that has various ways to search and sort signs based on the phonology, frequency, iconicity as well as specific glosses; and (3) a **scatterplot** tool that presents the scalable data (frequency, iconicity, neighborhood density) in individual XY plots. These components are dynamically-linked with each other in order to isolate particular types of data for various research and pedagogical applications.

The visualization presents all signs in the dataset as a network of relations based on phonological relatedness. Fifteen phonological feature types were selected to build the visualization. Edges (lines) between nodes (individual signs) are shown when the cursor is placed over a node; the connecting lines represent signs that match on fourteen out of fifteen features (for a description of features in ISL-LEX, see §5.6 and Morgan et al., in prep). The colors of nodes also reflect related clusters of signs that share phonological properties. A complex network modularity algorithm was used to aid the final form of the visualization, transforming the data into clusters.

5. Contents of ISL-LEX

5.1 Description of the Signs

The ISL-LEX dataset consists of 961 Israeli Sign Language signs. The signs come from two datasets: (i) 467 signs from the ISL Child Development Inventory (CDI) project (Novogrodsky and Meir 2020) and (ii) 494 signs that were selected randomly from a master list of 4,233 signs. These signs were collected for an online dictionary of ISL (https://www.isl.org.il) produced by the former Institute for the Advancement of Deaf Persons in Israel (IADPI; this organization re-formed as Ma'agale Shema, מעגלי שמע). The collection of the IADPI dictionary list was a collaborative effort by deaf Israeli signers, led by Sara Lanesman, the late linguist Irit Meir, and the director of the IADPI, Yael Kakon.

5.2 Videos of Signs

The videos of signs in the ISL-LEX interface are stored in Vimeo and connected with links to the interface. These videos are the same ones used for the phonological coding and for obtaining the frequency and iconicity ratings. Most of the videos, 798 out of 961, originate from the IADPI video dictionary of ISL just mentioned, while the other 163 videos were filmed at the University of Haifa for the last author's research project on ISL-Hebrew bimodal bilingualism in Israeli children (the 'BIBI' project, funded by the Israeli Science Foundation Grant No. 1068/16).

5.3 Subjective Frequency Ratings

All 961 signs have subjective frequency ratings that are an average of ratings provided by 19 deaf native signers (that is, deaf signers who acquired ISL as a first language), following a methodology similar to previous studies in sign languages (Mayberry et al. 2013; Caselli et al. 2017; Sevcikova Sehyr et al. 2021). Specifically, ISL signs were rated on a Likert scale from 1–7. Each video of a sign was presented along with a digital form for responses, using Google Forms. These instructions, translated here in English, were given in written Hebrew prior to the task: "The purpose of this questionnaire is to rate signs according to their frequency of use. How frequently is the sign used on daily basis? Our scale ranges from 1 to 7, where 7 represents the highest frequency, and 1 represents the lowest frequency."

Frequency ratings for the 467 CDI signs (see also Novogrodsky and Meir 2020) were collected first, followed approximately a year later by ratings for the second dataset of 494 signs (those selected from the IADPI dictionary). At least 15 out of 19 raters for each dataset are the same people, but the exact number is not recoverable due to an anonymization step. In both groups, it was found that some signers gave the same response for nearly every sign (1 person in the CDI group, 2 people in the IADPI group). These were excluded in the final ratings; i.e. they are not included in the final 19 raters nor are they in the ISL-LEX data.

In ISL-LEX, custom searches can be made by using a slider that selects signs with specific degrees of frequency. Signs in the dataset generally received high ratings. Altogether, the CDI signs have an average rating of 5.97, while signs selected from the IADPI's list have an average frequency rating of 5.42. Note that frequency of signs is based on subjective frequency judgements. The relations between

the current frequency measures and frequency measure that is derived from corpus data awaits future studies.

5.4 Iconicity Ratings

A subset of the data, 467 signs, was rated for iconicity as part of the ISL-CDI project and on-going research by the last author. Signs were rated by two groups, sign-naïve participants (labelled as 'NonNative' in ISL-LEX) and native signers.

The sign-naïve ratings are reported in Novogrodsky and Meir (2020). Participants were 41 sign-naïve adults (27 females, 14 males) who speak Hebrew as their native language with a mean age of 32 (SD = 12, Min–Max: 21–67). Each ISL-CDI sign was presented as a video along with a Hebrew translation. Each participant rated it on a computer using a scale of 1–7, with 1 as absolutely non-iconic and 7 as very iconic. The instructions were given in written Hebrew prior to the task. The translation in English is: "Sign languages tend to be iconic. That is, sometimes the shape of the sign resembles the shape of the object or entity in reality, or the movement of the sign is reminiscent of the action that the sign represents. Sometimes the sign is arbitrary and not-iconic. This means no connection between the sign and the concept it represents. Our scale ranges from 1 to 7, where 7 represents the highest degree of iconicity, and 1 represents the lowest iconicity size."

The native signer participants were 11 ISL signers (7 females, 4 males) with a mean age of 32 (SD = 10, Min–Max: 20–53). They were from different areas of Israel (north, center, and south), and belonging to a mid-high socioeconomic group (Novogrodsky and Meir 2020). The task was the same as with the sign-naïve participants.

In ISL-LEX, custom searches can be made for 'Native' and 'NonNative' ratings separately to create a selection of signs on the basis of degree of iconicity. Note that while these ratings differ, they show high correlations ($r = .71$, $p < .001$) (Novogrodsky and Meir 2020).

5.5 Acquisition Data

The signs in ISL-LEX are also meant to broadly reflect different stages of language acquisition because one reason they were gathered and coded was to address research questions about phonological complexity and acquisition (Morgan et al. 2019).

Approximately half of the signs in ISL-LEX v.1 (467 signs, 48.6%) are found in the ISL-CDI, an assessment tool for evaluating child acquisition of ISL, which is modeled on the MacArthur–Bates Communicative Developmental Inventory (Fenson et al. 1994). This assessment tool is described further in Novogrodsky and Meir (2020). It consists of 563 total signs. Novogrodsky and Meir demonstrate that this inventory of ISL signs was able to reveal developmental stages of expanding vocabulary capacity in 34 native ISL child signers, from 8 months to 7yrs old. That is, acquisition of the inventory increased dramatically for children between 18–29 months, and reached ceiling for children at 50 months old and older (i.e. around 4yrs old). Therefore, this collection of signs broadly reflects early-acquired signs in ISL. For example, it includes signs for '*mother*', '*father*', '*sleep*', '*water*', '*more*', etc.

What about the 96 signs in the ISL-CDI that are not in ISL-LEX? These are primarily compound signs, including 70 compounds and 15 signs whose compound status was uncertain; e.g. UGLY (מכוער), GAS-STATION (תחנת דלק), BEACH (חוף ים). Compounds were removed because the phonological coding system is based on components of single words.[1,2] Also excluded were two highly polysemous signs whose lexical distinctiveness from other signs in the dataset was in doubt and one sign with inadvertently complex morphology ('to film oneself').

The other 494 signs in ISL-LEX (51.4%) were chosen to complement this set of early-acquired ISL signs by reflecting a cross-section of the ISL lexicon, including many that would presumably be acquired later, after early childhood. This set of signs was selected from the master list of 4,233 signs in the dictionary of ISL. This was done by generating a list of 500 random numbers from 1–4,233 and matching those numbers to the index number for each sign. Excluded from this list (and replaced with a new batch of random signs in a second round) were: compounds, duplicates to the signs in the set of ISL-CDI signs, signs in the list whose videos could not be located in the online dictionary, and signs that were too similar in both form and meaning to signs already in the dataset.

In ISL-LEX, signs with a master index 2–555 are from the CDI signs and those with an index 556–1054 are from the ISL dictionary's master list. The interface does not currently allow custom searches on the basis of these two groups, but the data in OSF also contains these index numbers.

5.6 Phonological Coding

The phonological coding system is described in further detail in Morgan et al. (in prep), and summarized here. It has six overall phonological domains, each with a several formational types that occur in the database as fields. The six domains are (1) **articulator** with four fields, (2) **handshape** with nine fields, (3) **orientation** with two fields, (4) **location** with six fields, (5) **core articulatory movement** with nine fields, and (6) **manner of movement** with nine fields. These are listed in Table 1.

The phonological coding structure was created by the first author, based in part on a previous analysis of contrastive features in Kenyan Sign Language (KSL) (Morgan 2022). That analysis was contextualized within current theoretical models of sign language phonology for each parameter and feature (Sandler 1989, 2012; Brentari 1998; Kooij 2002). It also drew on comparisons of features found in other sign languages, such as ASL, Sign Language of the Netherlands, Hausa Sign Language, and others. Therefore, this coding schema is grounded in both theoretical and descriptive phenomena in sign language phonology.

The coding was done in a FileMaker Pro database created by the first author and performed by two coders: the first author, who is a hearing signer not conversant in ISL (but fluent in other sign languages) and a deaf native ISL signer, Debbie Menashe. The two coders met repeatedly for training sessions that were first mediated by an interpreter,

[1] Other lexical databases of sign languages with phonological coding, such as the Global SignBanks (Crasborn et al. 2020, Cassidy et al. 2018) also treat compounds in a similar way by coding the phonology of each sign in a compound separately.

[2] We did not include the singleton signs from compounds in the dataset because only the concepts as compounds were tested in the ISL-CDI. It is not known how children used these signs or whether they would recognize them as one sign or separate signs.

but later largely held through direct communication. As the coding progressed, these sessions became two-way discussions about the phenomena represented by the coding and Menashe's intuitions about categories of form—both at the level of fields themselves and values within the fields. Gradually, values like specific handshapes, locations, and movement types that did not fit the existing values were changed to fit ISL, and were added as new values in the database.

domain/parameter	field
articulator	number of hands
	symmetry of the moving hands
	symmetry of handshapes
	hands cross or connected
handshape	handshape dominant (h1)
	ending handshape (h1)
	handshape non-dominant (h2)
	initialized
	selected fingers
	flexion
	spread/stacked
	thumb position
	thumb contact (aperture)
orientation	palm orientation
	finger direction*
location	major area
	location 1
	location 2
	laterality
	contact (yes, no)
	contact type
articulatory movement	path movement (yes, no)
	axis of path movement 1
	axis of path movement 2*
	setting change 1
	setting change 2*
	handshape change (yes, no)
	handshape change type
	orientation (yes, no)
	orientation movement
manner of movement	path shape 1
	path shape 2
	syllables
	repeated exact
	alternating
	bidirectional/unidirectional
	displaced iteration
	switch dominance
	switch orientation
	trill

Table 1: Forty phonological fields in ISL-LEX (*in dataset, but not included as filter option in the interface)

However, it is important to point out that the coding was not then followed by a systematic phonological analysis to determine which units are phonemic in ISL (as it was in Morgan 2022 for KSL). Therefore, this coding should be viewed as "quasi-phonemic." That is, while it is likely many of the values in ISL-LEX are phonological units in ISL, probably not all of them are. The coding of the ISL dataset reflects a conservative approach to determining phonological structure because characteristics that could not be confidently assigned to a category are coded in the raw datasets as "unsure". This helps to highlight and demarcate important areas for future phonological research in ISL. It also demonstrates a principle expressed in Morgan (2022) that it is beneficial to use lexical databases as active tools for research and not only repositories of finished analyses. From this perspective, it is helpful to maintain (i) fields with information that is expressly phonetic as well as phonemic, and (ii) fields that may contain redundant information. For example, in ISL-LEX there is a field to indicate the presence or absence of path movement as well as several additional fields for details about the path (i.e. shape, axis, setting change).

6. Description of the Raw Data in OSF

In the ISL-LEX interface and on the landing page website a 'download data' button directs users to a repository on the Open Science Framework website where CSV files for English and Hebrew data can be downloaded (DOI: 10.17605/osf.io/jmwyx).

The CSV files have 961 records (i.e. 'rows' representing signs) and 52 fields (i.e. 'columns'). In addition to the 40 phonological fields shown in Table 1, there are fields for master index, glosses in English and Hebrew, compound status (all are single), the name of the video file, the unique Vimeo link to the video, one field for frequency ratings, two for iconicity ratings (Native and NonNative), and three fields for handshape image filenames.

In the event of minor changes to the ISL-LEX v.1 data, such as the correction of errors, new CSV files will be added to this repository, while older versions will also be maintained in OSF for archiving purposes.

7. Conclusion and Future Directions

In summary, ISL-LEX is a new resource of ISL signs that brings the results of linguistic research out of the university and into the public sphere. It is presented in a dynamic, searchable, online interface that has applications for research, teaching, and language learning (for research see Caselli and Pyers, 2017). Creating this resource was a highly collaborative endeavor, with input and cooperation from many individuals and institutions in Israel and United States.

While it is a relatively small dataset, it contains a lot of new information per sign, and is set to expand in a second version with input from a new natural language corpus in Israel (Stamp et al. 2022a, b). In fact, the data in ISL-LEX v.1 is serving as the initial input to a SignBank for ISL that is dynamically-linked to the corpus for purposes of managing ID-glosses and guiding annotation. In time, the ISL Corpus and SignBank will yield an expanded dataset of ISL signs derived from usage that can become the basis for ISL-LEX v.2.

8. Acknowledgements

The original work on the SIGN-LEX platform (initially for ASL-LEX v.1, v.2) was supported by the grants from National Institutes of Health DC010997 to Karen Emmorey and San Diego State University, a Tufts University Faculty

Research Award to Ariel Cohen-Goldberg, and a Tufts University Graduate Research Award to Naomi Caselli. Additional awards include: (i) NSF Award BCS-1918556 to Zed Sevcikova Sehyr and Karen Emmorey; (ii) NSF Awards BCS-1625954 to Karen Emmorey; (iii) NSF Awards BCS-1625793 and BCS-1918252 to Naomi Caselli; and (iv) NSF Awards BCS-1625761 and BCS-1918261 to Ariel Cohen-Goldberg.

Funding for the content of ISL-LEX was supported by an Israeli Science Foundation grant to Rama Novogrodsky (ISF grant No. 1068/16; the *Bimodal Bilingualism* project) and a European Research Council (ERC) grant to Wendy Sandler, under the European Union's Seventh Framework Programme, grant agreement No. 340140 (*Grammar of the Body* project). Additional support for the website and dissemination was supported by an ISF grant to Rose Stamp (ISF grant No. 2757/20; *ISL Corpus project*) and an internal grant from the Data Sciences Institute (DSI).

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