Sign Representation in the DW-DGS

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Abstract

In these project notes, we discuss the problem of not having a written form of German Sign Language available for lexicographic representation, consequences thereof, and different possible solutions. We describe the approach we have chosen for the DW-DGS and explain our rationale for this decision.

Zusammenfassung (German Abstract)

In diesem Arbeitspapier stellen wir dar, welche Probleme es mit sich bringt, dass man für die Repräsentation von Gebärden in einem Wörterbuch nicht auf eine bereits etablierte geschriebene Form der Deutschen Gebärdensprache zurückgreifen kann. Wir diskutieren die Folgen und verschiedene Lösungsmöglichkeiten. Wir beschreiben den Ansatz, den wir für das DW-DGS gewählt haben und legen die Gründe für unsere Entscheidung dar.

1   The Written Tradition in Lexicography

In the Western part of the world, the modern lexicographic standards and conventions have been developed and set by dictionaries of well-resourced languages with long written traditions such as German, French, or English. Such monolingual dictionaries primarily describe a specific language on the basis of its written form and use the commonly established writing system and orthography as means of representing the language in question (i.e., the object language). Orthographic established written forms are used as lemmas representing the lemma sign [1] and function as elements of the access structure, in cross-references, and in representations of other linguistic units used in context, such as examples, patterns, and collocations. The alphabetic writing system, the conventional ordering of its symbols (the alphabet), and the orthography of the object language are a crucial foundation which dictionary structures are based upon and informed by.

In monolingual dictionaries of well-resourced languages, the metalanguage to describe meanings, properties, and the behavior of the lemma sign is traditionally the same as the object language. However, in lesser researched, primarily oral or minority languages, the metalanguage used for description in the dictionary is often one that is more widely used and understood than the described object language (e.g., Latin in the Middle Ages, or Russian for indigenous Northern Eurasian Languages).

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[1] The word 'sign' in this instance does not refer to a sign language element, but to any lexical item described in a dictionary entry be it spoken language words/expressions or sign language signs/expressions. See for example Svensén (2009, 93).

2 Sign Language Representation in Dictionaries

In dictionaries, the object language must be represented in some way or other. When there is an established writing system available, it is the preferred means of representation. It guarantees stable reference to formal and semantic aspects of the object language and has all the graphic and systematic advantages of writing and fixed symbols in general, and is known to the dictionary users. Sign languages generally lack an established functional writing system. Although there are projects developing and trying to establish a writing system for signed languages in schools, e.g., the iconic writing system known as Sutton SignWriting[2], these are not widely used yet. For their written communication, sign language communities have found substitutes in the local written language that is available to them due to their functional bilingualism on the one hand and in the ever-evolving advances in technology that allow for more direct, i.e., video-based communication on the other hand.[3] Researchers of sign languages have taken to developing their own notation systems in order to record formational aspects of signed data in a written form (e.g., Stokoe Notation, HamNoSys[4]). With regard to dictionary structures and written representation of sign language in dictionaries, these notation systems are not a user-friendly solution for reasons that will be explained below. Sign language dictionaries thus face the challenge of representing a visual-spatial language in some other way than writing or notation[5]. For electronic dictionaries, video representation of the signs seems to be an obvious solution. However, this brings about the challenge of including videos in different places in the dictionary, as object language items are presented in the dictionary with various purposes.[6]

2.1 The Functions of the Lemma

The main representation of the lemma sign in each entry, i.e., the lemma, is the most notable place of representation of an element of the object language in the dictionary. The lemma usually serves several distinct functions in a dictionary. The first function is that of *representation*, that is, the lemma represents the lemma sign in an entry. For that purpose, a word form of the lemma sign is chosen as lemma (also called headword) and placed visually prominent at the beginning of an entry to catch the scanning eye easily. The lemma sign is recognized and identified by the form of the lemma. Second, the lemma – being a word form of the lemma sign – can be itself the *carrier of information* about the lemma sign (e.g. information about correct spelling) and fulfil the function of the *comment on form* (comp. Svensén 2009, 93f). Third, the lemma is an element of the access structure of the dictionary. In an alphabetical dictionary the lemma determines by its formational characteristics the place of the entry in the lemma list (macrostructure) that follows the conventional ordering of the alphabet. In this function the lemma serves as *guiding-element carrier* for the entry (comp. Wiegand 1989, 372). Fourth, consequently, the form chosen as lemma is the *item used to indicate the cross-reference address* in cross-references.

While for written languages the word form chosen as lemma usually fulfils all these functions at the same time, in sign language dictionaries no single element can fulfil all these functions at the same time. Pictures and videos can represent the lemma sign in an easily recognizable way and are used as the comment on form but they do not easily lend themselves to be elements of the access structure as guiding element carriers. As a consequence, sign language dictionaries

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[2] Sutton (1996); for DGS see Wöhrmann (2003).
[3] See König & Schmaling (2012, 342).
[4] See König & Schmaling (2012, 345-348 and 352-355).
[5] See Zwitserlood et al. (2013: 261-264) on this problem and some solutions.
[6] This problem exists regardless of whether the signed language is chosen as metalanguage or not. Comments on usage and meaning explanations may be aptly provided in the form of movies; labels and headers are preferred in a fixed form to provide orientation in the access and entry structure; see Kristoffersen & Troelsgård (2012, 312).

usually combine at least two different elements (pictures, videos, glosses, numbers, notations, textual form descriptions) to cover all these functions.

2.2 Other Instances of DGS Object Language Representation

While the headword of a dictionary entry is the most prominent place where a SL sign needs to be represented, it is not the only place in the dictionary where object language elements constitute the information to be presented. Many information types in the **micro-structure** of a dictionary entry directly consist of elements of the object language and therefore require adequate ways of sign representation:

- usage examples: exemplary use of object language items in context
- synonyms and antonyms: information on the meaning of the lemma sign given through signs with the same or the opposite meaning
- collocational patterns and multi-word expressions (MWE [7]): regular or frequent combinations with other object language items
- cross-references: links to other entries that cover signs that are in some way related to the lemma sign (e.g. signs with a similar form)

Apart from these places in the micro-structure, there are also some representations of the object language in the **access structures** of the dictionary: In a digital dictionary, a primary access structure that allows the user to access the entries with regard to their formational properties is needed. A dictionary might also provide access to entries through secondary information, i.e., not the form of the object language. The secondary information is then matched to a sign or a list of signs, the display of which requires object language representation. If search functions are provided in the dictionary, the list of results needs to include sign representations as well.

2.3 Lexicographic Requirements

Depending on the function and place of the sign representations, there are various **lexicographic requirements** that they need to fulfill. Essential properties of these representations are exactness, uniqueness, and searchability.

Exactness is needed when representing the citation form of an entry's sign, as well as its variants. The differences between the variants may be rather small, but still need to be discernable. Likewise, modifications of a sign also need to be represented exactly. This exactness property is particularly important for learners as they might acquire a new sign by reproducing it the way it is represented.

Unique identifiability of entries should be ensured so that entries are always recognizable and unlikely to be confused with each other. This requires one recognizable, distinct and unique expression as lemma, i.e., a representative form ("citation form") functioning as comprehensive label for all variants and modifications covered by the entry. When a lemma is unique, it can be used as an address carrier of cross-references from other entries and thus provide clear orientation to the user.

Lastly, searchability refers to the option of a form-based search of the object language. In order to facilitate such a search option, the dictionary needs to contain structured, machine-readable information on a sign's formational parameters.

There are also **practical requirements** regarding the form of sign representation. These, for example, include the size of the representation, as the amount of space available differs based on the placement in the dictionary. There is also the matter of how much content the sign representation has to cover and what amount of detail is required.

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[7] We use the term multi-word expression (MWE) for multi-sign units as the term is established in lexicography for all expressions that are composed of more than one independent lexical unit (word/sign).

First, instances of object language representations (of single items, combinations of single items, and of MWE) within the entry structure need to be comprehensible, but relatively small as not to cover too much space, since many of these may appear in the same section of an entry. Second, a clear and prominent placement of the lemma is necessary as landmark and 'badge' of the entry. The representation of the lemma needs to be concise, recognizable, and uniquely identifiable as a guiding element to provide orientation to the user. The lemma needs to be a unique address that can be referred to by cross-references.

Third, instances of object language use in context (usage examples, utterances, and parts of utterances) need to be comprehensible and true to natural use, i.e., coherent and fluent.

Fourth, information on or demonstrations of object language forms need to be presented clearly and in detail, they need to be illustrative to enable a correct reproduction by the user. This function is especially relevant for items that are unknown to the user and is thus essential to learners.

Last, in order to facilitate usability, the cognitive reception of the offered information is important to consider. Dictionaries contain a lot of information and their navigation is not trivial. Sign representations should thus be quick and easy to comprehend and encourage the possibility of skimming over a dictionary page in search of a specific element or to gain an overview of the contents. Mnemonic support is helpful in identifying signs based on their sign representation, be it through information on phonological form or semantic content.

2.4   Possible Solutions, their Advantages and Disadvantages

There are various ways to represent signs in a sign language dictionary to fulfill the function of representation, the function of the lemma as part of the access structure and as the information type of form comment. Below, we will point out some options and list their advantages and disadvantages. It is common practice to use a combination of more than one of these in sign language dictionaries in order to address all the functions of a lemma in a dictionary and solve the problem of adequately and uniquely represent the lemma sign in the entry.

- ID numbers
    - description: A string of numbers that uniquely identifies a given sign/entry.
    - advantages: unambiguous reference to signs (good for cross-references), machine-readable, conventional ordering (numerical order), easy to type in for searches
    - disadvantages: no information on form nor semantics, no mnemonic support
    - example: used as unique entry label and ordering element in the access structure in the AUSLAN-SD and in the Suvi (combined with video).[8]

- Glosses/ID glosses
    - description: a single written word (if necessary, with additional diacritic symbols or numbers) that functions as a unique label for a given sign
    - advantages: unambiguous reference to signs, mnemonic help for establishing an association of gloss word and sign via a shared meaning (either indicating underlying image or cue to meaning); a static, space-efficient, computer-readable form of representation, easy conventional ordering (alphabetical order), easy to type in for searches

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[8] See https://www.auslan.org.au/dictionary/words/purpose-1.html and
https://suvi.teckensprak.net/signsearch.php?a_id=45&showvideo=variationvideo_45_86.

- o disadvantages: interference of a spoken language[9]: gloss word sets expectations for both the meaning and the grammatical properties of the sign, provides no information on the sign's form
- o example: lemma representation and ordering element in the access structure in the NZSL-D (combined with video and drawn illustration) or in the ODT (combined with film still and video).[10]

- Written descriptions
  - o description: A written description explaining what the sign looks like or how it is produced with the hands; commonly used as additional information on the sign's form, rather than representation.
  - o advantages: good for supplemental information on the form and production of a sign (useful for learners), can indicate range of minor variations in an abstract and thus concise way, readable description, machine-readable
  - o disadvantages: Not suitable as short label for quick identification and reference, takes time to read and process, prone to misunderstandings, cannot be integrated into syntax of metalanguage, not suitable for cross-references, not suitable for stretches of signing
  - o example: not used as a single device, used as a comment on form; can be found in entries of the BSL-D in addition to gloss and illustration with arrows.[11]

- Writing systems[12], e.g., SignWriting
  - o description: composition of designated symbols to represent the form of a given sign designed to be as easy to perceive and produce as possible
  - o advantages: a readable and writable fixed form of sign representation; phonemic representation possible, efficient use of space promoting browsing of information on the page, machine-readable (to a limited extent): easy to sort and search by computers
  - o disadvantages: not widely used yet; needs training and skill – not user-friendly for occasional use of dictionary; no unique identification of signs that have the same form
  - o example: lemma representation in the D-LSFB, including ordering function and comment on form.[13]

- Scientific notations, e.g., HamNoSys, Stokoe Notation
  - o description: String or composition of designated symbols to represent the form of a given sign exactly. These notations aim to give a detailed account of the sign's form, either phonemic or phonetic.
  - o advantages: systematic and abstract fixed form, phonemic representation possible, machine-readable: easy to sort and search by computers
  - o disadvantages: readable/writable only for experts; not easy to memorize or recognize; representation mostly restricted to manual articulators; no unique identification of signs that have the same form

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[9] For further explication on this, see section 3 below.

[10] See https://www.nzsld.nz/signs/6029 and https://www.tegnsprog.dk/#soek%7Ctegn%7C284%7Csoeg%7C'tekst'orange%7Cresultat%7C4%7Ctrestjerner%7C1.

[11] See https://www.british-sign.co.uk/british-sign-language/how-to-sign/plane/.

[12] See König & Schmaling (2012, 344) for some examples of writing systems conceived for daily use.

[13] See http://dicto.lsfb.be/dico/orange_1.

- o example: lemma representation in the CDPSL; serves as comment on form along with illustrations of articulatory features (handshape and place of articulation) and a video.[14]

- Illustrations
    - o description: an illustration or image that shows a characteristic snapshot in the sign's production. These might be supplemented by symbols such as arrows showing the movement of the sign
    - o advantages: easily accessible static form, visual representation, usable for print, important aspects of form can be focused on (phonemic representation)
    - o disadvantages: complex movements, three-dimensionality, and temporal dynamics not easy to represent, so it is only an approximation to form representation; no unique identification of signs that have the same or a very similar form
    - o example: part of the lemma representation of the NZSL-D and the BSL-D, serving also as comment on form.

- Movies (recorded or animated)
    - o description: A video clip showing the full production of the sign.
    - o advantages: full and rich representation of form aspect, including information on body posture and facial expression
    - o disadvantages: takes time and a larger space for display, no fixed, static representation to the scanning eye, not easily integrated into the entries, limited with regard to phonological abstractions (e.g., range of handshapes cannot be visualized within one representative signed token), no unique identification for signs that have the same or a very similar form
    - o examples: Most online dictionaries use videos to show the form of the sign (see examples above).

For signed example sentences and utterances, there are three kinds of representation: signed video only, as in the D-LSFB, signed video plus translation into major surrounding vocal language(s) as in the Suvi and the CDPSL, or a signed video plus representation of the signed string in glosses serving as cross-references, plus translation into major surrounding vocal language, as in the ODT or the NZSL-D. In all online dictionaries cited, movies are used for the representation of signed example sentences, if they show example sentences at all.

3   Approach on Sign Representation in the DW-DGS

Our lexicographic work is based on the DGS corpus data as documented in the iLex database[15] and the dictionary production is interlinked with the corpus data and the type structures contained in iLex. Our iLex data base includes four elements that in principle could be used for lemma sign representation: i) videos of representative sign tokens including preferred studio recordings of the sign in isolation[16], ii) ID numbers for all data base elements including sign types, iii) unique glosses[17], and iv) HamNoSys notations of the types' citation forms.

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[14] See https://www.slownikpjm.uw.edu.pl/en/gloss/view/611.

[15] For details see AP06-2020-01 (Schulder et al. 2020).

[16] Representative studio recordings of the citation form of types are produced as needed in the context of dictionary production and corpus publication. For all types without studio recordings, the iLex system suggests a good representative token of the annotated data for internal reference use during annotation.

[17] These unique glosses could serve as ID glosses (cf. Johnston 2010), and they practically do so for the human annotator; however, since iLex internally uses real IDs (ii) independent of glosses (iii), the glosses can actually

Videos are the most likely choice to fulfil the function of illustrating the citation form of a lemma sign, its variants and signed examples in an adequate way in an electronic dictionary. We include a studio recording of the citation form as the comment on form in the microstructure of the entry – supplemented by some written information when needed. However, as videos are not very suitable lemma sign representations with regard to access structures (e.g. indicator of cross-reference addresses, listings of search results and the like) we opted for an additional way to represent lemma signs within dictionary access structures.

The iLex ID numbers were ruled out as a representational means. iLex ID numbers for sign types have reached a count nearing the sixth digit, which means that all disadvantages of ID numbers listed above prevail. Since IDs are convenient unique labels, we included entry IDs into our solution for lemma sign representation that are independent of type IDs in iLex (see below).

We have also decided against including HamNoSys and ID glosses in the surface structure of the dictionary for the following reasons: The Hamburg Notational System (HamNoSys) is very complex. Since it was developed for use in scientific contexts, it is very detailed in its descriptions and consequently difficult to learn and to process. As such, it is not user-friendly for occasional use. The dictionary entries do not display the notation openly, but the information of the HamNoSys notation available in iLex is used in the form-based search function in the dictionary.

Glosses, as mentioned above, easily lead to interference from the donor language of the gloss word. A user might (consciously or subconsciously) expect a sign to have similar properties as the German word used to label it, both in terms of meaning and grammar. For example, many signs in DGS can function as either a verb or a noun, i.e., they are not specified for part of speech. Any German gloss picked to represent such a sign would have to be either a verb or a noun, which would make the user expect to get a sign with a matching part-of-speech function. Also, a polysemous gloss word might not cover the same set of meanings as the sign. Furthermore, glosses imply a match of one sign to one word, which upholds the false belief of sign languages being exact matches to the surrounding spoken languages without their own language-specific properties. By using predominantly non-word visual sign representations, this belief can be counteracted. As elements of a second object language, German words can be put in relation to signs and thus fulfill the function as translational equivalents. To use German words in a second function as labels for signs (that is, glosses) would make it much more difficult for the user of a bilingual dictionary to keep the two object languages DGS and German apart and not confuse them.

There is another, more structurally informed reason of avoiding ID glosses in the dictionary. Through lemma establishment, the scope covered by an entry in the DW-DGS might differ from the scope covered by a type in iLex[18] and the Public DGS Corpus. One dictionary entry may include what the corpus would describe as several signs, i.e., several glosses; and one of the corpus' glosses might be split into two dictionary entries which would then have the same gloss. Thus, using glosses to represent lemma signs would require a new and somewhat different gloss system than the one used in the Public DGS Corpus *MY DGS – annotated*. Since

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be changed when desired – our iLex system makes sure that glosses for types are unique but it does not require glosses to stay the same as the internal ID for the types do not change.

[18] See project note AP10-2016-01 (Langer et al. 2020) and Langer et al. (2016).

the Public DGS Corpus does contain glosses and the DW-DGS is linked to this resource, it would be confusing to have two different sets of glosses in these interlinked products.[19]

For the lemma sign representation in the access structures of DW-DGS, we were looking for a solution that directly and exactly represents the signs' form and at the same time facilitates unique identification of the signs or entries respectively. The chosen solution is a combination of unique ID numbers (continually numbered entries) and movie thumbnails, which are small, moving images of the citation form. This combination of video and ID number is called a micon[20] (short for moving icon) in this article.

In the dictionary, we use movies and micons to represent signed units, trying to find the best solution for sign representation at the given spot in the dictionary structures. In the following, we will explain where they are used and how they interact with each other.

Each of our entries gets an ID number (see Figure 1), which is an integral number and uniquely refers to this entry and lemma sign. Wherever entries are referenced (in other entries, in indexes etc.), this number is used, so the user may clearly differentiate between entries. This is especially important to avoid confusion between entries that describe signs of the same or very similar form. The sign form chosen to represent the whole lemma sign – that also provides information on its form – is the citation form of the main variant. It is uniquely identified by the entry number with the variant indication (.1) added. Additional variants are indicated accordingly, e.g., 465.2 (see Figure 1).

Figure 1 ID number at the top of an entry in the DW-DGS

Movies are also used to show sign variants (see Figure 2) and examples (see Figure 3). Each entry and each index contains a movie display area on the left or upper part of the screen, in which the movies are shown. The movies in a given entry may include videos of the citation form of the sign, phonological variants[21], and various sign-mouthing combinations. These movies are recorded with signing models in a studio, so that a maximum of visual detail can be included. A high-definition studio-recorded video ensures high visibility of the sign and enables the use of different camera perspectives, which can be selected by the user in the dictionary.

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[19] For details on the interlinking of the Public DGS Corpus and the DW-DGS see Müller et al. (2020).

[20] The term micon comes from moving-icon and was first coined by Russel Sasnett (Brøndmo & Davenport 1989). In this original use, 'micon' referred to the small video playing in loop on its own. We have adapted the term for our purposes to include the ID number as well.

[21] What is called a phonological variant here is called a realization variant in other project notes. These variants may differ in more than one sign parameter from each other.

Figure 2 Video representation of a citation form in the DW-DGS

The movies for the example sentences are taken directly from the DGS corpus, which means that they are examples of authentic, natural, in-context signing. These movies are also high-quality and have two different camera angles that may be selected by the user (see Figure 3).

Figure 3 Video representation of a corpus example in the DW-DGS with German translation

The movie thumbnail is used as a smaller version of the sign variant's movies (see Figure 4). These are used for cross-references and in indexes to facilitate an overview of the given information. When first opening a site of the DW-DGS, these are unmoving stills of a characteristic position within the sign, but hovering over them with the mouse will make the small images move and thus allow the user to roughly recognize the sign's form. These are used to give a first impression of a sign when, e.g., searching for a specific form or switching between entries. If the thumbnail movie looks interesting to the user, they might click on the thumbnail to open the movie in the movie display area to get a larger, more detailed view of the sign. Clicking on the thumbnail movie does not move the user to a different part of the dictionary; it simply changes the content in the movie display area on the selected site.

As described above, movies are not suited as identifiers of entries, as some of the entries describe signs that look the same or very similar to each other.[22] Consequently, the movie thumbnails are not unambiguous either. In order to uniquely represent an entry, we have thus

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[22] In dictionaries, lemma signs and sign forms used for representation of form variants need a unique identification to distinguish homonyms/homophones or similar forms, which belong to different entries. All representational systems based on form only cannot provide a unique identification. They have to be combined with unique identifiers, e.g., an additional number.

chosen to combine these visual representations with the ID numbers. In places containing references to multiple entries, i.e., lists and tables, entries are identified by micons as they combine thumbnail movie and an ID number. When two entries look like they describe the same sign visually, the ID numbers will clarify that they are representations of different lemma signs in different entries. However, in case of two identical signs with different numbers, the user needs more information to decide which entry might be the one they are looking for. We have thus included a box in some relevant places that appears when hovering over the ID number part of the micon (mouseover function). This box shows the signposts indicating the different senses included in the entry and thus gives a hint on the semantic content of the entry. We call this a sense preview box.

Clicking on the ID number of the micon opens the respective entry represented by the micon.
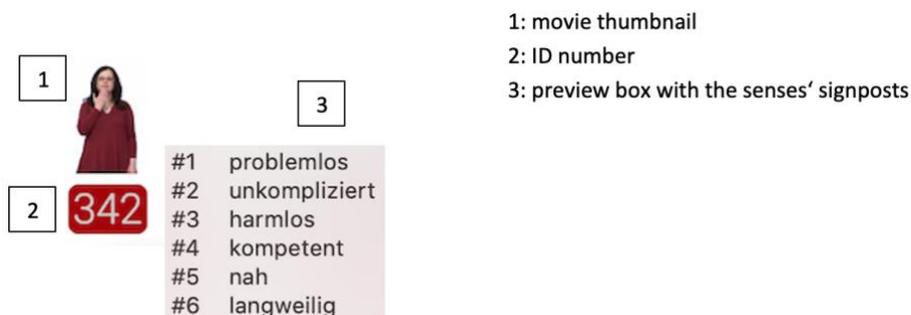

Figure 4 The structure of a micon with the sense preview box in the DW-DGS

Micons are also used as address indicators serving for direct access to a specific sense within the addressed entry. The addressed sense is indicated with the symbol '#' following the ID number (see Figure 5).

Figure 5 Micons in the German index of the DW-DGS

4 Conclusion

The DW-DGS uses two ways of representing sign language elements: videos and micons (a combination of ID numbers, movie thumbnails, and at certain places in the dictionary structure, sense preview boxes). These combine all the advantages of visual representations of signs (genuine representation of the object language, detailed information on sign form) with the exactness of identifying labels (in this case, ID numbers) and without requiring too much space. We have decided against ID glosses in the dictionary in order to avoid language interference on account of the signs being perceived in direct connection to a German word. The

disadvantages of the other representation options have been laid out in this paper. Their advantages are outweighed by those of the visual representations that we have chosen.

While we are still working on the dictionary, we started showing pre-release entries to our focus group in 2018 and to the general public in 2020. Based on these first insights into the dictionary, we have been getting positive feedback from users and from the DGS community in particular. People have been appreciative of our focus on visual representation, i.e., focusing on direct representation of DGS. There is oftentimes some confusion regarding the ID numbers, as people are not used to them and suspect a meaning in the choice of number, when there is none as they are simply used to differentiate between entries. Given some time to get used to the look of the dictionary, the confusion dissipates and the navigation via the different indexes becomes clearer. Afterall, entries can also be found through German words in the German index. The searches via the index usually give more than one possible sign for the German search term which represents the relationship between DGS signs and German words much more accurately than ID glosses would: They are possible translations of one another, not exact matches. Representing this relationship accordingly in the structure of our dictionary has been received favorably in the language community.

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5.2 Project Notes

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