SIGN LANGUAGE & LINGUISTICS

VOLUME 4 NUMBER 1/2 2001

SIGN TRANSCRIPTION AND DATABASE STORAGE
OF SIGN INFORMATION

OFFPRINT

SignPhon

A phonological database for sign languages

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This paper describes the SignPhon database, a tool for phonological research. The history and goal of the project are outlined, and the database is briefly compared to other projects like HamNoSys and SignStream. We present the structure of the database and an overview of the fields that are included. We conclude with a discussion of the experiences that we have had in using the database for our research.

Keywords: Sign language, phonology, phonetics, phonological database, transcription, notation, methodology

1. Introduction

This article describes SignPhon, a database designed to store information about the phonetic and phonological structure of (isolated) signs. The database contains a complete phonetic-phonological description of signs. This information is divided across 65 fields; altogether the whole set of linked databases contains 156 fields.

The database has been implemented in 4th Dimension, a database program for Apple Macintosh and Windows. In order to use the implementation one must have a "runtime version" of the 4th Dimension program, which is a freeware product. A detailed description of the database structure and of the implementation can be found in the SignPhon Manual which is available on the SignPhon web site (http://www.leidenuniv.nl/hil/sign-lang/signphon2.html). By sharing the database with other researchers, we hope to profit from their experience with the system. We therefore welcome any help, advice or criticism and, above all, collaboration.

This article contains seven sections. Section 2 provides information about the history of the project. Section 3 discusses the goal of the SignPhon project. Section 4 introduces the global structure of SignPhon, while Section 5 goes over the fields. In Section 6 we discuss some of the advantages of working with a database like SignPhon, and some of the problems or shortcomings that we have encountered. In Section 7 we

Sign Language & Linguistics 4:1/2 (2001), 215–228.
ISSN 1387–9316 / E-ISSN 1569–996x

end by discussing what we call "the database paradox", a problem that most designers of databases have to live with and its relation to more general problems of phonetic and phonological transcription.

2. History

An investigation into the phonological structure of any natural language requires insight into the array of phonetic properties and into the role that these properties play in distinguishing the morphemes of the language. Phonological-phonetic research generally uses three kinds of data sources:

1. dictionaries
2. native user judgments
3. transcriptions of videotaped materials

A fourth category of data that we did not list above consists of phonetic measurements of the articulation or the signal, comparable to phonetic measurements in speech research. For most of the researchers so far, this is impossible for practical reasons, and few such studies have actually been performed (e.g. Wilbur & Schick 1987, Mauk 2000).

Dictionaries generally provide illustrations of one prototypical token of each sign; sometimes, they also offer a transcription of the sign used, and information about regional or phonetic variation. Since most dictionaries that have been made so far list the core lexicon of the sign language, consisting of highly frequent items, they provide useful data on frequency of phonetic characteristics as well. This information typically is hard to access, since even on CD-ROMs, search facilities tend to be limited, and not always linked to an elaborate transcription (e.g. GLOS 1999).

Native signer judgments can be used to confirm the realization of a sign found in a dictionary, to distinguish between prototypical and odd realizations of signs, to test the phonological status of non-existing signs, and so on.

In collecting new material on videotape, some kind of transcription is necessary to categorize what was found. When we started working on the phonological structure of Sign Language of the Netherlands (SLN or NGT, Nederlandse Gebarentaal), we felt that detailed insight into the phonetic and phonological characteristics of the language was not sufficiently available and also was not easy to obtain by inspecting the data that had been published in a number of small dictionaries. We therefore decided to build a database.

We were aware that we would probably not be the first to have undertaken such a project. After consulting several colleagues we learned that although there are (or have been) quite a number of database projects, most of these have a more general lexicographic goal, implying that the phonological encoding is usually necessarily rather limited.

We therefore decided to start from scratch, relying as much as possible on insights into the structure of signs that are available in the theoretical literature on phonetic and phonological features and in encoding systems. The latter mainly consisted of notation systems, such as KOMVA (KOMVA 1988, which is based on Stokoe notation, cf. Stokoe 1960) and HamNoSys (Prillwitz et al. 1989). We started designing a database structure in which every record specifies information on signs in isolation.

During the second half of 1995 we designed the record structure which was implemented by Onno Crasborn and Rob Goedemans in the course of January 1996. February and March were used to make a start with the manual (version 0.1) and as of April 1996, we started entering the first 250 signs into the database. We expected that our first experience with storing data would lead to modification of the record structure and to a fine-tuning of the values necessary for each field.

At the sixth conference on Theoretical Issues in Sign Language Research in Montreal in 1996 we organized a special meeting on ways to improve the current state of the database. Various specialists on databases and/or phonology of sign languages were present at this meeting. Specific questions concerned the content of the database (what are the signs that we are going to fill the database with?) and the way temporal sequencing in the sign was stored.

We then designed a second version of SignPhon, which was implemented by Onno Crasborn in 1998. The present article describes this version, i.e. SignPhon2. This version has been set up as a relational database (a set of connected databases), whereas Version 0.1. was a single ('flat') database. Contentwise, Version 2 differs from Version 0.1 with respect to several fields and their codes. In addition, Version 2 allows us to encode various stages in time of a sign separately, thus better capturing the dynamic nature of signs. The choice of the number of stages is independent from a phonological analysis in terms of, for example, holds and movements (Liddell & Johnson 1984).

Most signs that are encoded have been videotaped; initially a few signs were transcribed on the basis of the photo dictionaries (KOMVA 1989). Relevant fragments of the sign in isolation and in context have been stored as digitized files. These video files have not been integrated in the SignPhon structure. In the future SignPhon could be linked to a database of digitized video fragments so that for each occurrence in SignPhon (a 'source', see below), the actual realization of the sign can be consulted. At this point, the video fragments have to be played back by another application such as QuickTime Player.

It is possible in principle to develop interfaces with other applications that would translate the coding system into other transcription or notation systems (such as HamNoSys). In SignPhon we do not use iconic symbols as values for fields, keeping the coding systems notation-neutral and purely alphanumeric.

3. Goal

The primary goal of SignPhon is to be a tool for research into the phonetic and phonological structure of sign languages. To analyze the phonology we must start at the lowest level, i.e. at the level of morphemes. We must establish the set of distinctive units from which morphemes are constructed. This is a purpose in its own right, leading to the description of lexical forms, but it is also a necessary step before we can investigate the phonology at higher levels, i.e. in complex words and phrases.

It is important to keep in mind, then, that SignPhon encodes isolated signs. One could call this the dictionary form of the sign, but apart from the fact that this notion is problematic in itself before a full analysis of a language is made, we do not claim any form of standardization. In principle, however, every encoded form is a possible (i.e. well formed) form in isolation. Signs that have been recorded have been elicited in isolation and in sentence context. The latter forms are not encoded, but could be in the future.

By storing detailed information about a relatively large collection of signs, we enable ourselves (among other things) to establish the inventory of phonetic properties, to decide which of these are distinctive, and to make generalizations on combinations of these properties.

The coding system (which we briefly describe in Section 5) allows us to encode relatively well-known properties of signs, but we have deliberately chosen to also encode finer phonetic detail. We have not avoided encoding properties of signs from various perspectives, using both familiar and new terminology, in order to facilitate its use by researchers from various theoretical persuasions, as well as more practically oriented users. Among other things, this implies that no systematic choice has been made for either a perceptually or articulatorily based encoding: some properties are easier to encode perceptually, others are more tractable when we consider the production side.

The signs that have been so far entered in the database are from SLN, but clearly SignPhon has not been designed as a language-specific system. The database was used in a study of the phonological acquisition of LIBRAS (Brazilian Sign Language; Karnopp 1999), and for a formal analysis of Uganda Sign Language handshapes (Nyst 1999). In principle, SignPhon can be used for any sign language. Expanding the database with data from other sign languages would make it a highly powerful tool for investigating sign language universals. Using a uniform computerized coding system will make it possible to exchange data from various languages easily.

SignPhon clearly differs in goal from the SignStream project (Neidle this issue): the latter is a software tool that is aimed at transcription of larger units than the word. Moreover, SignStream differs from SignPhon in that it provides relatively few prespecified categories and values. Although SignPhon is open-ended in the number of new values that one can add for a specific field in the database, the number of fields are fixed. SignStream could also be used for phonological research, especially with the improved search capacities in the second version. This would be preferable if very small timing distinctions need to be encoded for a specific project, since SignStream allows as many "stages" in time as the source material contains (for European video, this would be 25 or 50 Hz).

4. Structure of the database

The first version of the database had a so-called "flat structure": the program contained a number of fields (columns) which concerned different descriptive categories (gloss, translation, handshape, movement, etc.), and each sign formed one record (row) with values for all of the fields. This design was very inflexible: for example, it was not easy to describe multiple segments in the sign (e.g. an initial and a final orientation in an orientation change), or to store the fact that one sign occurred on multiple videotapes.

The new structure was designed with the goal of being more flexible. Especially in the area of the phonetic description in multiple stages in time, we wanted to be able to do more than just describe very simple signs, or to make gross abstractions enforced by the program. Below we present the new structure of SignPhon in the form of a diagram. It is a relational database design: the information is distributed in different groups, and there need not be a one-to-one correspondence between them. Arrows in the diagram point from "one" to "many": one language has many signs, one sign has multiple stages of phonetic description, one handshape can occur in multiple stages of phonetic description, etc. The shaded parts of the structure have not yet been fully implemented.

In our description of the record structure it will become clear that not all fields need to be filled for all signs. In addition, some fields are filled only once for all signs, like the fields in the handshape sub-database. Generally, it takes about 20 minutes to encode one sign. The present number of encoded SLN signs is a bit over 3000 (September 2000).

The central unit for usage is the sign: most frequently, the database will be used to answer questions like "how many signs are there which have property X?". One sign can be found in multiple places (on different video tapes, in different pictures and drawings in books, etc.). Each occurrence can be registered in the Sources part of the database. Each signer that is identified in the source of a sign is characterized in the Signers part of the database.

One sign can be described in multiple phases, stages in time. We call these stages of phonetic description. In SignPhon, as many stages are used as is necessary to describe the sign completely. This is independent of the phonological analysis of the sign: a stage of phonetic description does not correspond to a hold segment in the model of Liddell & Johnson (e.g. 1989) or to an X slot in the Leiden model (e.g. van

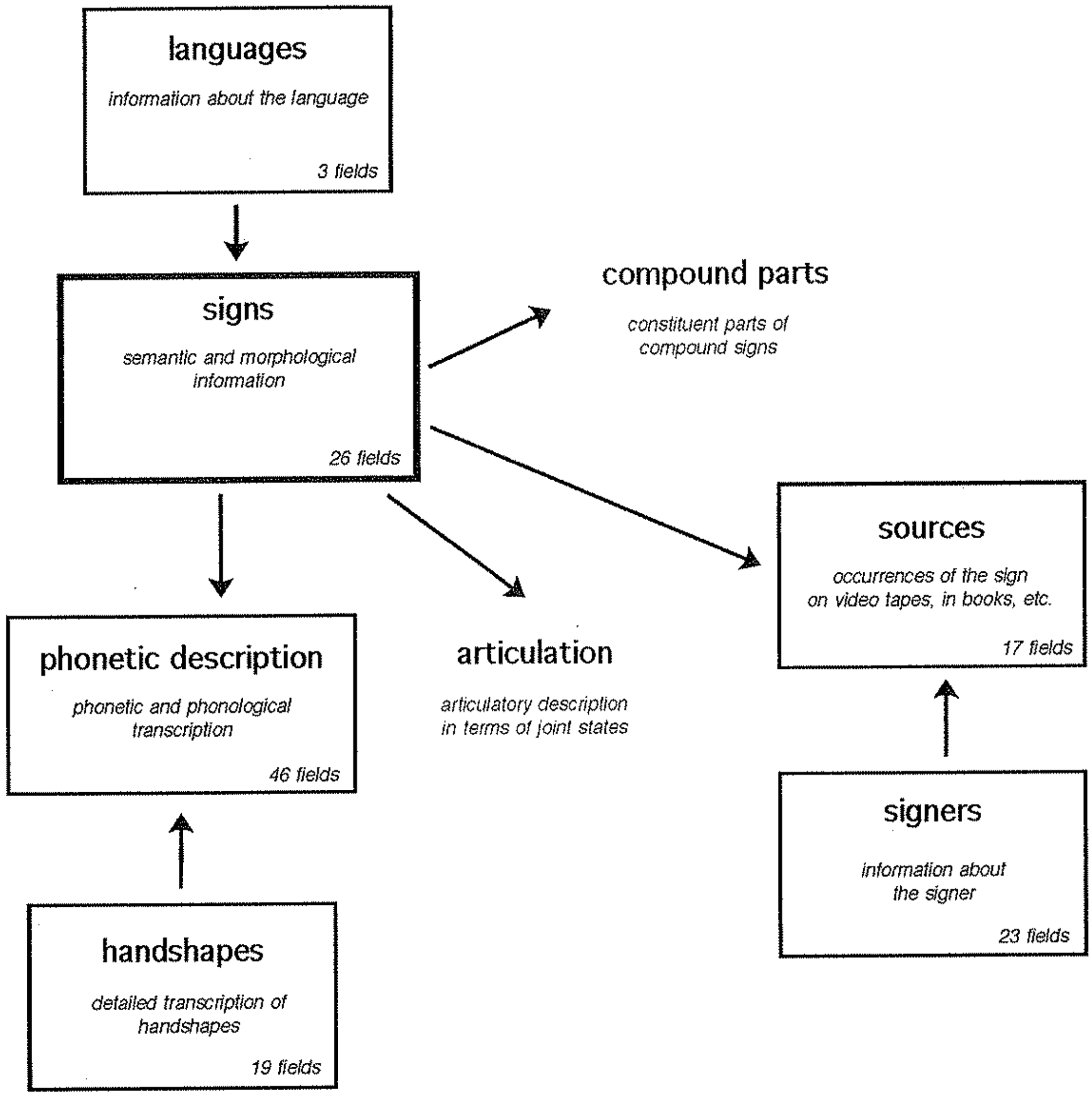

Figure 1. The structure of SignPhon.

der Hulst 1993, 1995). Thus, SignPhon transcription is similar to IPA transcription of speech sounds: it will take some effort to use the system independently of and unbiased by one's own phonological analysis. More importantly, conventions and agreement will have to be established by intensive use of the system. (Even so, like in spoken language transcription, it is unlikely that perfect agreement between transcribers can ever be achieved, despite explicit guidelines and intensive training; cf. Vieregge 1985.)

Handshapes are described in detail in a separate part of the database: it would be very inconvenient to have to describe for each sign with a B-hand in terms of its selected fingers and their exact position.

Future developments will include the addition of the articulation part, allowing transcription of each degree of freedom of each joint in the arm. (The articulation of the handshapes, or in other words the state of the joints of the fingers, can already be transcribed in the handshapes section.). Further, compound parts will be put in a separate sub-database, with more information on which stages of phonetic description describe it. Finally, it would be desirable to be able to add sentences (gloss transcription and video fragments), to enable comparison of citation forms and context forms of a sign.

5. Description of the fields

In this section, all the fields from the most important sub-databases are listed. The compound parts and articulation databases have not yet been fully implemented; the languages sub-database only contains a few fields such as the number of signers, and is only useful if several languages are transcribed in the same data file. We will list all the fields per sub-database and make a few brief comments.We cannot discuss all the fields individually, but we hope that the lists provide a solid idea of the amount of detail that is stored for each sign, even though it is not the case that all fields are relevant to all signs.

5.1 General fields

The fields mentioned here do not constitute a separate sub-database in the diagram. They surface in most sub-databases and contain administrative information, keeping track of who entered what and when. Every sub-database also contains a REMARKS field, where the user can store an unlimited number of comments.

ENTRY DATE
ENTERER NAME
LAST MODIFICATION DATE
MODIFIER NAME
REMARKS

5.2 Signs

This sub-database stores elementary semantic and morphological information.

GLOSS
LANGUAGE
NUMBER
NUMBER OF STAGES
DUTCH TRANSLATION
ENGLISH TRANSLATION
SEMANTIC FIELD

MOTIVATEDNESS
MORPHOLOGY
WORD TYPE
BORROWING
NUMBER OF PARTS
SEQUENTIAL COMPOUND
COMPOUND PART[1–5]

5.3 Phonetic description

The phonetic description sub-database is the most important database because here we encode in great detail the shape of the signs, divided over 46 fields. Most field names speak for themselves (if one is familiar with analyzing the formational structure of signs). Some fields with administrative information have been left out of the list below.

ARTICULATOR NUMBER
RELATION STATIC
RELATION DYNAMIC
ALTERNATING
HANDSHAPE STRONG
HANDSHAPE WEAK
HANDSHAPE CHANGE
PALM ORIENTATION STRONG
PALM ORIENTATION WEAK
FINGER ORIENTATION STRONG
FINGER ORIENTATION WEAK
ORIENTATION CHANGE
LEADING EDGE
LOCATION TYPE
PLANE
LOCATION STRONG
LOCATION WEAK
LOCATION SYMMETRY
CONTACT MOMENT
CONTACT PLACE
MONO/BI DIRECTIONAL
PATH ON PATH
PATH SHAPE
MOVEMENT DIRECTION
MOVEMENT DIRECTION WEAK
SEQUENTIALITY

REPETITION
SPEED
INTENSITY
SIZE
SIGNING SPACE
FACIAL EXPRESSIONS
FACIAL MOVEMENT
ORAL COMPONENT
POSTURE HEAD
POSTURE BODY

5.4 Handshapes

This sub-database provides an encoding for all the attested handshapes. The handshapes that are used in every individual sign are encoded in the phonetic description of that sign in terms of a code (HANDSHAPE CODE) which refers to this handshape database. The abbreviations MCP, IP, PIP, and DIP refer to the different joints in the fingers and thumb; these fields include an articulatory description of each handshape. The articulatory information for the rest of the articulator can be given in the articulation sub-database.

5.5 Sources

One can distinguish between signs from different sources, although currently for our own research most of them are recorded especially for the SignPhon project. Other sources are dictionary CD-ROMs, for example.

SOURCE
SIGNER
DIALECT
SWITCH
REGISTER
CONTEXT
COLLECTION

5.6 Signers

We try to keep track of as much information about the informants as we think might be relevant.

SIGNER CODE
FIRST NAME

SURNAME
SEX
HANDEDNESS
BIRTH YEAR
HEARING
GRANDPARENTS
PARENTS
SIBLINGS
CHILDREN
PARTNER
FRIENDS
FIRST LANGUAGE
SECOND LANGUAGE
AGE OF ACQUISITION
SCHOOL
REGION
CURRENT RESIDENCE

6. Our experiences with the database

In this section, we will briefly discuss some of the work that we have done with the database by describing some of the possible queries. We will draw attention to the kinds of findings that we think are useful and that would otherwise have been very difficult to obtain. Then we will also mention some of the drawbacks of the database and make suggestions for improvements.

In the course of the Ph.D. projects of Els van der Kooij (2002) and Onno Crasborn (2001), the main types of queries concerned frequency distributions of formal elements (for instance handshapes, points of contact, location types), of combinations of elements (for instance all handshapes in neutral space or on the head). The database also turned out to be useful in collecting data for specific investigations (for instance, what is the proportion of signs made near the temple that are not in the semantic field of 'mental state or activity').

A major drawback of the database was its content in relation to the goal and the type of research that we performed with it. All signs that were stored in immense phonetic detail were based on one phonetic instance of the sign articulated by one signer. Ideally, to make a phonological analysis one would want to compare different instances of the same sign, signed by various signers in various contexts. This could be done in SignPhon. However, a device that compares the content of the fields of different signs would be indispensable. Encoding of the signs would also benefit from such a device. In the current encoding procedure the encoder had no way to check if the sign at hand was already encoded. The database currently warns the encoder if a sign is already present with the same gloss. Since this gloss is just a label for the sign, it might also be the case that the sign itself is already present, but with a different gloss label. At this point it is not possible to automatically compare different records in the database. In the ideal case, one should be able to select a sign and search for similar signs, where the comparison criteria could be chosen from a set of predefined characteristics or composed by the user. Currently one has to do this by searching for a combination of criteria that is featured in the sign that one wants to compare.

To determine the nature and precise content of phonological features the comparison of several instances of a sign is necessary, and as we said, the database makes it hard to do this by not yet having preprogrammed routines for this. Moreover, in our research so far we have not gathered the kind of data for these comparisons. Given our experience that it takes about 20 minutes to transcribe one sign, it is obvious that building such a corpus of transcriptions would require the investment of a great deal of time and money.

7. The database paradox

In designing a database structure one runs into the following problem. The goal of building a database is to find patterns, distributional regularities, cooccurrences and frequencies in some domain, often with the goal in mind of using this information in the construction of a theory. That is, one uses it either to test certain hypotheses (that one may or may not already have), or as a heuristic for developing hypotheses. Thus, before the database is built, one does not yet have a comprehensive model of the relevant domain and there are a lot of questions and uncertainties. To maximize use of the database, one wants to encode the primary data so that in the phase of using the database one easily can sort the primary data in categories.

Now the problem is this: to encode the primary data one really must know what the database is designed to help one find out, i.e. the relevant categorization of the primary data. Therefore, the ideal encoding system is, in effect, the best theory of the domain. It follows from this paradoxical statement that any encoding system will be, at best, an approximation of this ideal. One seldom starts from scratch in the sense that there will usually be previous theories or ideas that one can rely upon. It follows (at least it did for us) that one should not dwell too long on constructing the ideal coding system. In particular, we did not try to make the coding system as economical as possible, avoiding all redundancy. Again, and in line with the paradox: how could we possibly know what the most economical or redundancy-free system is? Of course, we did the best we could, i.e. we have tried to incorporate codes for all the distinctions that we thought could be relevant, thus arriving at a rather rich set of codes and allowing for a phonetic encoding of each individual sign that is many times more complex than what we expect, in the final analysis, a parsimonious phonological representation to be.

SignPhon differs from transcription systems like HamNoSys not only in including non-phonetic information (about the morphology, semantics, and background of the signer), but also in being more detailed and more redundant. Orientation of the articulator, for example, is encoded in great detail (both "absolute" and "relative", Crasborn & van der Kooij 1997) and in addition to specifications of point of contact. There is also redundancy in the aim to encode both perceptual and articulatory categories. Another difference with transcription systems is that SignPhon allows the user to add categories (or rather values in the fields) without interference from the designer of the database. Most fields accept any (combination of) character(s), and in our experience this has been especially useful for adding handshape distinctions that we did not foresee.

This database paradox is not just present in the use of databases for research purposes, but more generally in the use of transcription systems for phonological research, in speech as in sign. The international phonetic alphabet (IPA) can be used for both broad and narrow transcriptions (using respectively few and many diacritics), but even in the case of narrow transcription the categories that one can use are already an abstraction, and they form a closed set. For more detailed analysis, phonetic experiments will have to be designed that make use of measurements of the articulation, the signal, or the perception of speech sounds.

We wish to make another point. We never had the ambition or illusion that we would come up with a coding system that would be satisfactory for everyone. Firstly, non-linguists, native-signers or otherwise, hoping to find information on how exactly to pronounce a sign will complain that this system is unusable. We agree. SignPhon is not a tool for non-linguists. It is a research tool. With it, we hope to serve the community of sign language users by finding things out about the phonological structure of sign languages that could be of use for descriptions, grammars or dictionaries. Secondly, sign language researchers who are not primarily interested in the phonetic shape, or phonological structure of signs, will also find our encoding overly tedious, and too difficult to use. Again we agree, SignPhon is a specialized research tool. One could, of course, quite easily construct a simpler database that uses all the signs that are encoded in SignPhon and a subset of the encodings, perhaps using user-friendly labels for the codes, but that would be a derivative that we are not, at this point, building. Thirdly, even a researcher who is specialized in the phonetic/phonological structure might find out that a certain property is not encoded in SignPhon, simply because we didn't think of it, or because this property is relevant to a very specific research question that we didn't even know existed.

The moral is: one has to start somewhere, and no one builds databases for the distant future. Better tools will be necessary (using insights and technology that we do not have at this point in time). Hopefully, SignPhon, apart from serving our immediate needs, can play a role in the design of such new systems.

Acknowledgments

The SignPhon project has been financially supported by two grants from The Dutch Organization of Scientific Research (NWO), project nos. 300–75–009 and 300–98–31. We also received a grant for equipment from the Gratama Foundation. Finally, the Faculty of Arts of the Leiden University gave us financial support for equipment and research assistants.

We wish to thank Marja Blees, Corine den Besten, Henk Havik, Alinda Höfer, Karin Kok, and Annie Ravensbergen for collecting, digitizing and coding of data, and Rob Goedemans and Jos Pacilly for technical assistance. In designing the structure of the database we have discussed various linguistic issues with Diane Brentari and Wendy Sandler. We wish to thank Jean Ann, Diane Brentari, Thomas Hanke, Bob Johnson, Scott Liddell, Chris Miller, Elena Radutzky, Wendy Sandler, Leena Savolainen, Trude Schermer and Ronnie Wilbur for their useful comments and criticism during a workshop on SignPhon in September 1996 in Montreal.

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