# Sign Language Phonetic Annotation meets *Phonological CorpusTools*: Towards a sign language toolset for phonetic notation and phonological analysis

Oksana Tkachman, University of British Columbia
Kathleen Currie Hall, University of British Columbia
André Xavier, University of British Columbia
Bryan Gick, University of British Columbia

Adequately representing data is challenging even for spoken languages, but in the field of sign language research this task proves to be one of the hardest nuts to crack. In the few decades that sign languages have been subject to linguistic research, several attempts have been made to create a written notation system for handshapes, such as Stokoe's (1960) Notation; the Hamburg Notation System, or HamNoSys (Prillwitz et al. 1989); and the Prosodic Model based transcription (Eccarius and Brentari 2008), among others. Though adequate for some purposes, those notation systems are inadequate for representing phonetic data or in phonological studies, especially for cross-linguistic studies (see Hochgesang 2014 for a detailed evaluation of the above systems). Recently Johnson and Liddell (2010, 2011a, 2011b, 2012) addressed this problem by proposing a notation system of hand configurations that aims to be as exhaustive as possible. We follow Hochgesang 2014 in calling this system Sign Language Phonetic Annotation, or SLPA. Johnson & Liddell argue that even though only linguistically relevant information should be included in a notation system, it is probably necessary to start with more information and reduce the description as certain phenomena are found not to be linguistically relevant. As a result, this system is too exhaustive, requiring between 23 and 33 symbols for each possible handshape, and capturing handshapes that are implausible in terms of being linguistically meaningful, either because they are perceptually nondistinct despite being anatomically different or because they are anatomically impossible to produce. Consequently, while allowing for an extraordinary amount of phonetic detail, it is too hard to capture patterns and make generalizations with this notation system, even the basic ones such as allophonic variants of the same phoneme.

We discuss three ways of simplifying SLPA in order to make it more linguistically relevant without losing valuable phonetic detail. First, the annotation should not include any of the anatomically impossible handshapes--these are analogous to the shaded boxes on an IPA chart. For example, Ann (2000) explains patterns in sign language handshapes in terms of hand muscle structure. There are separate extensor and tendon muscles for the index finger and the little finger, which allow them to extend independently; but in order to extend either the middle finger or the ring finger, a shared by all fingers extensor muscle has to be applied, while other muscles simultaneously flex the rest of the fingers. This means that when either the middle finger or the ring finger is fully extended, the rest of the fingers cannot be fully flexed, and therefore all the denotations of such forms with the rest of fingers fully flexed should be eliminated. Second, redundant handshape representations should be merged. For example, in order to flex distal joints the medial joints have to be flexed first; therefore, the representations that distinguish between cases where both the medial and the distal joints are flexed and cases where the distal joints are flexed but the medial joints are extended or hyperextended should be merged. And third, determining which types of handshape differences are perceptually nondistinctive will help to reduce the number of unnecessary phonetic details and make finding phonological patterns easier. As signers tend to look each other in the face during a signing conversation, the handshapes that are below the face area are perceived with peripheral vision which is not very sensitive to fine details, and therefore many handshapes that are anatomically

different are not perceived as distinct from each other (Siple 1978). Distinguishing such forms in the notation system is likely to obscure linguistic analyses rather than elucidate them.
Adopting these three kinds of changes will make phonological analysis of handshape easier in general, but will also have the benefit of making computational approaches to such analysis feasible. In particular, we will demonstrate how the revised SLPA system will allow corpora of phonetic handshapes to be imported into the *Phonological CorpusTools* software (PCT; Hall et al. 2015). PCT allows researchers to make fast, replicable analyses of various phonological patterns, such as the predictability of distribution and functional load of phonological units (e.g., for determining which units are contrastive vs. allophonic in a language) and the similarity of phonetic or phonological strings (e.g., for use in calculating neighbourhood density). By creating a relatively fine-grained, consistently applicable, and, importantly, unicode-character-based transcription system, these same measurements can be applied to sign language corpora. This will allow both for the documentation and analysis of individual languages and also for the comparative analysis of different languages, allowing greater understanding of the physiological vs. phonological patterns in sign language handshape.

We will give some illustrative examples of the revised SLPA and of the PCT adaptation of the revised system, as well as initial examples of PCT-based analyses of corpora of handshape inventories from different sign languages.

References


Ann, J. (2000). *Frequency of Occurrence and Ease of Articulation of Sign Language Handshapes*. Gallaudet University Press.

Eccarius, P., & Brentari, D. (2008). Handshape coding made easier A theoretically based notation for phonological transcription. *Sign Language & Linguistics*, *11*(1), 69-101.

Crasborn, O. (2012) "Phonetics." In: Pfau, Roland, Markus Steinbach & Bencie Woll (eds.) *Sign language. An international handbook*. (*HSK - Handbooks of linguistics and communication science*), pp. 4-20. Berlin: Mouton de Gruyter.

Hall, K.C., Allen, B., Fry, M., Mackie, S., & McAuliffe, M. (2015). Phonological CorpusTools, Version 1.0.1. [Computer program]. Available from https://sourceforge.net/projects/phonologicalcorpustools/.

Hochgesang, J. A. (2014) Using Design Principles to Consider Representation of the Hand in Some Notation Systems. *Sign Language Studies*, *14*(4), 488-542.

Johnson, R. E., & Liddell, S. K. (2010). Toward a phonetic representation of signs: Sequentiality and contrast. *Sign Language Studies*, *11*(2), 241-274.

Johnson, R. E., & Liddell, S. K. (2011a). A segmental framework for representing signs phonetically. *Sign Language Studies*, *11*(3), 408-463.

Johnson, R. E., & Liddell, S. K. (2011b). Toward a phonetic representation of hand configuration: the fingers. *Sign Language Studies*, *12*(1), 5-45.

Johnson, R. E., & Liddell, S. K. (2012). Toward a Phonetic Representation of Hand Configuration: The Thumb. *Sign Language Studies*, *12*(2), 316-333.

Prillwitz, S., Leven, R., Zienert, H., Hanke, T., & Henning, J. (1989). Hamburg notation system for sign languages. An introductory guide, HamNoSys version 2.0. *Signum, Seedorf, Germany*.

Siple, P. (1978). Visual constraints for sign language communication. *Sign Language Studies*, *19*(1), 95-110.

Stokoe, W. C. (1960). Sign language structure: An outline of the visual communication systems of the American deaf. *Studies in Linguistics: Occasional Papers 8.* Buffalo, NY: Department of Anthropology and Linguistics, University of Buffalo.