On the internal and external organization of sign language segments: some modality specific properties of segments in NGT.

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In this paper we focus on the notion of segment in the study of sign language, in particular of Nederlandse gebarentaal (NGT - Sign language of the Netherlands). We discuss what a useful interpretation of the concept ‘segment’ might be in the context of sign language, and how this interpretation relates to other units of the phonological representation (in particular to the syllable). Providing an analysis of the sign as a single segment we further show that where the syllabic structure dominates the segmental structure in oral languages, the domination relation is reversed in sign languages, i.e. syllable structure is intra-segmental. In the second part of this paper we compare the internal organization of sign and spoken segments and suggest explanations for the similarities and differences.

With reference to the manual aspect of sign Stokoe (1960) distinguished three important units, or rather types of units: the handshape, the location and the movement of the hand. For each of these units there is an array of possibilities (different handshapes, different locations, different movements). Although Stokoe (and later researchers) took the basic units to be on a par with spoken language segments, thus leading to a view of the sign as a whole as forming a kind of ‘syllable’, we suggest that the basic units are like class-nodes, which entails the proposal that the sign as a whole forms a single segment:

(1) a. sign segment
    ┌───┐
    │   │
    │ handshape orientation movement location │ manner place laryngeal
    │    │    │    │    │    │    │
    | index down straight forehead stop labial voiceless |

Stokoe (1960), taking basic units to be like ‘segment’, concluded that spoken and signed languages differ in that in spoken language phonemes are sequentially organized, whereas they are simultaneous in sign language. In our view there is no such difference, as units such as handshape in (1a) are just as simultaneous as units such as manner in (1b).

Somewhat later, a different concept of segment and syllable emerged in the sign language literature. Certain regularities in sign languages (involving phonological changes in the form, or morphological rules) seem to make reference to the beginning or the end of a sign. To accommodate the relevant phonological and morphological rules, the notion ‘beginning’ and ‘end’ must be formalized. This lead to a sequential structure in the phonological representation (Newkirk 1981, Liddell & Johnson 1989, Sandler 1986, Perlmutter 1992). The sequential units of the sign came to be referred to a segments (P stands for initial and final ‘Position’, M for the ‘Movement’ in between). Soon, the PMP ‘skeleton’ was seen as the sign analogue to spoken language syllables. In models of this type, the property Handshape (and a newly recognized property ‘orientation of the hand’) were treated as ‘autosegments’ that associated to all units in the skeleton. Specific details regarding initial and final location, as well as details regarding the type of movement were associated to single positions. Suppressing details, we conflate several proposals of these autosegment-syllabic models (Liddell & Johnson 1989, Sandler 1986, Perlmutter 1992) into the following diagram.

(2) (handshape)
      ┌───┐
      │   │
      ┌───┐
      │    │
      └───┘
      [orientation]
[P M P]

[=] [=] [=]  (place and movement features)
How will our monosegmental view, outlined above, accommodate the need for initial and final positions? To address this, we need to discuss the notion of movement more fully. The PMP model recognize movement of the hand as a whole (called Path movement) in terms of its skeletal unit M. However, apart from path movement there can also be movement involving either rotation of the hand (called orientation change) or movement of the fingers (called hand-internal change). The latter two movement types are treated in terms of more than one feature value on the handshape and orientation tiers. Wilbur (1993) argues that this same treatment can also be given to path movements, thus lifting the need for a skeletal tier. In her terminology, all multiple feature specifications constitute ‘syllables’ in their own right. In our segmental model, we adopt this view, representing multiple feature specifications as branching nodes. If we maintain using the term ‘segment’, we end up with the paradoxical conclusion that in sign language the unit segment dominate the unit syllable, and, in fact, that one segment can contain several (simultaneous) syllables. The following diagram is a simplified version of our model:

![Diagram of sign-segment](image)

We will discuss the model in somewhat more detail, motivating the particular ‘geometric’ grouping of its building blocks.

Our model does not deny the possibility of polysegmental signs, however. We will show that there are signs in NGT that consist of two segments. We will argue that several constraints that have been proposed in the sign language literature (such as the claims that ‘simple’ signs have one set of selected fingers and one ‘major’ place’) are, in fact, constraint at the level of the sign segment. Thus signs that violate these constraints must be polysegmental. Bisegmental signs are usually frozen remnants of fingerspelled words, or frozen (hidden) compounds.

In the second part of our paper, we will offer an explanation for this rather startling conclusion. Phonological categorization of the phonetic substance proceeds in two dimensions: vertical (sequential) and horizontal (simultaneous). Spoken language has long been looked at as purely in terms of an absolute precedence of vertical slicing over horizontal slicing. The vertical slicing produces a sequence of segments (organized in a syllabic structure), which is then followed by a horizontal slicing of each individual segment into co-temporal features. Consequently, each feature has scope over just a single segment. This absolute dominance of vertical over horizontal slicing is exemplified in the so called SPE-model; in prior and later non-linear models, such as Firthian Prosodic Phonology or Goldsmith’s Autosegmental Phonology it was recognized that in spoken language certain aspects of the speech signal may be sliced off horizontally before vertical segmentation takes place. These ‘suprasegmental’ properties (such as tones or nasality) take scope over stretches of segments.

We believe that Stokoe’s original insight, viz. that properties of signs are simultaneous, responded to the fact that in sign language phonology, a horizontal slicing of the signal generally takes precedence over a vertical slicing, making the latter (the syllable structure) subordinate to segmental structure. A consequence of this idea is that, indeed, signs are typically monosegmental (yet, segment-internally syllabic, or even polysyllabic). We will suggest that the reasons for the difference in dominance of vertical and horizontal slicing lie in the fundamental difference between auditory and visual perception.