Word formation below and above little x:
Evidence from Sign Language of the Netherlands

Inge Zwitserlood
Utrecht institute of Linguistics, Utrecht University

1. Introduction

Although in many respects sign languages have a similar structure to that of spoken languages, the different modalities in which both types of languages are expressed cause differences in structure as well. One of the most striking differences between spoken and sign languages is the influence of the interface between grammar and PF on the surface form of utterances. Spoken language words and phrases are in general characterized by sequential strings of sounds, morphemes and words, while in sign languages we find that many phonemes, morphemes, and even words are expressed simultaneously. A linguistic model should be able to account for the structures that occur in both spoken and sign languages. In this paper, I will discuss the morphological/ morphosyntactic structure of signs in Nederlandse Gebarentaal (Sign Language of the Netherlands, henceforth NGT), with special focus on the components 'place of articulation' and 'handshape'. I will focus on their multiple functions in the grammar of NGT and argue that the framework of Distributed Morphology (DM), which accounts for word formation in spoken languages, is also suited to account for the formation of structures in sign languages. First I will introduce the phonological and morphological structure of NGT signs. Then, I will briefly outline the major characteristics of the DM framework. Finally, I will account for signs that have the same surface form but have a different morphological structure by means of that framework.

2. The structure of NGT signs

2.1 Phonological components of a sign

Sign languages appear to be much alike in the structure of their signs. There are exceptions to the common sign structure that I will describe below, which are often caused by influence of the surrounding spoken language.[1] I will not discuss these here, but focus on the patterns that we see in 'real' signs, particularly in NGT.

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[1] Influences from the surrounding spoken language are the incorporation of fingerspelled elements and literal translations of compounds.

As words in spoken languages, signs in sign languages consist of smaller units. These are not sounds, but manual and non-manual elements. The sign components are illustrated by the NGT sign that means 'to be brave', in Figure 1:

Figure 1 The components of a sign

i. place of articulation
ii. handshape
iii. orientation of hand palm and fingers
iv. activity: a. change of place of articulation
　　　　　　　b. change of handshape
　　　　　　　c. change of orientation
v. non-manual component: a. facial expression
　　　　　　　　　　　　　　b. oral component
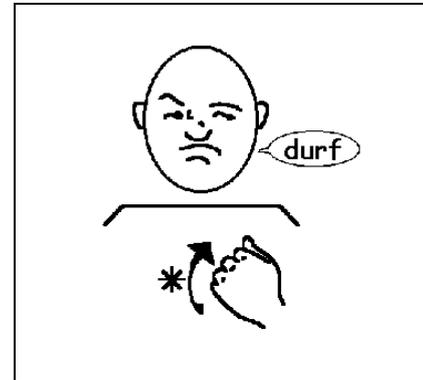
The place of articulation of the sign for 'to be brave' is the chest, the handshape a closed fist. The hand palm is oriented towards the body and the fingers to the contralateral side of the signer (slightly upwards). The sign has an activity: an arc movement from the place of articulation near the middle chest to that near the upper chest, during which there is brief contact with the chest. There are two non-manual components: a daring facial expression and the mouthing of the Dutch word "durf" (to dare). Many signs have only one activity: a change of places of articulation, a change of handshape or a change of orientation.[2] Signs can combine more than one activity (simultaneously), but the combination appears to be restricted to at most two activities. I assume that this restriction is caused by the sign language interface between grammar and PF.[3] The result is that most signs are monosyllabic (Aronoff *et al.* 2000). In contrast to most spoken languages, even many morphologically complex signs are monosyllabic.

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[2] In a sign with a handshape change, the handshapes are in fact related. This means that the selected fingers remain constant within the sign. The handshape change consists of a change in aperture: the hand(s) either open or close (see Brentari *et al.* 1996 and Van der Kooij 2002 for details).

[3] It has also been claimed that this is a phonological restriction (e.g. by Sandler 1989). However, it appears to hold for all sign languages investigated to date, for which reason I doubt this claim.

2.2 Locus agreement

The best known complexity within (monosyllabic) signs is formed by agreement verbs and classifier predicates. I will discuss the former here, and the latter in the next section. In agreement verbs, the place(s) of articulation of a sign are not fixed, but variable. They vary with the loci in signing space that are occupied by the referents that are involved in the event that is expressed by the verb.[4] I will illustrate this with the NGT sign for 'to visit'. The citation form of this sign is made with a small arc movement, the initial place of articulation is in front of the signer and the end place of articulation slightly away from the signer, as can be seen in (1).

(1)

visit
"to visit/visit"
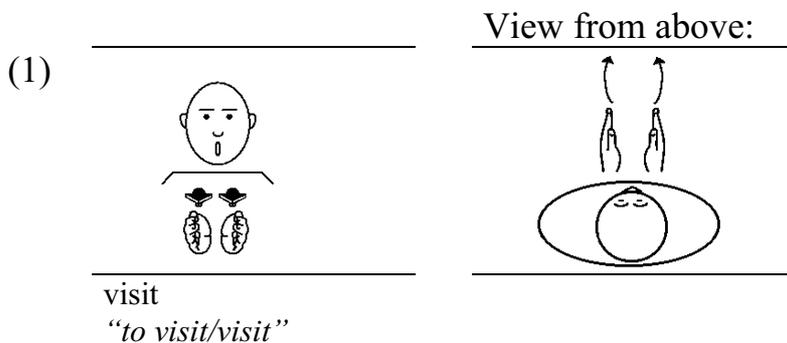
The places of articulation in the inflected forms of this sign are connected with the loci of the referents. The initial place of articulation is near the location of the subject, and the final place of articulation is near the location of the object; the referent who is being visited.[5] The sign has slots for two places of articulation, but the phonological features are not specified. Therefore, they can be substituted with meaningful loci in signing space. This is illustrated in (2a,b) below, where the signer indicates that different referents visit each other (the different loci in signing space are indicated by indices). For ease of illustration, both a picture of the sign and a view from above are given.

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[4] All referents that are present in the discourse situation automatically have a locus in signing space. Referents that are not actually present are assigned abstract loci in signing space, for instance by introducing the referent and, subsequently, pointing at a particular locus, after which the referent and the locus are connected.

[5] In the sign language literature, this is often called person agreement (e.g. Padden 1988). However, the category person seems to play a minor role in the agreement system of sign languages (Lillo-Martin & Klima 1990, Van Gijn & Zwitserlood to appear), for which reason I will use the term 'locus' agreement.

(2)a.

View from above

_{signer}visit_M
"I visit her (Mary)."

b.

_Mvisit_J
*"She (Mary) visits him (John)."*
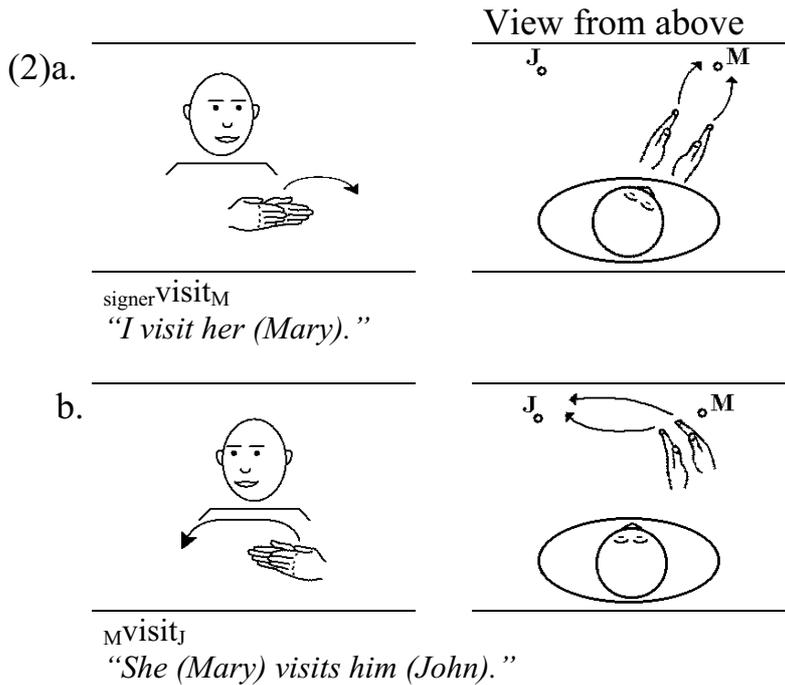
Not all verbs in sign languages are agreement verbs; many verbs show no or only partial agreement with their arguments. Some researchers (such as Padden 1988) claim that locus agreement morphology is blocked in such verbs because of their phonological feature specifications, others (e.g. Meir 1998, 2002) attempt to predict which verbs show agreement based on semantics. I will return to this issue in section 0.

2.3 Gender agreement
All sign languages investigated until now have verbs that express the existence, the location, or the path motion of a referent in space in which the phonemes are all meaningful.[6] Since sign languages have the possibility to literally make use of space, such verbs are expressed spatially: the movement of the hand(s) expressed the motion of the referent, and a lack of motion indicates the existence of the referent at a particular location. The handshape represents the referent that is involved in the motion: the Theme argument. The handshape is taken from a small set of meaningful handshapes and reflects a characteristic (often the shape) of the referent. For instance, in intransitive verbs, the ✋ handshape usually represents long and thin, or animate referents (pens, knives and poles, and humans and animals). Flat and wide referents (books, cars, paintings) are represented by the ✋ handshape and cylindrical (glasses, bottles) and round entities (balls,

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[6] These predicates are a subset of the *classifier predicates* in the literature on sign languages.

round fruits) are usually represented by the 🖐 handshape. Some examples are given in (3) and (4) below.

(3)a.
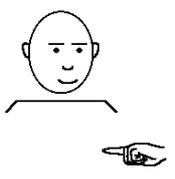
be-right-LONG&THIN REF.
"There's a pen to the right."

b.
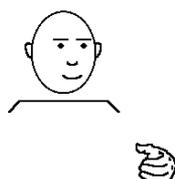
be-right-CYLINDRICAL REF
"There's a mug to the right."

c.
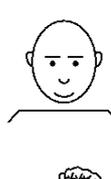
be-right-FLAT&WIDE REF.
"There's a book in front of me."

(4)a.
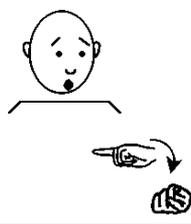
fall-LONG&THIN REF.
"The pen falls down."

b.
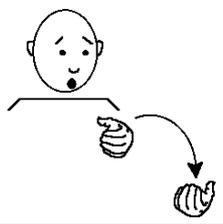
fall-CYLINDRICAL REF.
"The mug falls down."

c.
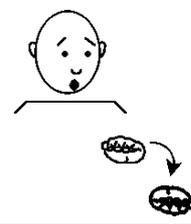
fall-FLAT&WIDE REF.
"The book falls down."

In transitive verbs, too, such meaningful handshapes appear to indicate the referent in motion. In these verbs the manipulated motion of a referent is expressed. Compare the examples in (5) with those in (4) above, where the same moving referents are expressed:

(5)a.
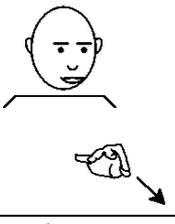
X.put.down.LONG& THIN REF
"(Someone) puts the pen down."

b.
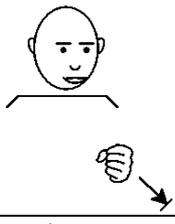
X.put.down. CYLINDRICAL REF
"(Someone) puts the mug down."

c.
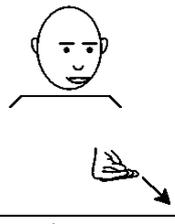
X.put.down.FLAT& WIDE REF
*"(Someone) puts the book down."*

In such verbs, the movement of the hand is considered as the root (Supalla 1982; Schick 1990, Zwitserlood 2003). The handshape is analyzed as an agreement morpheme (Glück & Pfau 1998; Zwitserlood 2003), expressing the referent that is involved in the motion, location or existence that is

expressed by the verb root.[7] I call this type of agreement *gender agreement*, because it is reminiscent of gender agreement in Bantu languages.[8]

Thus, sign languages appear to have two ways to express agreement relations: by loci in signing space (locus agreement) and by meaningful handshapes (gender agreement). The inflected signs are multimorphemic but monosyllabic; a phenomenon that is uncommon in spoken languages.

2.4 Morphological complexity

Not only agreement verbs are multimorphemic. Many other signs in sign languages have meaningful components. These meaningful components occur systematically in several signs, with a consistent meaning, and they are used in the formation of new signs. Body parts as a place of articulation often contribute to the meaning of a sign. They may refer to a physical characteristic, such as the body part itself, or the place where a garment is usually found, but also as a metaphorical characteristic. For instance, the place of articulation in signs that express cognitive concepts is usually the temple. Some illustrating NGT signs are in (6).

(6)a.   b.   c.

    nose   hat / to put on a hat   to think hard / thought
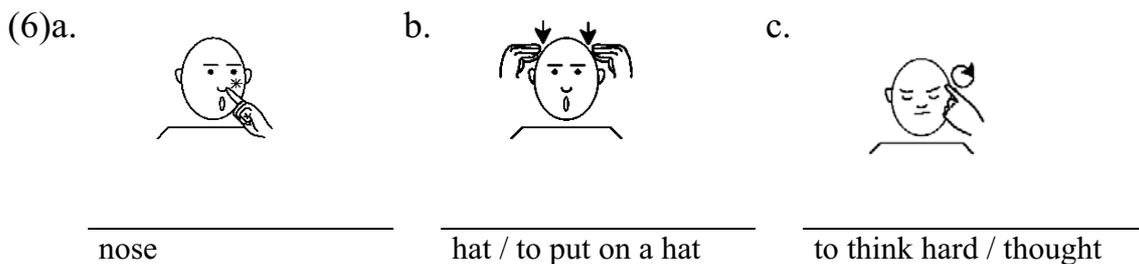
Besides the place of articulation, the handshape(s) in a sign can contribute to the meaning of the whole sign. We already saw that the ✋ and ✋ handshapes are used as agreement markers, referring to long and thin, and flat and wide referents, respectively. These handshapes are used with the same global meaning in several signs other than verbs expressing the motion, location or existence of referents. In the examples in (7), the ✋ hand obviously represents a toothbrush (a), and knitting needles (b), and the ✋ hand represents the cover and pages of a book (c).

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[7] This analysis is not uncontroversial. The reluctance in the literature to analyse classifiers as agreement morphemes has several reasons, among others the facts that classifiers in spoken languages are not considered as such, and that it has not been recognized before that meaningful handshapes have different functions in the grammar of sign languages, as discussed in Zwitserlood (2003).

[8] See also Van Gijn & Zwitserlood (2001, 2002) for arguments.

(7)a.

b.

c.
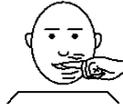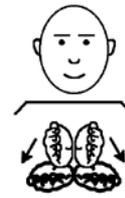
brush teeth / toothbrush   to knit   book

Although the motivatedness of the components is clear, it is difficult to exactly define the morphemes, even the more to do this in terms of a spoken language. For the moment, it will suffice to paraphrase them with terms as 'long and thin entity' and 'move up and down repeatedly', so that a literal translation of the sign in (7a) may be "long and thin entity moves up and down repeatedly near the mouth".[9] Further research is necessary for the exact description of the morphemic components.

In the sign language literature, signs like those in (7) are usually called *frozen forms* by which is meant that these signs are fossilized signs. Such signs are considered as evolved from 'productive' verbs of motion, location and existence (e.g. Supalla 1982; Aronoff *et al.* 2003). It is claimed that the handshape is not variable anymore in such signs, like it is in verbs of motion, location and existence, and some even claim that the signs have become monomorphemic. As explained in more detail in Zwitserlood (2002, 2003), this cannot explain the structure of many of these complex signs, nor the fact that new 'frozen forms' appear frequently in the language. Some examples of recent signs are shown in (8), in which the hand represents the extension of a cell phone (8a) and the hand the flat parts of a laptop (8b) and a pay card (8c):

(8)a.

b.

c.

(to phone by) cell   laptop   pay card
phone
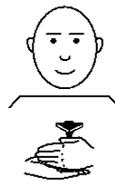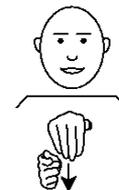
Thus, we see that places of articulation and handshapes can be used in a consistent way and with a consistent meaning within signs. The function that these sign components have differs: either a place of articulation or a handshape indicates a referent that is involved in the event expressed by a

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[9] This is reminiscent of complex signs in American-Indian languages, such as Mohawk.

verb; or it denotes physical or metaphorical entities and/or events or activities of such entities.

As can be seen from the translations of the NGT signs in (7) and (8), many can be used descriptively and predicatively, in other words, as nouns, and as verbs or adjectives. Thus, they do not have a particular grammatical category, which means that the composing morphemes do not have or assign a grammatical category. In these signs, the places of articulation and handshapes do not have a functional category either, since they do not form agreement markers. Therefore, these components are roots without a grammatical category.

Summarizing, the NGT facts that we have seen and that a model of the grammar needs to account for are:

1. the productive morphological complexity of signs
2. the different functions of sign components: (categoryless) roots or agreement markers (or merely phonemes)
3. the monosyllabic surface form of a sign.

3. A brief overview of the Distributed Morphology framework

In this section, I will briefly explain the principles of the framework of Distributed Morphology (DM). For detailed accounts, see Halle & Marantz (1993), Marantz (1997a,b) and Marantz (2001) among others. The DM framework is based on the EST model, but has a separate component for morphology (Morphological Structure or MS) between SS and LF, as shown in Figure 2.

DM does not have a lexicon in the traditional sense in generative grammar, that is a list of morphemes, words and phrases that have a meaning and phonological features. In DM, morphemes, phonological features, and meaning are in separate components or *lists*. List A contains roots and morphosyntactic features. List B contains phonological features (*Vocabulary Items*) and List C (the encyclopedia) contains non-linguistic knowledge. Items from List A enter syntactic operations (Merge, Move, Copy) and the resulting derivations move to LF and, via MS, to PF. Meanings are negotiated only after the derivation is shipped off to LF. The morphemes in the terminal nodes of a derivation do not receive phonological features until after syntax (*Late insertion*). Only at PF these morphemes are spelled out with phonological features (called *Vocabulary Items)*. Vocabulary Items need not be fully specified for the terminal nodes in which they will be inserted (that is, they are *underspecified*), and they compete for insertion, which means that the

Figure 2 The DM model
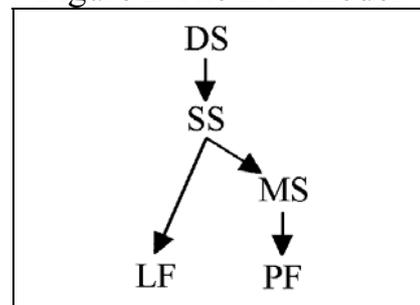
Vocabulary item that matches most of the morphosyntactic features in a terminal node without violating any of them wins over other possible Vocabulary items. I will illustrate this briefly with the (poor) agreement system of Dutch. In the present tense, the three persons singular in Dutch are marked with only two agreement markers, one of which is zero, the other *-t*. The three persons plural are all marked with one agreement marker (*-en*). Instead of specifying Vocabulary Items for all of the combinations of features for person and number, the Vocabulary Items in (9) suffice for the insertion of the right Vocabulary Items in the right terminal nodes.

(9) a. -∅   1   [+1, +sg, +pres]
    b. -t   1   [+sg, +pres]
    c. -en   1   [+pres]

Insertion of *-t* in a terminal node consisting of features for 1st person singular is blocked by the more highly specified -∅, and insertion of -∅ in a terminal node holding features for second person present results in a feature class.

Morphemes in List A do not have a grammatical category. They receive a grammatical category by merger of a category node. This category node is called *little x*, where *x* stands for noun, verbs or adjective. The node forms a cyclic boundary, at which the structure derived so far is shipped off to PF and LF (which, thus, happens several times in the derivation of one sentence).

I base my account on the DM analysis of Glück & Pfau (1999) and claim that the principles of the DM framework, in combination with the particular sign language interface between grammar and PF, are well suited to account for sign language phenomena described in section 1. Now let us turn to the derivation of complex NGT signs in this framework.

4. The derivation of complex NGT signs
4.1 Word formation below little x
As we saw in section 0, the sign in (7a) can be used predicatively, meaning 'to brush one's teeth', and descriptively, meaning 'toothbrush'. The sign itself is morphologically complex, and has an up and down movement of the hand (*move up and down*), a 👆 handshape (*long, thin entity*) and the mouth as place of articulation (*near the mouth*). All of the three morphemes occur simultaneously, and so far I have not found a way to determine whether one of them has scope over any of the others. The sign has a tripartite root and I assume for now that that the derivation starts out with *move up and down*, which merges first with *long, thin entity* and then with

near the mouth. Having arrived at this point in the derivation, the sign does not have a grammatical category yet. It receives a grammatical category after merger of a category node. If this category node is 'little n', for instance in a context such as "John buys a toothbrush", it will become a noun. If the category node is 'little v' then the sign will be a verb. This is illustrated in Figure 3.

Figure 3 Derivation of structure below little x
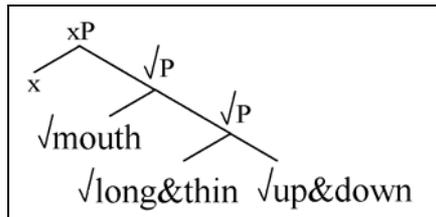
Note that the structure does not have phonological material nor a meaning at this point in the derivation. After merger of little x, it will be shipped off to PF, where Vocabulary Items will be inserted, and to LF and the conceptual interface, where the meaning of the derivation will be negotiated. This is illustrated in Figure 4. Thus we see how morphologically complex signs are derived below little x. Such signs are also called *simultaneous* or *root compounds*.

Figure 4 Vocabulary insertion and meaning negotiation
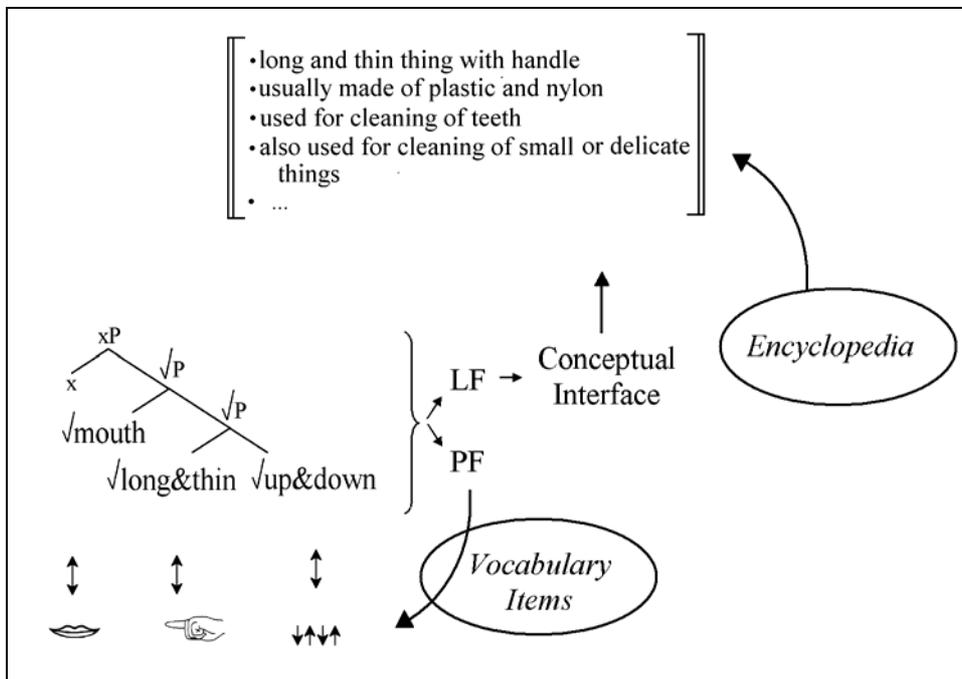
4.2 Word formation above little x

The meaningful components of signs, although expressed by the same Vocabulary Items and having a similar meaning, do not necessarily act as roots. We have seen in sections 0 and 0 that they can also function as agreement markers, thus as functional elements. The difference between these functions is the point in the derivation at which they are merged. Functional elements are merged *above* little x. I will use a ditransitive verb to illustrate the derivation of verbs with agreement markers, namely the NGT sign for 'to give', that agrees with the subject, the direct object and the indirect object. Note that transitive constructions are derived from intransitive ones by merger of a voice node above little v. Recall that I illustrated the specification of the Vocabulary items in the poor agreement system of Dutch in section 0. For NGT, the specifications are more complex, because there are sets of locus markers, gender markers for intransitive verbs and (different) gender markers for transitive constructions. In the example structure, it is expressed that a woman gives her brother a pen. The specifications for the set of agreement markers necessary in this example is the following:

(10) /👆/   ↔   [+straight,+thin]; [+animate]
    /✌/   ↔   [+thin]/ [+voice]
    /✊✋/   ↔   [+straight]/[+voice]
    /$_{index}$/   ↔   [+loc]

All referents can be agreed with by both locus and gender markers. Therefore, both the arguments of the verb (the woman, the brother and the pencil) must have both locus and gender features. The latter happen to be spelled out with the same Vocabulary Items, viz. 👆, on an intransitive verb. On a transitive verb (that is, in the environment of a voice marker), the Vocabulary Item spelling out the morphosyntactic features of the pen are ✌, and those of the woman and brother are ✊✋). It is possible to predict which type of agreement marker will appear in a particular verb from i) the restrictions on the surface form of signs ii) the phonological specifications that will be inserted in the terminal node of the root, iii) the semantic role of the referent, iv) the principle of competition for insertion of the Vocabulary Items connected to the agreement nodes; and v) for gender agreement markers: the presence or absence of a voice node, that marks a transitive or intransitive verb. Let me illustrate this with the structures in Figure 5 and Figure 6, from which, because of space limitations, material that is irrelevant for the discussion is left out.

Figure 5 Derivation until voiceP
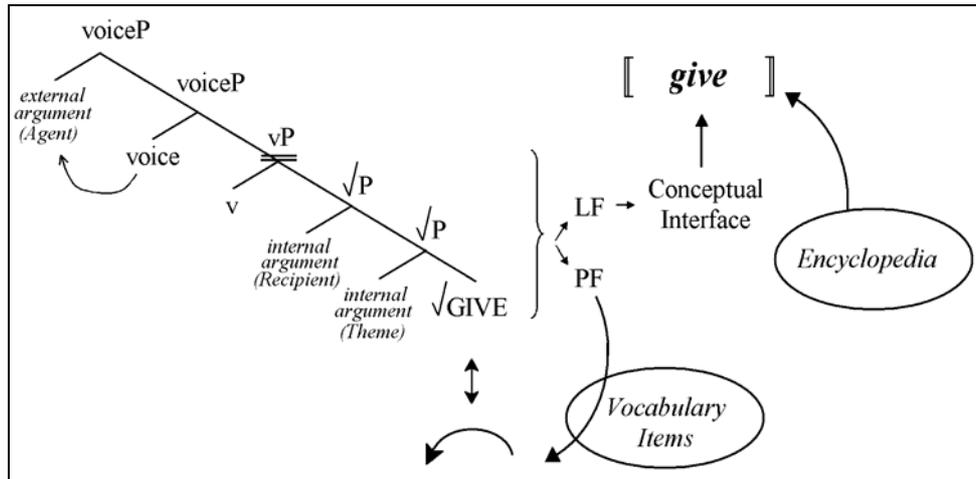
First the structure until little x is derived. Recall from section 0 that a verb of motion, location or existence has only one root. As soon as in the derivation little v is merged, the structure built to that point is shipped off to PF and LF, and the terminal node holding the root will be spelled out with a movement of the hand(s), indicated with an arc arrow in Figure 5.

After that, functional nodes are merged, starting with a voice node (triggering merger of an external argument), agreement nodes, and tense and aspect nodes (not present in the structure). At some point in the derivation, the structure is, once again, shipped off to PF and LF. Vocabulary Insertion is cyclic and starts from the innermost part of the derivation, working its way outwards to the periphery of the derivation. Assuming that merger of the terminal nodes that hold agreement features reflects merger of the arguments, and that the Theme argument is closest to the verb, we predict that the agreement features of the Theme argument (the pen) will be spelled out first, followed by those of other arguments (the Agent and Recipient; the woman and her brother respectively). Competition for insertion ensures that the most highly specified Vocabulary Item that does not cause any feature clashes will be inserted into a terminal node. the first agreement node to be spelled out (AgrDO) will be inserted with a handshape, because the gender agreement markers are more highly specified than location features,. Two possible handshape Vocabulary Items can be inserted into the terminal node marking agreement with the Theme argument: the ✋ hand and the ✌ hand. The presence of a voice node in this structure ensures that the ✌ hand wins over the ✋ hand, since its features match most of the features in the terminal node.

The Vocabulary Items that spell out the terminal agreement nodes for the Agent and Recipient could in principle be handshapes as well.

However, since phonological handshape features have been inserted already, this is ruled out by the sign language interface. Therefore, these agreement nodes will be spelled out with location features. This is illustrated with the structure in Figure 6.

Figure 6 Vocabulary Insertion into the agreement nodes
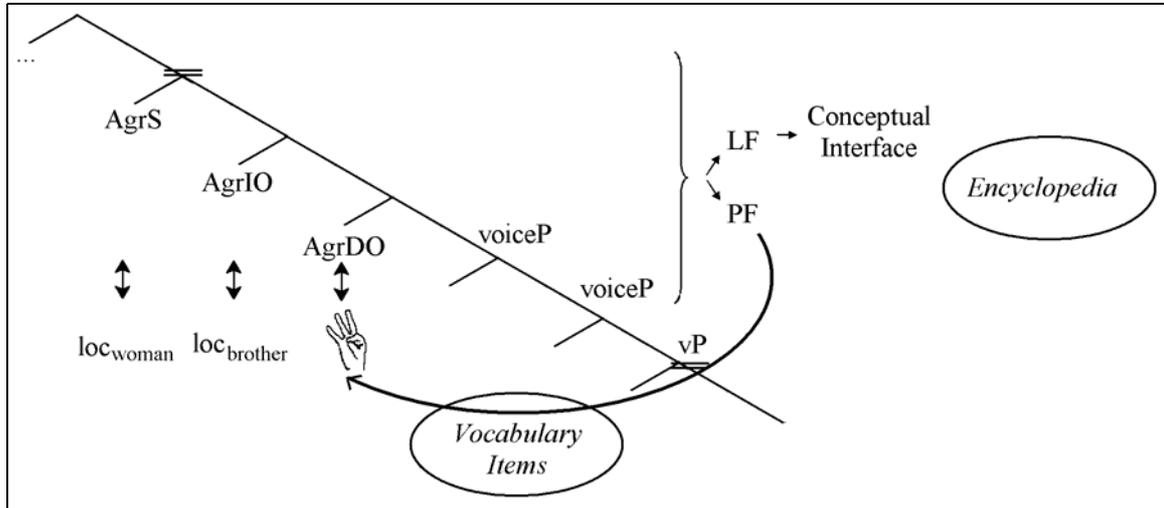
5. Conclusion

The surface form and derivations of the NGT signs are well accounted for by a combination of the principles of the DM framework, combined with the output of the sign language interface between grammar and PF. The differences in structure and meaning between verbs of motion, location and existence and root compounds are accounted for by the position in the derivation where the meaningful elements are merged: movements, handshapes and places of articulation spell out *roots* that are merged below little x and agreement morphemes that are merged above little x. This account makes it also possible to make predictions about the (surface) agreement possibilities of verbs. As mentioned in section 0, it is claimed in the sign language literature that verbs that have phonological specifications for place of articulation cannot take (locus) agreement morphology. My theory predicts that it will be particularly root compounds which cannot take (overt) locus *and* gender agreement, because the roots have been spelled out with the Vocabulary Items that are also used to spell out the features of agreement nodes. The sign language interface prohibits Vocabulary Insertion of the same phonological material within one sign. These signs may thus have agreement features after all, which are not spelled out with overt phonological material.

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