0. Introduction

In sign language phonology, lexical items are traditionally described and analyzed in terms of four parameters (Corina and Sandler 1993; Sandler 1995; Stokoe 1978). A sign can be characterized by specifying its handshape, the orientation of the hand, the location of the hand, and the movement that the hand makes. In this paper, we want to reconsider the traditional conception of the orientation parameter. We argue that instead of taking orientation to mean the absolute direction in space that the fingers and palm are pointing at, it is better conceived of as the relation of a part of the hand to the place of articulation. This view of orientation correctly predicts patterns of phonetic variation that one sees in the articulation of hand orientation. The proposal thus emphasizes the need for a model of phonetic implementation, which is currently non-available. As we have argued before (van der Kooij and Crasborn 1996), the set of apparent counterexamples to the proposal can be dealt with by taking into account the iconicity of the orientation parameter in these signs.

The paper is organized as follows. In section 1, we discuss the two different conceptions of orientation that have been advanced in the literature. In section 2 we advance several arguments for choosing relative orientation for almost all signs. Section 3 discusses the cases in which absolute orientation seems to be more applicable, for which we propose a re-analysis in terms of relative orientation. A representation of orientation in a phonological model is presented in section 4. In section 5 we examine how orientation specification interacts with other feature classes to fully characterize different types of signs.1 Section 6 sums up the conclusions.

1. Two types of orientation

In the first modern linguistic analysis of sign language phonotactics in 1960, Stokoe did not distinguish orientation as a separate parameter of signs: it seemed

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1 In this paper, we do not deal with orientation changes. We tentatively suggest that in the context of our current proposal orientation changes might be described in terms of branching nodes with stative articulatory features like [prone] and [supine], which are independent of the given relative orientation value.
at the time that the way the hand was oriented in space did not systematically
distinguish pairs of signs (Stokoe 1978). To cover the few signs that were
distinguished only by palm orientation, such as CHILD and THING in American
Sign Language (henceforth ASL) (Klima and Bellugi 1979:48), Stokoe used a
diacritic to the symbol for hand configuration in his notation system.2 In the
literature since 1960, orientation has been systematically attributed the status of
'parameter' (Battison 1978; Battison et al. 1975; Sandler 1989).

Orientation has been described in two different ways, which we will refer to
as absolute and relative. Absolute orientation refers to the orientation of the hand
in space, or, more informally, the direction that the sides of the hands are pointing
at (Brentari 1990; Sandler 1989; Stokoe 1978). As the hand is a three-dimensional
object, specifying the orientation of two sides of the hand describes its full
orientation. As far as we know, without exception, and without explicit
motivation, the palm side and the finger side have been chosen in sign language
literature.

To facilitate description for signs with different handshapes, finger orientation
has frequently been interpreted as "extended finger orientation", describing the
direction in which the fingers point in a sign if the fingers were extended
(Greftegreff 1992). Another way of characterizing this revised view on finger
orientation is by saying that it is not the direction in which the fingers point that
is relevant, but rather the direction in which (the distal end of) the metacarpal
bones in the hand point.

To give an example, the sign VAKANTIE 'holiday' from Nederlandse
Gebarentaal (Sign Language of the Netherlands, henceforth NGT) would include
in its lexical specification that the palm is pointing contralateraly and the fingers
are pointing upwards. The sign is made with a B hand (all fingers extended and
adducted) which touches the ipsilateral side of the chin twice.3

Alternatively, orientation can be described by specifying how the hand relates
to the place of articulation (Friedman 1976; Mandel 1981); this we will call
relative orientation. For the sign VAKANTIE, one would then say that it is the
radial (or thumb) side of the hand that is related to the place of articulation, and
specify the (left side of) the chin as the location of the sign.

When one looks at the literature, confusion is likely to arise: various terms
have been used for relative orientation. Among these terms are focus, facing, and
point of contact (e.g., Mandel 1982; Friedman 1976; Liddell and Johnson 1989).
Focus often refers to the part of the hand that is pointing in the direction of the
movement. Facing often means the part of the hand that is oriented towards the
location, and point of contact is the part of the hand that touches the place of

2 We follow the general convention of sign linguists in using capitals to write glosses of signs.
3 Ipsilateral means 'the same side of the body as the articulator', contralateral means 'the opposite side
of the body as the articulator'.
articulation. We want to emphasize here that these aspects are partly overlapping in content. In our proposal, these three aspects are all subsumed under relative orientation. As we will indicate later on, the specific interpretation of relative orientation depends on the specified movement and location aspects of the sign.

In the phonological models that have been designed, absolute orientation has been the dominant perspective. In the few models where relative orientation has been proposed, this has been in addition to a full absolute orientation specification, see e.g. Liddell and Johnson (1989). The only place where relative orientation has been given emphasis is in Greftegreff (1992), in her discussion of indexical signs. These are signs in which the hand (generally, index finger extended only) points to a location in space which has been assigned a grammatical role. Greftegreff argues that variation in handshape of these signs, from variants where the index finger is fully extended to variants where it is bent to various degrees at all joints, makes the position untenable that it is the (palm and finger) orientation of the hand in space which is crucial in these signs. Rather, the pointing of the fingertip in the direction of the (grammatical) locus is what matters, allowing the actual orientation of the hand to vary from utterance to utterance.

2. Arguments for relative orientation

We want to expand the argument made by Greftegreff, by forwarding the hypothesis that it is always relative orientation that needs to be specified in the representation of the sign. There are two types of arguments in favor of this proposal. In the first place, specifying both relative and absolute aspects of orientation leads to redundancy in the phonological representation. This is especially so if contact features are also present in the representation (van der Kooij 1996; 1997). To properly characterize the phonotactic patterns of the language, one should strive towards eliminating such redundancy, and opt for either one of the two types of orientation features, but not both.

In the second place, there are several arguments in favor of relative orientation. These have to do with variation in handshapes, variation in orientation, and morphosyntactic phenomena. We will discuss these arguments below.

The handshape variations described by (Greftegreff 1992) for indexical signs seem to us to occur widely in other signs, too. For example, the NGT sign MENSEN 'people' in the citation form is uttered with a hooked-B handshape (cf. KOMVA 1989). However, one frequently encounters variants where the handshape is different, looking more like a C-hand (all fingers slightly bent at all joints) with the thumb in non-opposed position. The same goes for many signs with B or 1 handshapes in which the fingertips touch the location. It seems, then, that it is not an absolute or concrete specification of handshape and hand
orientation that is called for in the representation of such signs, but rather a more abstract representation. As for orientation, this representation would have to contain the relationship between the fingertip of the hand and the place of articulation. As for the handshape, it seems that all that needs to be specified is knowledge of the selected fingers. The finger configuration is what varies in different utterances, so this should be left open, as far as phonological specification is concerned. This is in agreement with the status of the finger configuration node as a dependent (but not a head) in the representation of handshape suggested by (Brentari et al. 1996). Thus, underspecification plays a crucial role in this proposal.

Another source of variation is the actual, or phonetic, orientation of the hand. Here, too, for many signs we find variation from utterance to utterance. For example, the sign IDEE ‘idea’ (index finger extended, moving from ipsilateral temple outwards) may be produced with many different palm orientations. In the ‘dictionary form’ (KOMVA 1993) the palm orientation is diagonally downwards-contralateral. However, both in connected signing and in productions in isolation the palm orientation seems to vary from almost straight down to almost fully contralateral to backwards. What remains constant in all these utterances is the relation between the tip (or pad) of the index finger and the place of articulation (the ipsilateral temple). Thus, whereas the actual or phonetic orientation would require different absolute orientation values for each variant, the relative orientation is constant for all variants. We interpret this as another source of support for representing signs like IDEE with a relative orientation value, and not an absolute one.

A third source of evidence for the importance of relative orientation comes from morphosyntactic agreement. In agreement verbs, the beginning and end locations of the path movement and the orientation of the hand may differ depending on the arguments of the verb (Bos 1993; Meir 1995). As pointed out by Meir, it is not the absolute direction in space, nor the direction of the movement that marks the relation between subject and object (cf. backwards verbs), but rather the facing of the palm of the hand in the direction of the object of the verb (and consequently, the back of the hand pointing to the subject). Absolute orientation is not a useful notion in the description of verb agreement.

Concluding, then, there are three types of arguments favoring the use of relative orientation as opposed to absolute orientation. The arguments from variation in the production of signs appear very powerful to us. Although they are based on initial informal observations, it seems that variation in absolute phonetic

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4 We have not carried out systematic research aimed at eliciting variation; the data come from observations of both spontaneous signing and of the corpus of video data that were gathered in the context of SignPhon (Bles et al. 1996).
orientation is abundant. It is clear that more, and more systematic, research is needed on this topic.

For sign phonology in general, the remarks on variation here cannot be the whole story, of course. The questions arise which variants occur under what circumstances, and how exactly the actual handshapes (more appropriately, the actual finger curvatures) and orientations are derived from the other values in the representation together with the context. In other words, we need to develop a picture of the phonetic implementation of the phonological specification of signs. We leave this as a topic for future research.

3. A place for absolute orientation?

Is there no place at all, then, for absolute orientation values? We can identify a small group of signs in which indeed absolute direction in space seems to matter. We will discuss this group below. We will point out that in all cases, these orientation values are motivated. This leads us to a tentative re-analysis of these cases as a special class of relative orientation values.

3.1 Cases of absolute orientation. There are two related sets of cases where absolute orientation is what matters, it seems. These are classifier morphemes, and the weak hand in unbalanced two-handed signs.

For many classifier handshapes, the orientation of the hand seems to be part of the underlying representation. For example, the human being classifier in NGT consists not only of the 1 handshape, but also of the information ‘finger pointing upwards’. Modifying this information leads to a change in meaning, viz. a change in the posture of the human being. Similarly, the classifier for relatively short and wide vehicles (cars, small boats) is distinguished from the classifier for relatively long and high vehicles (bikes, buses) by its orientation only: both have a B-handshape, the former with the palm pointing downwards and the latter with the palm pointing sidewards. The human legs classifier is a V handshape with the fingers pointing downwards. In all these cases, it seems that the absolute orientation in space is what matters; it is certainly not the relation of a part of the hand to a place of articulation, as classifiers have no inherent place of articulation: they are articulated at a certain location only when combined with other phonological characteristics in forming a complex predicate. Thus, they are bound morphemes.

A second category of cases where absolute orientation seems applicable is in specifications of the so-called ‘weak hand’ in unbalanced signs. Unbalanced signs are signs in which one hand moves, and the handshape and orientation of the weak hand tend to differ from those of the strong hand (van der Hulst 1996). At least for all cases where the orientation of the weak hand differs from that of the strong hand, it seems that this orientation can best be characterized in terms of
absolute orientation. For example, in these signs we do not find the kind of
alternation in handshape and orientation discussed in section 2. In many cases, as
far as we can see, the weak hand looks just like a classifier in complex predicates;
such a sign may have originated from a classifier construction historically
(Brennan 1990).

These two groups of signs with absolute orientation specifications, classifiers
and a subset of the unbalanced two-handed signs, have three things in common.
First, they do not have a specified (distinctive) place of articulation. They receive
a place of articulation either by default (neutral space) or by entering in predicate
constructions with a specified place of articulation (generally, also neutral space).
Second, the hand in these cases does not move. Third, we would like to
hypothesize that the orientation value in both of these groups is motivated, or
iconic. In the next subsection, we will provide a brief discussion of motivatedness
in sign language phonology; then, in section 3.3, we use this iconicity to work out
a re-analysis of the above cases in terms of relative orientation.

3.2 Motivatedness. In many signs, there seems to be a non-arbitrary relationship
between some part of the referent or concepts that are associated with it, and a
part of the form of the signs (Mandel 1977); this has been referred to as
‘motivation’ or ‘iconicity’. In research around 1980, several authors recognized
the presence of such iconicity, but at the same time argued that since it does not
seem to play a (beneficiary) role in sign language acquisition or processing, it is
not a highly relevant topic for linguistic research (Klima and Bellugi 1979;
Poizner et al. 1981). Iconicity, they argued, was a historical relic from the process
of creating new lexical items, rather than an integral and accessible part of the
lexical knowledge that signers possess.

More recently, it has been argued that in studying word formation processes
and phonological structure of signs, iconicity needs to be an integral part of the
investigation. Brennan (1990) argues that word formation processes show that
much of the iconic information present in frozen lexical items is accessible to
signers. It is important to note that it is kind of misleading to speak of ‘iconic
signs’. Signs typically are not iconic as a whole, rather a part of the sign
resembles a part of the referent. It is never the case, then, that all aspects of the
referent are encoded, so to speak, by the linguistic form; our conceptual
knowledge is much to rich for that. Taub (1996) discusses the precise way in
which the selection of information to be iconically represented takes place.

Looking at absolute orientation, we see that the hand(shape) symbolizes a
certain object, the referent. This referent in reality typically has a specific
orientation. For example, if a handshape (the symbol) symbolizes a car (the
referent), this car typically has a fixed, absolute, orientation in space: the bottom
of the car is normally pointing towards or parallel to the ground surface. The
same thing we see in the hand(shape) symbolizing a car: its palm is typically
pointed downwards. The palm of the hand, then, is associated with the bottom of
the car, and the back of the hand is associated with the top of the car. If the car classifier is used with the palm pointing in a different direction than downwards, this is interpreted as a change in meaning. The interpretation of the sign could then be, for example, that the car is located on a non-horizontal surface (for example, a hill), or that the car is lying upside down. Summarizing, the orientation of the hand is meaningful in these cases, and the meaning is interpreted with reference to the absolute space around the signer, where the signer is standing perpendicular to the ground. A parallel case can be made for the other classifiers, and for the weak hand in unbalanced two-handed signs.

3.3 A tentative re-analysis of the absolute orientation cases. In the case of the car classifier, then, we see that although it is the absolute orientation in space that matters, in a sense, this too could be considered relative orientation: it is relative to the constructed three-dimensional space that the signer envisages. At first sight, this sounds just like a play with words: it is absolute, but you can relativize anything if you want. However, we think that there is a significant sense in which the relativity here is important, namely that it is not just the physical space around the signer to which a part of the hands relate, say the ground surface that the signer is standing on or sitting on, but rather a part of the hand relates to a part of a conceptually constructed, imaginary, space. This becomes more clear when we consider the example of a car going uphill. We want to assume there that the bottom of the car (symbolized by the palm of the hand) is pointing towards the ground surface. We can only do that if we assume that the conception of the ground surface has changed such that it is no longer identical with the physical ground surface that the signer is located on.

Thus, there is an argument for considering absolute orientations to be relative orientations, too. The problem with this re-analysis is that, typically, we considered relative orientation to mean ‘relative to the phonologically specified place of articulation’. In the cases just discussed, the hand seems to be related to a specific part of neutral space, which has not traditionally received a specific location specification. In most phonological models, there is a location feature value [neutral space], but no subdivisions have been made according to the construction of imaginary objects and surfaces -- which are argued to be highly flexible and productive (Liddell 1990; 1995). We will not attempt to make a proposal for additional location features here, we refer to the work of Liddell for some initial remarks. The need for the representation of imaginary locations in space is also felt in morphosyntactic research on agreement verbs (Uyechi 1995; Engberg-Pedersen 1993)
4. Representation

Assuming that indeed all we need is relative orientation values, the representation of orientation becomes very straightforward. We assume here the model developed in Leiden, see e.g. Crasborn (1996), van der Hulst (1993; 1995), van der Kooij (1996). In this model, orientation is one of the two dependents of a structural head called ‘selected fingers’. Both are sub-constituents of the articulator node, which in turn is one of the two dependents of the place node. This is illustrated by the diagrams in (1).

(1) Phonological model of signs

The only thing that we propose to change, is the content of the feature values that the orientation node can have. In previous versions of the model, absolute feature values like [fingers up], [palm down], etc., were proposed. We suggest the following feature set, indicating the side of the hand that points towards (is related to) the place of articulation.

(2) Proposed feature set for the orientation node

[palm]
[back]
[wrist]
[front]
[fingertip(s)]
[ulnar]
[radial]

As we discussed above, for many signs such as all indexical signs, the value [fingertips] is relevant. The feature value [front] is used for the ‘end side’ of the hand; if the selected fingers are extended this equals the fingertips, but if the
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fingers are closed to a fist ‘end side’ refers to the distal end of the metacarpals (the knuckles at the end of the back of the hand) or the dorsal side of the proximal phalanges. The value [back] refers to the dorsal or back of the flat part of the hand (the metacarpals). [ulnar] refers to the pinky side of the hand, and [radial] refers to thumb side of the hand.

5. The relation between orientation, point of contact, direction of movement, and A-manner

In this section we would like to discuss how the interpretation of relative orientation relates to some of the aforementioned properties of signs like point of contact, focus, and facing. We hypothesize that each of these properties is the result of the phonetic interpretation of the interaction of relative orientation values with other phonological properties of the sign, namely setting specifications, handshape, and the relation between the two hands. Precisely how the phonetic interpretation works for all cases is a major subject of future research; below we will only indicate the specific relations between features that such research will need to focus on.

For instance, in van der Kooij (1997) it is argued that given the location specification contact is completely redundant, and therefore should not be represented. As discussed above, we think that another aspect of contact, namely the part of the hand that makes contact with a location (point of contact), is not different from relative orientation. We predict, then, that given the specifications for selected fingers, location and relative orientation, the part of the hand that makes contact is predictable.

Path movement, in the Leiden model, is represented by specifying two setting values for the beginning and end of the movement trajectory. Here, too, we think that these features in combination with a relative orientation value can account for all the properties of the movement, including the ‘facing’ of a part of the hand in the direction of the movement. This was represented under the node hand position in van der Hulst (1993). For example, in the NGT sign AL ‘already’, the B hand moves downward, palm facing contralaterally. The movement of this sign is specified in the model by a branching setting node, with an initial value [high] and a final value [low].\(^5\) The relative orientation of this sign, then, is the ulnar side of the hand, if we assume that it is the second setting value that this side relates to. From this it follows that in this sign the part of the hand that points in the direction of the movement does not need separate specification. The actual

\(^5\) For further details on the representation of movement and linear order, see for example van der Hulst (1993).
palm and finger orientation that we find, we would like to suggest, is the result of phonetic implementation rules.

In balanced two-handed signs, there is no specific place or setting specified. The major place feature [neutral space] is filled in by default (van der Hulst and Sandler 1994). A second relevant fact about balanced two-handed signs is that in the actual orientation of the hands we find a lot of variation. What seems to be constant in these signs is the relation between the hands. We want to tentatively suggest that in these signs the actual orientations result from an interaction between handshape specifications, relative orientation specification, and features regarding the relation between the hands. In Crasborn (1995; 1996), the node A-manner was proposed as the home for features like [alternating], which specify the temporal relation between the two articulator nodes. We suggest, then, that this node can also be the home of spatial articulator relation features, such as [on top of], [next to], etc. We suggest that future research in this area is highly needed.

Summarizing, we suggested that the aspects of the sign that have been treated as distinctive features or feature classes are all the phonetic result of one single phonological specification, namely relative orientation.

6. Conclusion

In this paper we have argued that orientation as one of the formational aspects of the sign is best conceived of as relative to the place of articulation. By representing orientation in a relative manner, we make explicit and testable predictions about the form of signs. In the first place, we predict that there is much more variation in actual orientation than hitherto assumed. Second, we predict that there may be an important set of phonetic implementation rules, which determine the actual absolute, or phonetic, orientation values. These two predictions are connected, of course: phonetic implementation rules are dependent on contexts of different sorts (sentential, sociolinguistic, etc.) in which different variants arise (cp. Lindblom 1990; Pierrehumbert 1990).

We arrived at a reduction of the set of possible distinctive feature classes by showing that in our model point of contact, focus and facing can all be analyzed as the phonetic interpretations of one feature class - relative orientation - in combination with information about the handshape and the place.

We showed that the two cases that seemed to pose a counterexample to the relativized approach - weak hands and classifier hands - can be reanalyzed by referring to their iconic nature.

Several areas of future research were pointed out. Firstly, predictions about the predictability of actual orientation and point of contact need to be tested. The SignPhon database that we are currently developing will allow for a more systematic investigation of such aspects of the lexicon of NGT than hitherto possible (cf. Blees et al. 1996). Secondly, as was mentioned already, we think that
it is necessary to seriously study phonetic variation when making phonological analyses. Related to this, a model of phonetic implementation of phonological categories needs to be worked on. Finally, it was suggested that more research on iconicity can be relevant for phonological analyses. For example, we need to investigate how the motivated relation between the referent’s orientation and the sign’s orientation influences the possible shapes of signs, and to which extent such iconic relations should be part of the lexical representation of signs (cf. the work of Brennan 1990).

References

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