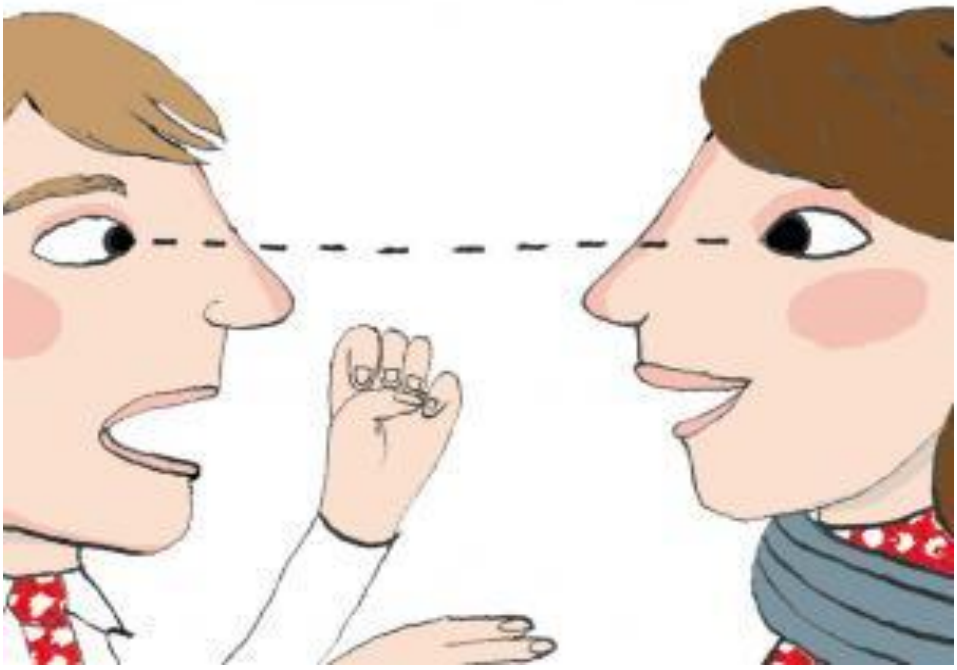
A Linguistic Description of the Phonetics and Phonology of Danish Sign Language



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Front cover: The illustration is reprinted with permission from The Danish Deaf Association.

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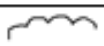
1H	One-handed sign
2H	Two-handed sign
BAL	Balanced
C	Central
CL	Contralateral
DH	Dominant hand
HS	Handshape
HSC	Handshape change
IL	Ipsilateral
LOC	Location
M	Mouthing
MA	Mouth action
MG	Mouth gesture
MOV	Movement
NDH	Non-dominant hand
NS	Neutral space
ORI	Orientation
UNBAL	Unbalanced

Abbreviations of sign language names

AdaSL	Adamorobe Sign language (Mumu kasa)
ASL	American Sign Language
Auslan	Australian Sign Language
BSL	British Sign Language
DGS	German Sign Language (Deutsche Gebärdensprache)
DSL	Danish Sign Language (Dansk tegnsprog)
HSL	Hausa Sign Language (Maganar hannu)
HZJ	Croatian Sign Language (Hrvatski znakovni jezik)
ISL	Israeli Sign Language

KSL	Kenyan Sign Language (Lugha ya I ya Kenya)
NGT	Sign Language of the Netherlands (Nederlandse Gebarentaal)
PISL	Plains Indian Sign Language
TSL	Taiwan Sign Language (Taiwan Ziran Shouyu)

Graphical representations	
	A single unidirectional path movement where the direction of the arrow shows the direction of the path.
	A repeated unidirectional movement where the direction of the arrow shows the direction of the path.
	A bidirectional movement.
	Shows the shape of the path movement, in this case a curved movement.
	Shows the shape of the path movement, in this case a circular movement.
	Shows the shape of the path movement, in this case a zig zag movement.
	Indicates that the handshape closes in the direction of the arrow.
	Indicates that the hands meet.
	Indicates that the hands meet repeatedly.
	Indicates that the fingers are wiggling.

Abstract

Information and research on the phonetics and phonology of Danish Sign Language is scant. This thesis presents an initial description on the phonetics and the phonology of Danish Sign Language. The aim has been threefold: 1) To identify the phonetic inventory of the different parameters handshape, location, movement, orientations and mouth actions; 2) to explore the distinctive features of the different parameters in the inventory by referring to minimal pairs and near minimal pairs and investigate possible allophonic variants. Of specific interest I found that the position of the thumb is non-distinctive and is largely predictable based on which part of the hand is in contact with the body during the articulation of a given sign. Furthermore, allophonic variation in some handshapes can largely be predicted according to their orientation and if the signs are articulated in neutral space, or on or near a point on the body.

Finally, I have shown that there are three types of manual signs: *One-handed signs*, *Two-handed balanced signs* and *two-handed unbalanced* signs. Referring to Battison's (Battison 1978) proposed conditions for sign formation in two-handed signs I found counter evidence to his *Dominance Condition*. Although it holds true for most of the unbalanced signs found in the database, I have shown that in some two-handed unbalanced the non-dominant hand is also specified for movement. Furthermore, in DSL the non-dominant hand in unbalanced signs can have more than the seven handshapes proposed by Battison (Battison 1978).

1 Introduction

In his work from 1960 Charles F. Hockett proposes a set of thirteen design features all of which are shared by all human languages and distinguishes them from the communication systems of animals (Hockett 1960a; Hockett 1960b). One of these features is duality of patterning. This feature refers to the ability of human languages to arrange a relatively small set of meaningless, yet linguistically significant, sounds (phonemes) into are larger sets of meaningful elements (morphemes) (Hockett 1960a; Hockett 1960b). This can be illustrated by words such as "ton" and "not" which have different meanings but are composed of the same three phonemes. Thus, human languages are said to be patterned on both the level of form and the level of meaning (RW.ERROR - Unable to find reference:396).

Up until the 1960s, by which time research on signed languages began to emerge, linguistic research was based on studies of spoken languages only. It is therefore a relatively recent insight that also signed languages have this duality of patterning. As in spoken languages there are rules on how the segments in signed languages can be combined (Van der Hulst 1993).

When describing a language phonologically one first has to determine the set of phonetic parameters that are used in the language (Ladefoged 1999). It is on the basis of these parameters that one can begin to investigate the distinctive features and describe the phonology of the language.

Within sign linguistics it is a widespread practice to use the terms *phonetics* and *phonology*, adapted from research on spoken languages, when referring to the study of the building blocks of signs[1] of a signed language[2] (Crasborn 2001). I will follow this convention in this thesis.

[1] Within sign linguistics the notion of 'sign' has been used in the same way as 'word' has been used in research on spoken languages. Therefore, in this thesis the notion of 'sign' is used to refer to the smallest unit that is meaningful and can stand on its own (Vermeerbergen 2006).

[2] As it aligns with *spoken* the term *signed language* will be used when discussing similarities, or differences between languages in the two modalities. Elsewhere the term *sign language* will be used.

Danish Sign Language (henceforth DSL) is the visual-gestural language used by the Deaf[3] community in Denmark. It is the primary language of about 5,000 people[4]. Because of the close contact with spoken and written Danish, DSL is and has always been influenced by the majority language.

Research on the phonetics and phonology of DSL is scant. This thesis is the first to investigate and provide an initial description of this aspect of DSL. As has been described for other signed languages, the signs in DSL can be analysed into smaller segments commonly referred to as *parameters*. These can be divided into *manual parameters* (handshape, and location, movement, and orientation of the handshape) and *non-manual parameters* (facial expressions, head, body, eye gaze, and mouth actions).

Currently sixty-five different handshapes, twenty-one locations and thirty-five different mouth gestures have been identified in DSL. These are listed in the online dictionary of the language[5]. However, whether these different handshapes, locations and mouth gestures are distinctive has yet to be determined. Nor do we know the full range of distinctive values for the other parameters. My thesis will address this lacuna and present an initial description of the phonological features that are used in the production of signs in DSL.

1.1 Aims

The aim of the thesis is threefold: Firstly, I will show that the phonological structure of DSL is comparable to findings from research on the phonological structure of other signed languages. I will do this by identifying the phonetic inventory of the handshapes, locations, movements, orientations and mouth actions that are used in DSL.

Secondly, I will explore the distinctive features of the different parameters in the inventory in an attempt to set up an inventory of distinctive features found in the signs of DSL. I will do this by referring to minimal pairs and near minimal pairs and investigate possible allophonic variants.

[3] "Capitalised Deaf designates a cultural affiliation with the Deaf community and DSL; lower case deaf indicates audiological status. Individuals who are deaf may not be Deaf." (Lucas et al. 2001:358).

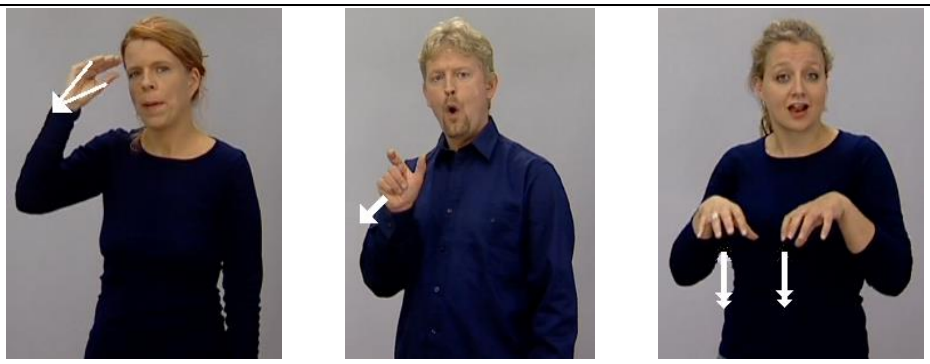
[4] This number is an estimate made by Danske Døves Landsforbund [Danish Deaf Association]. However, there are no official statistics of the number of Danish deaf signers using DSL (Bergman & Engberg-Pedersen 2010)

[5] www.tegnsprog.dk

Finally, I will describe the manual sign types used in DSL. I will show that there are two main types of two-handed signs: Two-handed balanced signs and two-handed unbalanced signs. This has also been found in research on other signed languages such as Australian Sign Language (Auslan) (RW.ERROR - Unable to find reference:328), Adamorobe Sign Language (AdSL) (Nyst 2007), and Hausa Sign Language (HSL) (Schmaling 2000). Referring to Battison's (Battison 1978) proposed *Symmetry* and *Dominance Conditions* for sign formation in two-handed signs I argue that not all two-handed signs in DSL apply to these conditions.

1.2 Scope

The database used in this thesis consists of monomorphemic lexical items such as the DSL signs MAND 'man', ORD 'word', and LEJLIGHED 'apartment' presented in Example 1. In these manual signs the individual phonological parameters of handshape, location, movement and orientation are meaningless units.



MAND 'man' | ORD 'word' | LEJLIGHED 'apartment'

Example 1: *Three examples of monomorphemic signs in DSL*.

Due to the limited space and time, this thesis does not include an analysis of the following classes of lexical items: *Depicting signs*, and non-native sign forms such as *fingerspelled signs*, *initialised signs*, and *signs based on the Mouth-Hand System* (MHS). The four types of signs will briefly be described in the following.

Depicting signs. As the name suggest the main function of these signs is to *depict* objects, or events in the real world. An object or event can be described from different points of view. The signs consist of the manual parameters handshape, location,

movement, and orientation, and each of these parameters carries meaning (Schembri 2003). For example, in some depicting signs the hand configuration (its shape and orientation) may be used to signal different meanings through the number of fingers that are selected, or the degree of spreading between the fingers, and how much they are bent (Corina 1990 cited in Johnston & Schembri 2007). In sign language research the different parameters have thus been analysed as separate morphemes that, when combined, produce complex polymorphemic constructions. The signs have therefore been viewed as distinct from monomorphemic lexical items such as the three pictures in Example 1 above (MAND, ORD, and LEJLIGHED) in which the different parameters are considered to be meaningless (Schembri 2003).

The handshape unit has received the most attention in research on depicting signs. There has been little agreement about the analysis of these signs, and the number of categories in which to divide the different handshapes used in these signs varies from one to seven categories. However, there are three categories, although scholars have given them different labels, which recur in all previous research:

- *Entity handshapes* which represent the whole of an object, e.g. car, person, or some part of an object, e.g. the paws of a cat, or hooves of a horse.
- *Handling handshapes* which imitate the animate agent handling a given object (Engberg-Pedersen 1993), e.g. a hand holding the handle on a bucket, or a dog carrying a bone.
- *Size, shape and surface specifier handshapes* which are used to describe the outline or surface of the object referred to, e.g. index fingers tracing the outline of a lake, or flat hands with palms facing down describing the rugged surface of a landscape.

Depicting signs can be used to extend, or modify the meaning of lexicalised signs (RW.ERROR - Unable to find reference:328).

In the last two of the following three pictures in Example 2, pictures of a handling handshape and an entity handshape are given. The depicting signs describe an event and an object in that event from different perspectives. The event is *a person driving a car looking for a parking place*. The object is *the car*.

The first picture (starting from the left) shows the citation form of the manual sign BIL 'car'. The second picture describes an event from the driver's perspective. He is in a car. The signer uses a handling handshape to indicate that the driver is handling the steering wheel while looking around for a parking place (the facial expression indicates that the signer is searching for something). Although the handshapes are similar in configuration in the first two pictures, there is a difference in the way they are articulated, and in their meaning.

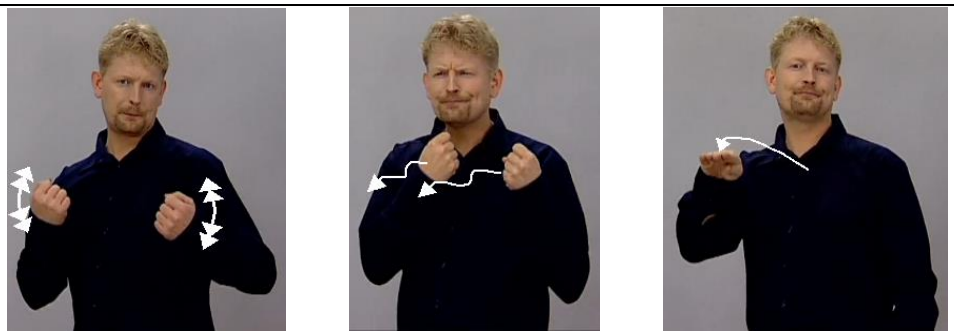
In the first picture the signer moves his hands up and down. That is, when the right hand moves up, the left hand moves down and vice versa. There is also a slight change in the orientation of the hands as if the signer was turning a steering wheel of a car. The translation of this sign is BIL 'car'.

In the second picture the shape and the orientation of the hands are similar to the handshape and orientation of the hands in the first picture. However, the movement is different. Here the hands move in a zigzag way away from the signer (in this case indicating that the driver is driving forward in a crowded place). In addition the facial expression (lowered eyebrows) of the signer indicates that the driver is searching for something. Of course you cannot tell all this from just one picture. This example (the middle and last picture in Example 2) is from the online dictionary of DSL. The pictures are taken from a short video clip that tells the story of a man looking for a parking place in a place full of people. For the purpose of describing the use of depicting signs, I have frozen the video frame by frame and picked out the shots where the signer uses depicting signs.

In the third and last picture the viewpoint changes again. Now we see the event from an observer's perspective, i.e. we are looking at the whole car being parked somewhere. The handshape that is used is an entity handshape. As mentioned previously an entity handshape is used to represent either the whole, or part of an object. In this example the hand represents the whole car. The entity handshape is a flat hand (a B3-handshape – See Appendix 4) which is the handshape that can be used to represent vehicles in general (car, bicycle, or boat). Here the orientation of the hand describes the actual orientation of the car. Had the palm of the hand had an upward orientation, this would mean that the car was lying on its roof. Had the palm of the hand been facing left, this would mean that the car

was tipped over and lying on its right side[6]. The tip of the fingers represents the front of the car. The translation of video clip is: '*There were a lot of people, but luckily I found a parking place for the car.*'(*Ordbog over dansk tegnsprog*) [7].

For an overview of research on depicting signs see Schembri (Schembri 2003).



BIL 'car' (Lexical item) | Handling handshape (Handling the steering wheel) | Entity handshape (Depicting the whole car)

Example 2: *A person driving a car looking for a parking place.*

What I have tried to make clear above by the description of the two depicting signs is that these types of signs are much more complex in structure and meaning than the monomorphemic signs MAND 'man', ORD 'word' and LEJLIGHED 'apartment'. There is so much more information put into each parameter in depicting signs.

Fingerspelled lexical items. Using the manual alphabet of DSL (Appendix 2) these signs are fingerspelled representations of words from Danish. In DSL, a one-handed alphabet is used as opposed to two-handed alphabets, which are used in sign languages such as Auslan, BSL and HZJ.

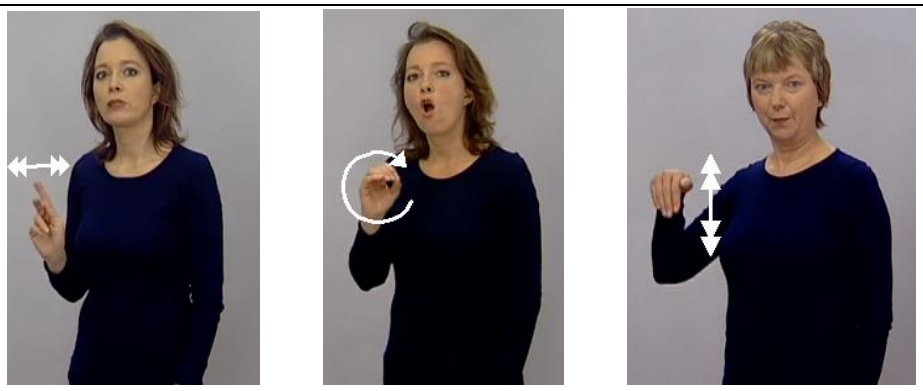
Fingerspelling is typically used for many specialised words, place names, and proper names. Although Danish deaf signers do use fingerspelling it is not as widespread in DSL as in for example ASL. From my observations of discussions on different sites on the internet, DSL users seem to prefer to coin new signs rather than using the manual alphabet to fingerspell the Danish (or English) words. It would be interesting to study this phenomenon of DSL sign formation in future research.

[6] A flat hand (used as an entity handshape) where the palm is facing left could also represent a bicycle had the manual sign for CYKEL 'bicycle' been introduced instead. If this was the case and if the palm was facing downwards this would mean that the bicycle was tipped over and was lying on the ground. As with the car the tip of the fingers represents the front of the bicycle.

[7] See Appendix 6 for the still shots of all six signs used in this video clip.

Initialised signs. These are signs in which the handshape unit represents the initial letter of the common Danish gloss of the signs (Johnston & Schembri 2007). The movement pattern in these signs is typically a shaking movement, a circular movement, or a repeated up/down movement. The signs are, with a few exceptions[8], typically signed in front of the signer in neutral space.

Three examples of initialised signs are given in Example 3. The first sign, KUSINE '(female) cousin', is articulated with what is called the K1-handshape (see Appendix 2), while shaking the hand. The second picture in the sample is the sign for ONKEL 'uncle', which is articulated with the O-handshape with a circular, counter clockwise movement. The third and final picture in the sample is the sign MANDAG 'Monday', which is articulated with an M-handshape a repeated up/down movement.



KUSINE	ONKEL	MANDAG
'(female) cousin'	'uncle'	'Monday'

Example 3: *Initialised signs in DSL showing some of the typical movement patterns.*

Signs based on Mouth-Hand-System. These are signs that are articulated using the MHS. The MHS is a one-handed phonetic system meant as a tool for teaching spoken Danish in deaf education. It consists of fifteen different handshapes. One handshape is used as a basic handshape. It represents the vowels in Danish and the consonants *b* and *v*. The rest of the fourteen hand shapes each represent the consonants in. /F/, /h/, and /p/ are

[8] The sign for NYBORG (a city on the eastside of the island of Funen) is signed with an N-handshape, using a shaking movement, palm of the hand is facing downwards, and the location is the right side (ipsilateral side) of the signer's neck. Other place names such as *Vejle*, *Randers*, and *Aalborg* are also signed using the initial letter of the place name.

represented by the same handshape though. During signing the hand must be held under the chin to aid in lip-reading.

The MHS was invented and developed by dr. phil. Georg Forchammer during the late 1800s. Forchammer, who was a former principal at the Deaf-Mute Institute, called the system '*a visible writing in the air in which mouth and hand supplement each other; that which cannot be seen on the mouth can be seen on the hand, and that which cannot be seen on the hand can be seen on the mouth.*' [Present author's English translation] (Forchhammer 1903; RW.ERROR - Unable to find reference:411).

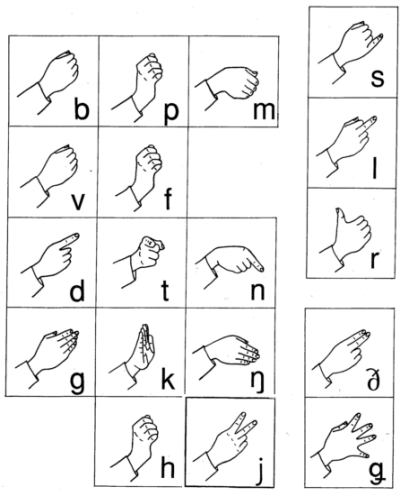


Figure 1: *The handshapes used in the Mouth-Hand-System* (RW.ERROR - Unable to find reference:411).

I have not included fingerspelled lexical items, initialised signs, or MHS-signs in my analysis because of their influence from Danish.

1.3 Methodology

In this section the methodology used in the phonetic and phonological study of DSL is briefly described.

1.3.1 The database

The database used for this thesis consisted primarily of video clips of single manual signs in citation form. In a few cases I used still shots of signs abstracted from short video clips of example sentences signed in DSL. All signs were retrieved from the online dictionary of DSL *Ordbog over Dansk Tegnsprog*, which consists of about 2,000 single signs in citation

form. The fact that the signs were available in video format serves my study well because it made it possible to see how every parameter in the signs behaves. In dictionaries in printed formats it is not always clear from the pictures and the descriptions of the signs how the signs are articulated.

As the limited time and space do not allow for an analysis of all the signs represented in the dictionary, the phonetic forms of a total of 516[9] single signs, which satisfy my criteria, have been transcribed in an Excel spread sheet[10]. The selection of the signs was chosen from a list of Danish glosses of the signs available in the dictionary. That is, every fifth, tenth or twentieth sign was selected the list. The shift in the interval of the selected signs was due to limited time available for encoding all the 2,000 sign presented in the dictionary. Deviations from this interval selection occurred if the next sign in the line was not the type of sign (monomorphemic signs) under investigation. Excluded from the database were then the following types of signs:

- Depicting signs
- Initialised signs
- Fingerspelled signs
- Signs derived from MHS
- Polymorphemic signs

In future studies on the phonetics and phonology of DSL the database should include all signs to provide a complete description of the phonetics and phonological structure of DSL.

For a phonetic description of the 516 monomorphemic signs they have been transcribed for the following aspects:

- Manual sign type, i.e. whether the signs are produced using one hand, or two hands.
- Handshape of the dominant hand.
- Handshape of the non-dominant hand if the sign is produced using both hands.

[9] Two of them turned out to be polymorphemic and will not be taken into further account in this thesis.

[10] Appendix 8 is a CD which contains the excel file with the encoded signs.

- Location of the sign, i.e. place of articulation on, or near the body (head, trunk, arm or hand), or in neutral space.
- Body contact, i.e. whether or not the hand is in contact with the body during the articulation of the sign.
- Movement, i.e. which type of movement is involved in the production of the sign. It can be either internal movement of the hand like *wiggling of fingers* or *handshape change*, or path movement such as *up, down, towards* or *away* as seen from the signer's point of view.
- If there is a change in handshape, which handshapes are involved?
- Orientation of the palm during signing such as up, down, toward or away from the signer's point of view, and if the orientation is static or dynamic.
- Mouth actions: *mouthings* and *mouth gestures*.
- Danish gloss.
- English translation of the Danish gloss.

The Danish glosses have been determined in collaboration between the deaf and hearing linguists working on the dictionary. The English glosses have been determined by the present author for the use in this thesis.

As is common within studies on Western sign languages when describing their handshape inventory, I have used terms such as *B-handshape, S-handshape*, and *1-handshape* and so on when encoding the handshapes used in DSL. The terms refer to the handshapes that make up the numeral system (numbers 1 to 9) of DSL and the manual alphabet[11] used in many Western sign languages. Although there are handshapes representing the language specific letters of the Latin alphabet used in the different spoken languages, the manual alphabets used in many Westerns sign languages are very similar to one another.

[11] The manual alphabet is first introduced into deaf education in Denmark in 1809 by N. Roosen (Castberg 1811:7). It is not known exactly when and who invented the manual alphabet used in Western sign languages. However, the oldest depiction of a manual alphabet is found in a rare work by Fray Melchor de Yebra (1526-1586) published in 1593 (Werner 1932:244   cited in Von Der Lieth 1967:135).(Werner 1932)

For handshapes deviating slightly from the handshapes used in the Western manual alphabet, or handshape that are not represented there altogether I have used the SignPhon handshape codes (Crasborn, Van der Hulst & Van der Kooij 2001). However, since the hand configuration is not apparent from these codes, I have used them in combination with the labels *flat, bent* and *hooked*, from the HamNoSys handshape chart (Prillwitz et al. 1989) to encode the handshapes on the dominant hand, the non-dominant hand, and for encoding the handshape changes used in DSL. A handshape conversion chart is provided in Appendix 4. It provides an overview of the labels I have used and how they correspond to the labels in SignPhon and also how they are depicted in the HamNoSys [Hamburg Notation System].

Some of the signs taken into account were not part of the database, and whenever they are discussed in the text this will be mentioned explicitly.

1.3.2 Transcription conventions

Example signs throughout the thesis are glossed in Danish and written in capital letters, e.g. HUS, and an English translation is also given, e.g. 'house'. Signs that are glossed with more than one Danish word are separated by a hyphen between each gloss, e.g. NOT-YET. It is important to note the difference here from traditional descriptive linguistics in which hyphens usually indicates morpheme boundaries. Within sign linguistics it is a convention to use hyphens in the gloss when more than one word in the meta language is needed to convey the meaning of a monomorphemic sign.

Following the conventions used within sign linguistics, the handshapes in this thesis are, as is briefly mentioned above, referred to by names which are based on the manual alphabet and numerals of the sign language under investigation, in this case DSL. Thus, some of the handshapes are named after the letters of the Latin alphabet, and some are named after numerals. Finally, a few handshapes are named after the handshapes used in other signed languages if the handshape is not a part of the manual alphabet of DSL.

Letters, e.g. O-handshape  , C-handshape  , and F-handshape  .

Numbers (1-9), e.g. 1-handshape  , 3-handshape  , and 7-handshape  .

Names, e.g. Bent 1-handshape[12]  .

In addition to the letters and numbers, some of the handshapes are also referred to by their characteristic features, such as *bent*, *closed*, *flat*, *hooked*, or *open*. Finally, some handshapes differ only with regards to the position of the thumb, e.g.  ,  . These are therefore labelled with a letter and a number, for example A1  and A2  .

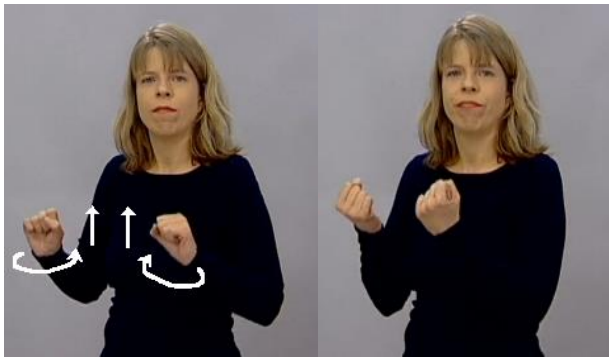
Below is an example of how the sign pairs in this thesis are presented. The text below the pictures in these boxes gives a quick overview of the different components in the sign examples. This is to help the reader, with no prior knowledge of sign language and sign linguistics, understand the terminology and description of the different parameters that are used when articulating a sign.

- The first line in the box is the Danish gloss of the sign followed by an English translation of the Danish gloss.
- The second line informs the reader about the type of manual sign that is being described. That is, whether one or two hands are involved in the articulation of the sign.
- *HS* informs about the type of handshape that is used in the articulation of the sign.
- *LOC* informs about where the sign is articulated (neutral space, or on or near a part on the body). This can be further specified by information about the point of articulation. For example, if the sign is articulated on the nose, the specific place such as tip or bridge of the nose will be mentioned too.
- *MOV* informs about the movement of the hand(s) during signing. There can be two types of movement involved. One is path movement, which is the hands movement, for example away from the signer. Another is internal movement, which is a movement within the hand.
- *ORI* informs about the orientation of the palm(s) of the hand(s) in relation to the signer's body.

[12] As the name refers this handshape is named after the handshape 'T' in the manual alphabet of Irish Sign Language.

- *MA* informs about the type of mouth action that may accompany the sign. It is further specified whether the signer uses a mouthing (M), or a mouth gesture (MG).
- *CONTACT* informs about whether the hand(s) are in contact with the body during the articulation of a sign.

A detailed description of the different building blocks of signs will be provided in the thesis. Besides being described before each example, the deviant feature(s) in minimal or near minimal sign pairs will be in bold font.

AKTIV 'active' • SIGN TYPE: 2H BAL • HS: S • LOC: Neutral space • MOV: Up • ORI: Away to towards • MP, MG: Long blow • CONTACT: No	

The majority of the DSL signs analysed and described in this thesis are based on and can be viewed in the online dictionary of DSL *Ordbog over Dansk Tegnsprog* at www.tegnsprog.dk. To view a video of the production of a given DSL sign used in this thesis go to the webpage and type in the Danish gloss for that sign where it says *Søgeord*, and then press *Enter*.

The majority of the illustrations of handshapes, locations and the majority of pictures of signs and mouth actions used throughout this paper are reprinted with permission from the authors of the DSL dictionary.

1.3.3 Outline of the thesis

In the next chapters, the phonetics and phonological structure of DSL will be described and analysed. It begins in chapter 2 with a brief introduction to the methodology used when describing the phonetics and phonology of a language (2.1). Then an introduction to sign language linguistics is given (2.2), including a brief overview of the main approaches within sign linguistics (2.2.1), and an introduction to the study of phonetics and phonology

of signed languages (2.2.2). Chapter 3 is the analysis and comprises four sections. In section 3.3, the different types of manual signs that are found in DSL will be presented by describing their characteristics with regards to whether one or two hands are involved in the production of the sign, as well as their frequencies and distribution according to place of articulation. Section 3.4 deals briefly with other sign types found in DSL. In section 3.1, the phonetic parameters found in DSL will be presented as well as their frequencies in the different types of manual signs. The different phonetic parameters will be described in turn. Section 3.2 explores the distinctive features of the different parameters described in section 3.1 and aims at defining their phonemic status. Sections 3.1 and 3.2 each ends with a summary of the findings. Finally, chapter 4 concludes on the findings and gives suggestions to further research.

2 Theory

2.1 Describing the phonetics and phonology of a language

The field of phonetics is concerned with discovering and describing the sounds of a language. The questions that are of interest to phoneticians and which divides the field into three subfields are: What is the physical structure of the sounds of the language under investigation (articulatory phonetics)? What are the acoustic characteristics of the sounds (acoustic phonetics)? And how are the sounds perceived (auditory phonetics)? This thesis will focus on articulatory phonetics.

The sounds of a language are produced in the vocal tract which comprise the following organs: the lungs, which produce the airstream that will be modified; the larynx in which the airstream is influenced by the tension in the vocal folds; the nasal cavity, and the oral cavity where airstream can be modified by the position of the tongue and the lips and thereby produce a variety of sounds. The two major groups of sounds are *consonants* and *vowels*.

Consonants are sounds that are produced by obstructing the airstream in the vocal tract. They can be further divided according to where along the vocal tract the airstream is constricted, *place of articulation,* and how the airstream is constricted, *manner of articulation*.

Vowels contrast with consonants in that they are produced with no impedance of the airstream (RW.ERROR - Unable to find reference:396). They can be described according to the position of the tongue, that is, whether the tongue is placed in *front, central, back, high, mid* or *low* position, and whether the lips are *rounded* or *unrounded*.

When one wants to describe the sounds of a language at the phonological level one must first transcribe and gloss a set of data phonetically in order to set up the inventory of sounds that are found in the language under investigation. When the phonetic inventory of sounds is set up the analysis can begin (Ohala 1999). The questions that are of interest to phonologists are: Is there a pattern in the way the sounds are used? In which environments do the sounds occur?

When one wants to determine how the sounds are used and how they pattern in the language the first thing to do is to look for suspicious pairs. That is, to pick out phones

which are similar, and then analyse these to see in which environments they occur, and whether they are contrastive or if they are allophones of the same phoneme. That is, do they represent different phonemes, or are they different realisations of the same phoneme? (RW.ERROR - Unable to find reference:396).

The method traditionally used in determining the distinctive features of a language is to identify minimal pairs or near minimal pairs. By minimal pairs is meant sets of words that differ by only one sound. By near minimal pairs is meant sets of words that contrast by more than one sound. The following example (Example 4) of a minimal pair is from English:

[s] and [z] in [sɪp] and [zɪp]

Example 4: *Example of a minimal pair in English.*

When the initial sound in these two words is changed it changes the meaning of the words. Thus, when the two words in a minimal pair have different meanings the two sounds are different phonemes.

If the two words have the same meaning the sounds are allophones of the same phoneme and the two sounds are said to be in free variation. This means that the sounds can be interchanged without changing the meaning of the words. Allophones are the different realisations of a phoneme. That is, a sound may be pronounced differently in the different environments in which it occurs.

One cannot necessarily find minimal pairs for all sounds as some sounds may never occur in the same phonetic environment, but that does not mean that they are not contrastive. Sounds that do not occur in the same environments are in complementary distribution which means that the presence of one excludes the presence of the other (RW.ERROR - Unable to find reference:396). Examples of sounds in Korean that are in complementary distribution are the sounds [r], which is word initial, and [l], which is word final (http://pandora.cii.wwu.edu/vajda/ling201/test2materials/Phonology1.htm 2011).

2.2 An introduction to research on signed languages

This section introduces the concepts of phonetics and phonology in signed languages. It begins, however, by providing a brief overview of the main approaches in research on signed languages.

2.2.1 Approaches in sign language research

Linguistic research on signed languages is a relatively young field. It emerged in the 1950s with Tervoort's doctoral dissertation (Tervoort 1953) on the use of signs with deaf children, and the first modern linguistic analysis of a signed language conducted by William C. Stokoe (Stokoe 1960). From the onset of research on signed languages the theoretical framework has been debated forming two opposing approaches. The first approach has been described as being motivated by the urge to prove the linguistic status of signed languages, while the second approach has emphasized on the unique features of these the visual-gestural languages. This will be briefly outlined on the following.

Before Stokoe's seminal work on American Sign Language (ASL), signed languages were generally not considered natural human languages, but were regarded as unanalysable gestures with no internal organisation (Sandler & Lillo-Martin 2006), (Vermeerbergen 2006), and (RW.ERROR - Unable to find reference:328):

> Some communities have a gesture language. Such gesture languages have been observed…among groups of deaf mutes. It seems certain that these gesture languages are merely developments of ordinary gestures and that any and all complicated or not immediately intelligible gestures are based on the conventions of ordinary speech (Bloomfield 1933:39).

However, Stokoe showed that the signs in ASL were compositional in nature. They could be analysed as linguistic structures consisting of a set of non-meaning-bearing, distinctive properties (Van der Hulst 1993) . He defined three manual parameters which formed the signs in ASL: *handshape*, *location* and *movement*, for which he coined the term

cheremes[13] in analogy to phonemes in spoken languages (Stokoe 1960). However, this proposed terminology never gained much acceptance (RW.ERROR - Unable to find reference:328). Instead it became a widespread practise to adopt the terminology used in linguistic descriptions of spoken languages:

> Given the extent to which sign phonology mirrors that of spoken language, it can be argued that the meaning of the term [phonology - JH] itself should be made more abstract, or modality free; that the definitions of the terms used should reflect the abstract nature of the language phenomena being described (Siple 1982:323 cited in Johnston 1989a:45).

Following Stokoe's research, which established signed languages as natural languages, the interest in studying signed languages increased in the US and from the 1970s in other Western countries too, including Denmark (Hansen 1985).

In 1978 Battison (Battison 1978) suggested a fourth parameter, *orientation*. This parameter refers to the orientation of the palm(s) during signing. Battison considered it another important segment in the production of signs, and this is now accepted by most researchers (Van der Hulst 1993). Later research has also investigated the role of *non-manual features* which include mouth actions, movements of head and body, eyes, and facial expressions (Sutton-Spence & Woll 1999; Lucas et al. 2001).

For many years, similarities between spoken languages and signed languages have been the main focus in most sign linguistic research, and theories based on centuries of research on spoken languages have been used in the study of signed languages. This approach has been described as *the oral language compatibility view*. As the name suggests this approach presupposes that the structures of signed languages are in general compatible with linguistic concepts used to describe spoken languages(Vermeerbergen 2006:170).

Another approach, although less widespread, has been *the sign language differential view*. The essential points in this approach is that the structure of signed languages is unique, and that one cannot assume that all linguistic concepts in spoken language research

[13] The term *chereme* is based on the ancient Greek word *χείρ* meaning 'hand' and is used analogous to *phoneme*.

can be applied to the study of these visual-gestural languages (Vermeerbergen 2006; RW.ERROR - Unable to find reference:328)

2.2.2 The phonetics and phonology of signed languages

The research that has been done on the phonetics and phonology of different signed languages is substantial, and several models of analysis have been proposed. It is beyond the scope of this thesis to adequately cover it all. Omitting some of the important ideas and arguments for different theoretical frameworks within this area is thus inevitable.

Signs in signed languages are composed of a combination of *manual* (handshape, location, movement, and orientation) and *non-manual* (facial expressions, head, body, eye gaze and mouth actions) features commonly referred to as *parameters* (Figure 2). The four manual parameters handshape, location, movement and orientation are usually considered the most central. However, it has also been suggested that *non-manual* parameters play an important role in the internal structure of signs (RW.ERROR - Unable to find reference:328):

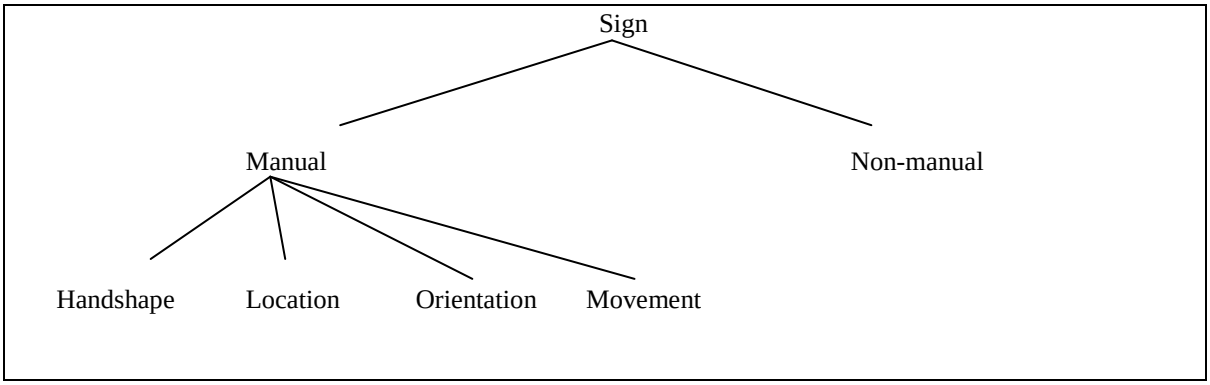


Figure 2: *The properties of the sign* (Van der Kooij 2002:15).

When analysing the formation of signs the notion of *signing space* is included (Kuhn, Alibasic Ciciliani & Wilbur 2006:35). The signing space refers to the area that extends from a little above the signer's head to a little below the signer's waist, and from the signer's left to right side in about half an arm's length from the body. The signing space is illustrated in Figure 3 below.

Figure 3: *The signing space* (Kuhn, Alibasic Ciciliani & Wilbur 2006:35)

Furthermore, within the signing space signs can be produced along different planes that divides the body into front/back (frontal plane), top/bottom (horizontal plane), and left/right (sagittal plane). This is illustrated in Figure 4. This is also relevant in the specification of movement which is discussed in section 2.2.2.3.

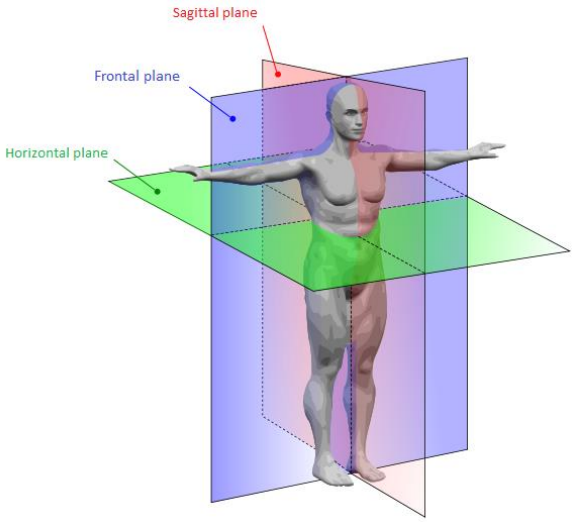


Figure 4**: *Planes of the body*** (*Sagittal plane*)

In the following subsections the manual and non-manual parameters will each be discussed in turn.

2.2.2.1 Handshape

As indicated by the term, handshape refers to the shape of the hand(s) when articulating a sign. The hands are able to produce a large number of different shapes. The handshape and its formational characteristics are often considered to be the most complex segment in the production of signs (Sandler & Lillo-Martin 2006:144).

Sign linguists have described the handshape parameter in different ways resulting in a number of different classifications based on the main features of the handshape. For example, handshapes can be described according to whether all fingers are closed into a fist  , or if one  or more fingers  are selected.

The handshapes can be described further with regards to the configuration of the hand, that is, whether the selected fingers are extended  , flattened  , or bent at the first, second  , or all joints  , if the fingers are spread  , held together  , crossed  , or whether the thumb is in contact with one  or more fingers  . The thumb can also have three different positions  .

Although a vast number of signs can be produced from these different hand configurations "*every sign language has a limited inventory of formational components with limitations on distribution, and these inventories differ from sign language to sign language, e.g. every sign language has a finite subset of handshapes which does not exhaust the set of handshapes that is physiological possible*."(Schmaling 2000:61). That is, some handshapes occur in one sign language but not in another, or some handshapes may have phonemic status in one sign language but not in another (Schmaling 2000; RW.ERROR - Unable to find reference:328). However, there are some handshapes, such as B-hand  , 5-hand  and 1-hand  that occur in most of the signed languages described so far (RW.ERROR - Unable to find reference:328).

The number of phonetic and phonemic handshape varies from signed language to signed language. One possible explanation to this might be explained by the different approaches in the analysis of the handshapes. In Table 1 below is a list of the size of the phonetic and phonemic handshape inventories in a number of sign languages. Taiwan Sign Language is represented three times as there have been different proposals as to the number of total handshapes used in the language.

Table 1: *Phonetic and/or phonemic handshape inventories of different sign languages*[14].

Sign language	Phonetic HS	Phonemic HS
Adamorobe (Nyst 2007)	29	7
Auslan (RW.ERROR - Unable to find reference:328)	62	37
Croatian (Kuhn, Alibasic Ciciliani & Wilbur 2006)	44	-
Hausa (Schmaling 2000)	-	35?
Jordanian (Hendriks 2008)	55	-
Kata Kolok (Bali) (Marsaja 2008)	-	28
Kenyan (Morgan 2010)	52	-
NGT (Van der Kooij 2002)	-	31
Plains Indian (Washabaugh 1986) cited in (Nyst 2007:47)	10?	10?
Taiwan (Lee 2008)cited in (Tsay & Myers 2009:102)	-	57
Taiwan (Smith & Li-Feng 1979; Smith & Li-Feng 1984) cited in (Tsay & Myers 2009:102)	56?	56?
Taiwan (Chang, Su & Tai 2005) cited in (Tsay & Myers 2009:102)	60?	60?

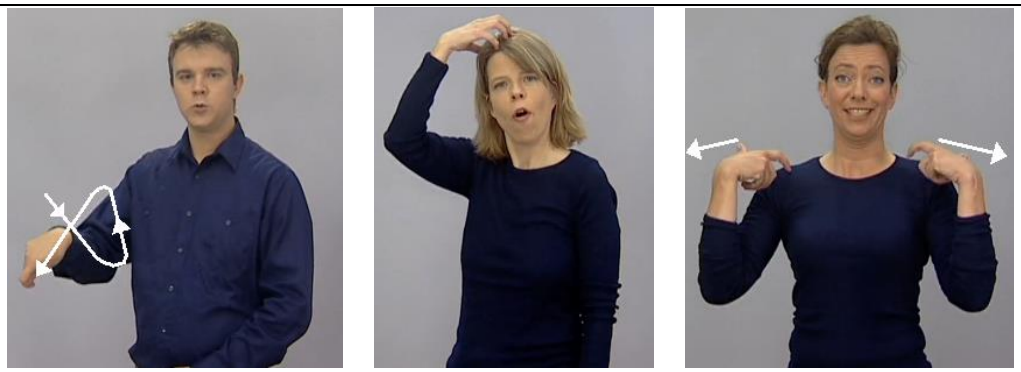
As can be seen from Table 1 the size of the phonetic and phonemic handshape inventory of AdaSL (and Plains Indian Sign Language (PISL)), a sign language used in a village in the Eastern Region of Ghana, is relatively small compared to the Westerns sign languages such Auslan and Signed Language of the Netherlands (NGT). This is a typical characteristic for a signed language such as AdaSL which is classified as a village sign language. A village sign language is described as a sign language restricted to a particular village where there is a high incidence of hereditary deafness (Nyst 2007).

2.2.2.2 Location

Location refers to the hand's or hands' place(s) of articulation (POA) during the production of a sign. Signs may be produced on, or near the signer's trunk, arm, hand, head, and in the neutral space as. Neutral space has been described as being "*an area from a little above the signer's waist to her throat*" (Engberg-Pedersen 1993: 36-37).

[14] As some of the figures in table 1 are taken from articles citing other articles it is not clear whether the figures provided are of the phonetic or phonemic handshape inventory. This is marked in the table by a '?' after the figure, and the figure is listed under both the *phonetic* and *phonemic* columns. In the case where the figure is retrieved from the research article on the particular sign language, the figures are listed in both columns if figures for both inventories are provided. Otherwise the figure is listed in the relevant column and a hyphen is used in the other column.

Furthermore, two different places of articulation may be involved in the production of a sign. Examples of different locations are illustrated in the following picture sample (Example 5). Further distinctions may be made on each of these locations.



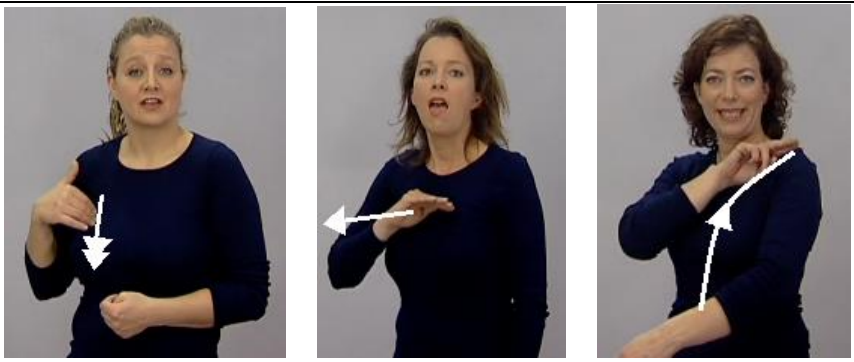
In neutral space *On the body (head)* *Near the body (shoulders)*

AFLYSE 'cancel' *KONGE 'king'* *CHEF 'boss'*

Example 5: *Examples of places of articulation in DSL.*

The location of the handshape may also be described with regards to its position according to the signer's body, where the *ipsilateral* (IL) and *contralateral* (CL) sides distinguish between the same (IL) and the opposite (CL) side of the signer's body with regards to the dominant hand. The notion of *dominant hand*, vs. *non-dominant hand*, refers to which hand is the most active hand during signing. Hence some researchers have also used the terms *active* and *passive* hand, or *strong* and *weak* hand (Padden & Perlmutter 1987; Nyst 2007). In this thesis I will distinguish between the dominant hand and non-dominant hand.

The dominant hand determines which side is the ipsilateral and contralateral side. Which hand is the dominant hand depends on whether the signer is right- or left handed. That is, if the signer is right handed the dominant hand is the right hand and the ipsilateral side is then the right side of the signer's body. The contralateral side would then be the signer's left side. The non-dominant hand is the non-moving hand in two-handed signs. The notion of ipsilateral and contralateral side can be illustrated by the following picture sample (Example 6).



HVID	HERRE	SPANIEN
'white'	'master'	'Spain'

Example 6: *From left to right: The ipsilateral, the central and the contralateral side. Each sign in the three examples is signed by right-hand dominant signers.*

2.2.2.3 Movement

Some signs are static[15], while other signs involve some kind of movement. The movement parameter refers to the movement of the hand(s) during the articulation of a sign. There is a general distinction between *path movements* and *internal movements*.

Path movement, also known as *global movement* (RW.ERROR - Unable to find reference:413), is specified as movement in the elbow or shoulder, moving the handshape from one location to another. Movement can occur in the signing space, or on or near the body. It can also occur from the body and into space and the other way around (Van der Hulst 1993; Brentari 1998; Schmaling 2000). The basic path movements occur along the different planes of the body (Figure 4, section 2.2.2). These movements are *up*, *down*, *left*, *right*, *towards* and *away*. Concatenations of the simple path movements are possible so that *down*/*left* would draw an imaginary diagonal line in the signing space in front of the signer. Or the up and down movement may be combined thus "*leading to a distinction between unidirectional path movements…and bidirectional path movements*" (Van der Hulst 1993: 219). The manner of a path movement can either be a straight, curved (or arched), or circular.

Internal movements, also known as *local movements*, involve handshape change and change in orientation of the hand(s) (Van der Hulst 1993; RW.ERROR - Unable to find reference:328). A change in handshape usually involves the configuration of the hand

[15] The sign KONGE 'king' in picture 4 is an example of a static sign.

changing from being open to being closed, flattened, hooked or bent, or the other way around. Handshape change from a closed to and open handshape or vice versa is referred to as change in aperture (Wilbur 1987). Examples of change in aperture from DSL are change from B2-hand  to closed B-hand  (open to closed), as in the sign ACCEPTERE 'accept', or from Bent 1-hand  to L-hand  (closed to open), as in the sign DYR 'expensive'.

The two types of movements may be combined. In the following sign example from DSL, the sign AUSTRALIEN 'Australia' (Example 7) both path movement and internal movement is involved. The path movement is away from the signer. The internal movement is in the form of a change in handshape from an 8-hand to a 5-hand.

1st segment 2nd segment

Example 7: *The sign AUSTRALIEN 'Australia' which involves movement away from the signer and handshape change from the 8-handshape to the 5-handshape.*

In the next example from DSL only internal movement, described as 'squeeze', is involved (Example 8).

Example 8: ***The sign MOSE 'moor' is produced with the internal movement.***

The internal movements that involve repeated changes in handshape, or orientation have been termed secondary movements by some sign linguists (Liddell 1990; RW.ERROR - Unable to find reference:328) but the issue is a matter of debate (Van der Hulst 1993). In my analysis of the movement parameter in DSL (3.1.4) I will distinguish between path movement and internal movement only, thus including repeated changes in handshape and/or orientation under internal movements.

2.2.2.4 Orientation

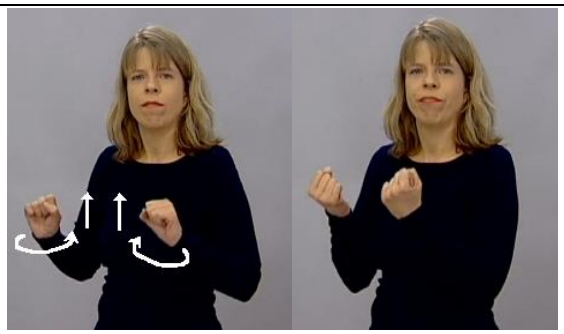
Orientation refers to the orientation of the palm(s) and finger(s) in the signing space with respect to the signer's body, for example palm facing left as in the DSL sign SØNDAG 'Sunday' in Example 9 below.

1st segment 2nd segment

Example 9: *The sign SØNDAG 'Sunday' in which the palm of the hand is facing left.*

Orientation of the palm(s) can be either static throughout the production of a sign, or it can be dynamic which involves internal movement, in the form of changing the orientation

during the articulation of the sign. Example 10 gives an example of a sign which involves dynamic orientation of the hands in that the palms of the hands are pointing away from the signer in the beginning of the articulation of the sign and end up facing towards the signer.



1st segment 2nd segment

Example 10: *The sign AKTIV 'active' involves dynamic orientation of the hands*.

This forth parameter was identified by Battison in 1978 (Battison 1978) and he suggested that in addition to handshape, location and movement, orientation also played an important role in the production of signs. The role of orientation is still debated among sign linguists, and some believe this feature to be redundant (RW.ERROR - Unable to find reference:328). However, evidence supporting Battison's suggestion has been found in the signs from database used for this thesis.

2.2.2.5 Non-manual parameters

Non-manual parameters include movements of the head, body (bending forward or sideways), facial expressions (smile, frown, the direction of the eye gaze) and mouth actions. All the features are important when communication in the visual-gestural modality and they have several functions (Crasborn et al. 2008). For example, some actions on the mouth have certain grammatical functions.

At the morphosyntactic level of structure non-manual features can be used to express differences in sentence type. At the phonological level non-manual features such as mouth actions can be used to distinguish two otherwise identical signs. On this level, although they are not used for every sign formation, they are regarded as "*a separate phonological characteristic*." (Kuhn, Alibasic Ciciliani & Wilbur 2006:49).

Previous research on mouth actions in sign languages distinguish between *mouthings* and *mouth gestures* (Crasborn et al. 2008). While the movements of the mouth in mouthings

are derived from words of the spoken language(s) with which the signed language co-exists, the movement of the mouth in mouth gestures are sign language inherent (Nyst 2007:52; *The Correlation Between Word Class and Mouth Actions in Irish Sign Language (ISL)*) .

2.2.2.6 Sign types

Signs can be manual, non-manual, or they can be a combination of the two. Manual signs are the most frequent type of sign. They can be subdivided according to whether they are signed with one hand, or two hands. The different manual sign types can be further divided into signs that are articulated in the signing space, and signs articulated on, or near the body.

Signs that are produced non-manually only are rare. Non-manual features usually co-occur with manual signs. This type of sign has been referred to as *multi-channel signs* (Brennan 1992). The different types of manual signs will be further investigated and described in detail in chapter 3.3.

2.2.2.7 Constraints on sign formation

As described in section 2.2.2, signs are articulated within what is called the signing space, although if a signer wants to emphasize the height of a tall person that she has seen, the signer can articulate the sign above the upper limit of the signing space relative to her own height. However, the articulation of signs is rarely extended beyond the signing space. Researchers have argued that constraints of perception are a part of the explanation for signers keeping signs within the signing space (RW.ERROR - Unable to find reference:328).

In her research, Siple (Siple 1978: cited in Johnston & Schembri 2007:102) showed that during conversation signers focus on the face of their interlocutors and not their hands. Thus, peripheral vision seems to have "*a significant effect on the location of signs on the body*" (RW.ERROR - Unable to find reference:328).

Johnston & Schembri (RW.ERROR - Unable to find reference:328) have examined the distribution of one- and two-handed signs according to their place of articulation. Their study showed that two-handed balanced signs[16] tend to be articulated on the trunk, while

[16] Two-handed unbalanced signs were not taken into account (RW.ERROR - Unable to find reference:328).

one-handed sign tended to be articulated in the head region (RW.ERROR - Unable to find reference:328).

In his work in ASL from 1978 Battison (Battison 1978) formulated two conditions that were intended to account for the possible formations of the dominant hand and non-dominant hand (Battison uses the terms *active* and *passive* hand) in two-handed signs, as well as constraints in their formation. One condition, known as the *Symmetry Condition*, states that:

a) If both hands of a sign move independently during its articulation, then
b) Both hands must be specified for the same location, the same handshape, the same movement (whether performed simultaneously or in alternation), and the specifications for orientation must be either symmetrical or identical. (Battison 1978:33).

The other condition, known as the *Dominance Condition*, states that:

a) If the hands of a two-handed sign do not share the same specification for handshapes (i.e., they are different), then
b) One hand must be passive while the active hand articulates the movement, and
c) The specification of the passive hand is restricted to be one of a small set: A, S, B, G, C, and O (Battison 1978:34)

In the following analysis of signs in DSL I will investigate whether these production constraints apply to two-handed signs in DSL.

2.2.2.8 Transcription tools in sign language linguistics

There have been several proposals as to how one best describes and present the segments that make up signs in signed languages. Two of these will be briefly mentioned in the following.

SignPhon is a tool designed for phonological research of signed languages. It is a database developed by the Dutch sign linguists Crasborn, Van der Hulst and Kooij. The database has been designed to store information about the phonetic and phonological

structure of signs in citation form "and contains a complete phonetic-phonological description of signs." (Crasborn, Van der Hulst & Van der Kooij 2001). It has been developed with the aim at creating a standard procedure for the transcription of isolated signs. The goal is "…to find patterns, distributional regularities, cooccurrences and frequencies in some domain…". The database is divided into several subfields of which one is about the phonetic description of the shape of signs. In addition a chart with handshape codes have been developed. SignPhon can be compared to the IPA transcription for spoken languages (Crasborn, Van der Hulst & Van der Kooij 2001).

The Hamburg Notation System, or *HamNoSys*, is another transcription tool developed by German sign linguists Prillwitz, Leven, Zienert, Hanke & Henning (Prillwitz et al. 1989) in an attempt to have a tool for describing the phonetics and phonology of signed languages. The HamNoSys includes a chart which divides handshapes into four main groups based on whether the main feature of a handshape is a fist, a flattened hand, and the number of fingers involved in the configuration of the hand. Although it is based on the handshapes of DGS, the HamNoSys can to some extent be compared to the IPA used for spoken languages. The system is different from SignPhon in that is uses symbols for the different handshapes, locations, movements and orientations used during the production of a sign. Figure 5 is an example from Schmaling's descriptive analysis of Hausa Sign Language in which she uses HamNoSys for the encoding of HSL signs (Schmaling 2000):

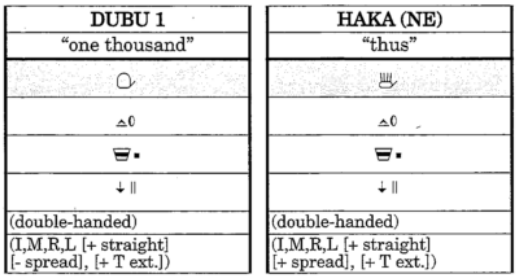


Figure 5: *An example of a transcription using the Hamburg Notation System* (Schmaling 2000:76).

The contents of the box with a transcription of the HSL sign DUBU 1 'one thousand' (to the left) in Figure 5 will be briefly described in the following.

In the first row in the box a gloss in Hausa is provided. In the second row an English translation of the Hausa word is given. In the third row is a symbol that indicates the handshape used during the production of the sign with the meaning DUBU 'one thousand'.

The symbol here refers to the use of a B-handshape  . The fourth row provides information about the orientation of the hand during the production of the sign. In this case the symbol in the fourth row tells us that the hand is orientated with its palm facing to the left as seen from the signer's point of view. The symbol in the fifth row indicates the location of the sign, i.e. that the sign is signed on the chest and further that it is signed on the right side of the chest. The symbol on the sixth row refers to the movement parameter and it indicates that the sign is produced with a downward movement. Finally the last two rows provide us with information about which type of sign is described. In this case it is what Schmaling terms a double-handed sign (Schmaling 2000). This means that it is signed with two-hands and that both hands share the same type of handshape. Furthermore, the specific characteristics of the handshape configuration is described, i.e. that the fingers index- to little finger (I,M,R,L[17] [+straight]) plus thumb [+T ext.] are extended, and that they are not spread [-spread]. The two sign examples given in Figure 5 are an example of a minimal pair in HSL in which only one parameter differs. The only difference between the two signs is the choice of handshape. In the transcription to the right the 5-handshape  is used instead of the B-handshape  while the rest of the parameters remain constant.

3 Analysis: The phonetics and phonology of Danish Sign Language

As mentioned in section 2.1, the basis for a phonological analysis of the building blocks of a language is to determine the set of phonetic parameters. This chapter presents the set of phonetic parameters used in DSL and analyses their phonological features.

I will begin by presenting the inventory of phonetic parameters found in DSL in section 3.1. In section 3.2, the distinctive features of the different parameters will be analysed and

[17] T, I, M, R, L = Thumb, index, middle, ring, and little finger.

described. I will do this by referring to minimal pairs, near minimal pairs, and sets of signs, looking for signs whose meaning is distinguished by a change in one or more of the parameters mentioned above. Where possible, the findings for DSL will be compared with findings from research on other signed languages. Each parameter will be dealt with in turn in the sections 3.2.1 to 3.2.5. In section 3.2.6 I will investigate whether minimal pairs can be found that differ only in being signed with one or two hands. In section 3.1, I will move on to a description of the different types of manual signs that were found in the database. I will show that in DSL there are two types of two-handed signs which have also been found in research on other signed languages. In section 3.4 I give a brief presentation of other sign types.

3.1 The phonetic inventory

In this section I will present and describe the inventory of the manual parameters *handshape, location, movement and orientation*, and the non-manual parameter *mouth actions*, which are used in the articulation of signs in DSL. In section 3.1.1, I will begin by presenting the set of phonetic handshapes that I found in the database. In the subsequent sections I will present the other parameters in turn.

3.1.1 Handshapes

The inventory of the sixty-five phonetic handshapes used in DSL is given in Table 2. The labels for each handshape are given under the respective handshapes following the numerals and the manual alphabet of DSL, and where these do not apply I have used labels from SignPhon (Appendix 4). For the rest of the thesis I will be using these labels when discussing the different handshapes.

As can be seen from the table DSL has a large number of phonetic handshapes when compared to the figures in Table 1, section 2.2.2.1, showing the number of phonetic handshapes found in other sign languages. The different handshapes are listed in the online dictionary of DSL, which divides them into six main categories (*Ordbog over dansk tegnsprog*) based on a set of basic characteristics such as clenched fist, flat hand, the number of extended fingers (one, two, or three to five fingers), and closed circle. These are then further specified within their category according to different features such as bent finger(s), hooked finger(s), and the position of the thumb. Each category consists of between four to seventeen different handshapes.

Table 2: *The phonetic handshapes used in DSL.*

Group 1: Closed fist


[A1-hand]


[S-hand]


[A2-hand]


[E1-hand]

Group 2: Flat hand


[B1-hand]


[B2-hand]


[B3-hand]


[Flat B1-hand]


[Flat B2-hand]


[Flat B3-hand]


[Bent B3-hand]


[C-hand]


[E2-hand]


[Flat C-hand]


[Closed B-hand]

Group 3: One extended finger


[1-hand]


[D-hand]


[Flat 1-hand]


[T-hand]


[2-hand or 1b]


[X1-hand]


[X2-hand]


[Mid-hand]


[I-hand]

Group 4: Two extended fingers


[L-hand]


[Bent L-hand]


[G-hand]


[gC-hand]


[H1-hand]


[H2-hand]


[Bent H-hand]


[Flat H-hand]


[H3-hand]


[V-hand]


[Flat V-hand]


[Bent V-hand]


[R-hand]


[Y1-hand]

Group 5: 3 to 5 extended fingers


[3-hand]


[Bent 3-hand]


[K1-hand]


[K2-hand]


[Y2-hand]


[Y3-hand]


[6-hand]


[W-hand]


[M-hand]


[F1-hand]


[F2-hand]


[Flat open 9-hand]


[4-hand]


[Flat mid-hand]


[5-hand]


[Bent 5a-hand]


[Bent 5b-hand]

Group 6: Closed circle

[9-hand]	[Flat 9-hand]	[gO-hand]	[Hooked H-hand]	[O-hand]	[Bent 1-hand]	[Closed 2-hand]
						
[Closed 3-hand]	[7-hand]	[8-hand]				

Of the sixty-five different handshapes listed above twenty-one of them occur in the one-handed manual alphabet (Appendix 2)[18], and nine of them are used in signs for numerals (Appendix 3).

As is evident from Table 3, the five most frequent handshapes in DSL are 1-hand, 5-hand, B2-hand, S-hand, and the A2-hand in that order. Although studies on other signed languages show a slightly different pattern in the ordering of the most frequent handshapes, the three handshapes 1-hand, 5-hand, and B2-hand have been found in the top six of most frequent handshapes in other signed languages such as Adamorobe Sign Language (AdaSL), Nederlandsee Gebarentaal (NGT), American Sign Language (ASL), British Sign Language (BSL), Israeli Sign Language (ISL) (Nyst 2007). This is illustrated in Table 3 below.

Table 3: *Frequency in percentages of handshapes of the dominant hand in five different sign languages - adapted from* (Nyst 2007:61)[19].

Handshape name	**DSL**	**AdaSL**	**NGT**	**ASL**	**BSL**	**ISL**
B	8	25	22	23	24	20
1	11	19	15	14	15	14
S	6	14	10	9	9	10

[18] Handshapes that occur in the manual alphabet are: **A1**, B1, C, **D**, E1, F1, **G**, **H1**, **I**, K1, L, M, **O**, R, S, T, V, W, X1, Y1, and Bent 5a. The handshape that are in bold font are handshapes that recur in the manual alphabet, but are modified either by orientation or movement and thus covering all 29 letters in the Danish alphabet.

[19] Although I do not have their frequency of occurrence, the most common handshapes in Hausa Sign Language are similar to the order of frequency of the handshapes in Table 3: S, B2, 1, and 5 (Schmaling 2000).

bO/closed bB”	1	6	5	?	3	8
(Lax) O	?	4	<1	4	2	6
5	10	3	13	7	7	8

The ten most frequent handshapes in DSL account for 59 per cent, while the rest of the handshapes account for the remaining 41 per cent.

3.1.2 The arm as articulator

In three of the signs (1%) in the database, the articulator comprised the arm and the hand. From my own knowledge of the language at least three more signs in DSL are articulated using the arm and the hand. The signs are: BARN ‘child’, FLAG ‘flag’, KRAN ‘crane’, SKOV ‘forest’, TRÆ ‘tree’, and WHISKY/SKOTLAND ‘whisky/Scotland’. It is not unlikely that there are more. Five of the signs are presented in Example 12.

The signs SKOV and WHISKY/SKOTLAND are listed in the online dictionary of DSL, but they were not part of the database used for this thesis. The sign KRAN was not part of the database either, nor is it listed in the online dictionary. However, I consulted two Deaf signers[20] (a man and a woman, age 35 and 49) using DSL as their primary language. I asked them how the sign is articulated. In order not to influence their answer by asking if the sign was articulated with the arm and the hand, I showed them a picture of a construction crane (Appendix 6). Both language consultants articulated the sign with the arm and the hand. I also asked them about the other five signs referring to the video clips in the online dictionary.

In all the signs in Example 12 as well as in the sign KRAN, the arm of the dominant hand is bent at the elbow. In three of the signs, FLAG, SKOV and TRÆ, the non-dominant hand is used as place of articulation. When the woman signed TRÆ and SKOV I noticed that the palm of her non-dominant hand was oriented upwards in both signs. She informed me that using the non-dominant hand under the elbow of the dominant hand was optional in the four signs FLAG, SKOV and TRÆ, which was later confirmed by the other language consultant. She also informed that the palm of the non-dominant could be oriented both up and down without changing the meaning of the signs.

[20] These language consultants were not part of the eight deaf signers from the database. When asking them about the signs I used DSL.

The shape of the hand in the four signs, FLAG, KRAN, SKOV and TRÆ, and the use of the non-dominant hand as place of articulation in all of these signs except KRAN seem to be iconically motivated. That is, in the signs FLAG, SKOV and TRÆ, perhaps least in the sign FLAG, the non-dominant hand could be described as representing the ground on which the entities stand.

In the sign FLAG the handshape (B2-hand ) represents the flag itself, while the arm represents the flagpole. Furthermore, the movement parameter in this sign seems to represent a flag flapping in the wind. I am unsure with regard to why, in this example, the non-dominant hand is articulated on the middle of the lower arm and not under the elbow of the dominant hand in the three pictures of that sign. More examples of the same sign, articulated by different Deaf signers, are needed before anything can be concluded.

In the sign BARN the whole arm and the clenched hand (S-hand ) seem to represent the child. The palm, had the hand been open, is facing towards the signer. I have never seen the sign articulated with the palm facing away from the signer. The movement in this sign is a downward repeated movement. Whether it represents something about a child is uncertain. A possible explanation could be that the arm and hand represent the child lying by the shoulder of the mother as if to burp after a meal. However, this is only speculation. The origin of the sign might not be remembered by signers anymore. Furthermore, research on the etymology of signs in DSL is scant. In a dissertation from 1967 by Lars Von der Lieth (Von der Lieth 1967), he deals with the subject in one of the chapters. His study is based on the earliest wordlists[21] and dictionaries and on interviews with Deaf signers. In 1985 another small scale study was conducted by Faustrup (Faustrup 1985).

In the sign KRAN the handshape (X1-hand ) seems to represent the hook of a crane, while the arm represents the body of crane itself. The palm of the hand as well as the hooked finger is facing downward. The movement used in this sign is and upward path movement as if lifting something. It is unsure whether this sign can be signed using the non-dominant hand as place of articulation.

[21] The first wordlist on DSL appeared in 1871 and covered 118 signs. It was published by the Deaf teacher Andreas C. Nyegaard (Nyegaard 1871).

Together with the sign BARN, the signs WHISKY/SKOTLAND are the only sign where the non-dominant is not used as place of articulation. In these signs, WHISKY/SKOTLAND, the elbow moves towards the signer's body, hitting the side as if imitating the squeezing of a bagpipe. Scotland is typically associated with whisky and bagpipes (although bagpipes are found in a variety of shapes and sizes in different parts of the world). It seems likely that the sign has developed from these associations. One of the language consultants (the man) informed me that when the sign is used with the meaning WHISKY the hand can take the w-handshape  . Using this handshape when articulating the sign, the sign could actually be regarded as an initialised sign and would then not fit within the scope of this thesis.

In the signs for TRÆ and SKOV the handshape (5-hand ) represents the crown of the tree, while the arm represents the trunk of the tree. The internal movement, *wiggling the fingers*, seems to represent the branches moving in the wind. This internal movement recurs in both signs. The sign SKOV also involves a sideways movement of the arm and hand to the signer's right.

In DSL, and other sign languages (Pfau & Steinbach 2006), a sideways movement can be used as plural marking on nominals. This type of marking involves a complete reduplication of the noun. For example, in the sign BARN, described above, a sideways movement can be added (arm and hand moving to the right if the signer is right-handed, and to the left if the signer is left-handed) to the downward repeated movement, thus adding a plural marker on the sign BARN, so that the sign means BØRN 'children'. Pfau & Steinbach refer to this process as a stem internal modification (Pfau & Steinbach 2006).

Reduplication is frequently used for plural marking in spoken languages. It involves a modification of the stem in some way. In Pfau & Steinbach (Pfau & Steinbach 2006) they distinguish between three types of reduplication. Two of the types involve complete and partial reduplication respectively.

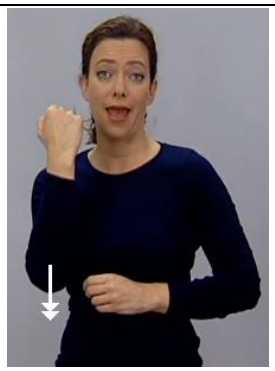
The first example (a) in Example 11 is from Warlpiri (Nash 1986:130; cited in Pfau & Steinbach 2006). It involves what Pfau and Steinbach describes as "*the simplest kind of reduplication"* (Pfau & Steinbach 2006:142) which is an exact complete reduplication of the base.

The next example (b) is from Ilokano. It is more complex as it involves only a partial reduplication of the base (Hayes & Abad 1989; cited in Pfau & Steinbach 2006:142):

a)	kurdu	‘child’	>	kurdu-kurdu	‘children’	(Warpiri)
b)	kaldíŋ	‘goat’	>	kal-kaldíŋ	‘goats’	(Ilokano)

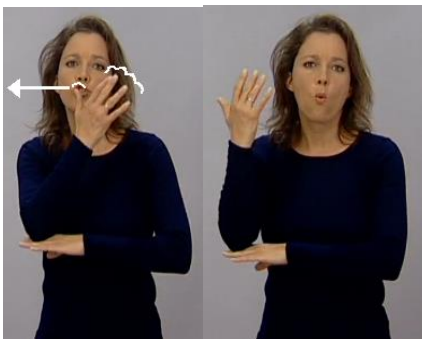
Example 11: *Examples of complete and partial reduplication in two spoken languages.*

Whether the sign SKOV originally derived from ‘tree-tree’ (many trees) is subject to further investigation. However, at this point a further description of these morphological processes in DSL is beyond the scope of this paper.



BARN
’child’

FLAG
’flag’



1st segment 2nd segment
SKOV
’forest’

TRÆ
’tree’

1st segment 2nd segment
WHISKY/SKOTLAND
’whisky’/’Scotland’

Example 12: *Signs using the arm and hand as articulator.*

Signs in which the arm and hand are used as articulators has also been found in other sign languages such as AdaSL, ASL, Auslan and BSL (Nyst 2007). In ASL the sign for 'tree' and 'Scotland' is signed using the same articulators as in the DSL sign. The sign WHISKY, however, is a two-handed balanced sign (Example 13).

1st segment 2nd segment

TREE SCOTLAND

1st segment 2nd segment

WHISKY

Example 13: *The signs TREE, SCOTLAND and WHISKY in ASL (**http://www.aslpro.com/cgi-bin/aslpro/aslpro.cgi**).*

3.1.3 Locations of the hand(s)

The inventory of forty-one phonetic locations found in the signs from the database is given in Table 4. As expected I identified a large number of areas on, or near the body that can

be used during the articulation of a sign. These can be divided into five major areas: *Head, trunk*[22]*, arm, hand, and neutral space* (Figure 6).

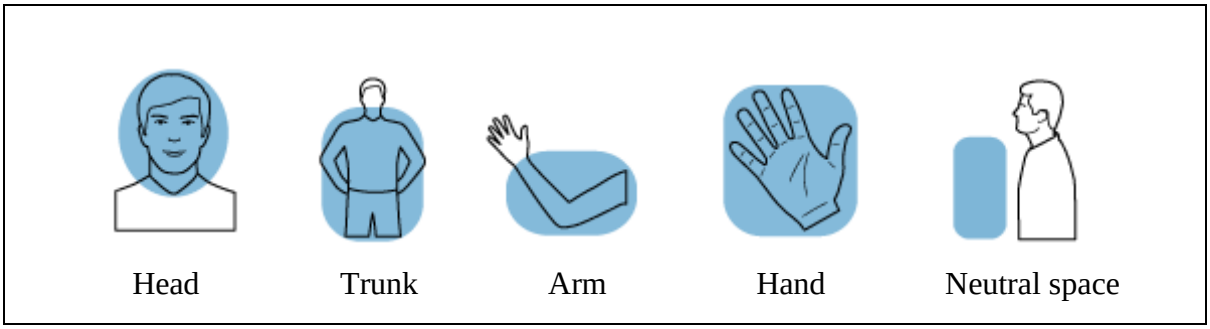


Figure 6: *The five major places of articulation used in DSL.*

Table 4 below lists all the specific areas of the four body areas and provides examples of signs produced in these areas.

Table 4: *Phonetic locations used in DSL*[23].

LOCATION	SIGN EXAMPLES	LOCATION	SIGN EXAMPLES
Head		**Trunk**	
Above	*BRUSER 'shower'*	Shoulders	CHEF 'boss'
Top	HAT 'hat'	Chest	
Whole	ALVORLIG 'serious'	Ipsilateral	FORBEREDE 'prepare'
Temple	ERFARING 'experience'	Central	ALENE 'alone'
Forehead	AMBASSADE 'embassy'	Contralateral	AMATØR 'amateur'
		Armpit	ABE 'monkey'
Ear		Stomach	DESSERT 'dessert'
Earlobe	*SIGØJNER 'gypsy'*	Waist	BÆLTE 'belt'
Behind	FALSK 'false'	Thigh	HUND 'dog'
Whole	*FRIKADELLE 'meat ball'*	**Arm**	
Eye		Upper	SYGEPLEJERSKE 'nurse'
Under	LØG 'onion'	Lower	KAPTAJN 'captain'
Side	FLIRTE 'flirt'	Elbow	ALBUE 'elbow'
Whole	IMPONERET 'impressed'	**Hand**[24]	

[22] The upper parts of the thighs are included, but only few signs are produced here, for example one of the signs for HUND 'dog'. This sign is produced with a B2-hand tapping on the upper part of the thigh as if calling to a dog.

[23] The signs written in italic were not a part of the data.

Nose		Back	DIAMANT ’diamond’
Bridge	AFFØRING ’faeces’	Palm	AFHØRE ‘interrogate’
Tip	AFFALD ’garbage’	Wrist	ADVOKAT ’lawyer’
Side	GAMMEL ‘old’	Index finger	AFSNIT ’section’
Under	ALKOHOL ’alcohol’	Fingertip(s)	JORDBÆR ’strawberry’
Cheek	FED ‘fat’	Ulnar side	*BESTEMT ’certain’*
Neck		Radial side	ALLIGEVEL ’anyways’
Ipsilateral	AFHÆNGIG ’dependent’		
Central	DØD ‘dead’		
Contralateral	HISTORIE ‘story’		
Mouth	BLOMME ’plum’		
Chin			
Under	FÅ ‘few’		
Mid	BAGATEL ‘trifle’		
Side	*HVORFOR* ’why’		

3.1.4 Movements of the hand(s)

Movements from the two major categories *path movements* and *internal movements* have been found in the database. Each category will be described in turn in the following subsections.

3.1.4.1 Path movements

In the database I found evidence of six main path movements: *Up, down, towards, away, left* and *right*. They can all be described as a simple movement where the hands move in one direction, that is, from ‘a’ to ‘b’ (Van der Hulst 1993; Schmaling 2000). The inventory of the simple path movements is presented in Table 5 and includes sign examples for each path movement.

Table 5: *Types of path movement used in DSL*[25] .

PATH MOVEMENT	**SIGN EXAMPELS**
Towards	FÅ ‘get’
Away	TOG ‘train’
Up (vertically or diagonally)	FORÅR ‘spring’ (vertical), AFLYSE ‘cancel’ (diagonal)

[24] For an overview of the specification of the hand see Appendix 7.
[25] The signs written in italic were not part of the data.

Down (vertically or diagonally)	GENNEMSIGTIG ‘transparent’ (vertical), AFLYSE ‘cancel’ (diagonal)
Right	UGE ‘week’
Left	ANSÆTTE ‘employ’

Analysing and describing path movements turned out to be complicated matter as it involves much more than just the simple path movement from ‘a’ to ‘b’. Path movements can be combined thus forming several more complicated types of path movements. Van der Hulst (Van der Hulst 1993) distinguishes between unidirectional (simple) path movements (ab) and bidirectional (complex) path movements (ab+ba). Examples of each type are presented in the signs in Example 14 below.

From ‘a’…..to ‘b’

SKAL

‘must’

(Not in the database)

From ‘a’..… to ‘b’ and from ‘b’….. to ‘a’.

ALLEREDE

‘already’

Example 14: *Example unidirectional (ab) path movement away from the signer (first picture sample), and bidirectional (ab+ba) path movement away and toward the signer (second picture sample).*

Van der Hulst also discusses the issue of repeated unidirectional vs. repeated bidirectional path movements. He writes that “bidirectional paths must be distinguished from non-inverted reduplications, which lead to a repeated unidirectional path movement (ab+ab).”(Van der Hulst 1993:219). The question of how to account for repeated unidirectional and repeated bidirectional path movements in DSL is an issue that requires a separate and closer study of this parameter as I am not sure I can fully see the difference between the two types of path movements.

There is another aspect of path movements which involves the shape of the path movements (Van der Hulst 1993). It comprises the shapes which are presented in Table 6.

Table 6: *Shapes of path movements.*

SHAPE	**SIGN EXAMPELS**
Straight line	TOG 'train'
Curved (or arched) line	*VEJR* 'weather' (Example 15)
Circular[26], horizontal plane	HAVE 'garden'
Circular, frontal plane	*TIME* 'hour'
Circular, sagittal plane	ÅR 'year'

In Example 15, the sign VEJR 'weather' is articulated with a B2-hand facing away from the signer. The sign involves a curved path movement to the signer's right.

1st segment 2nd segment

VEJR

'weather'

Example 15: *A sign involving a curved (or arched) path movement.*

3.1.4.2 Internal movements

Besides the nine different path movements I found evidence of seven different internal movements in the database. These are presented in Table 7. As mentioned previously internal movements refers to a movement within the hand(s) and/or fingers.

Internal movements in the fingers comprise changes in the handshape, rubbing the thumb against the four opposing fingers, wiggling the fingers, and opening and closing of the finger as if squeezing something (Table 8, section 2.2.2.3).

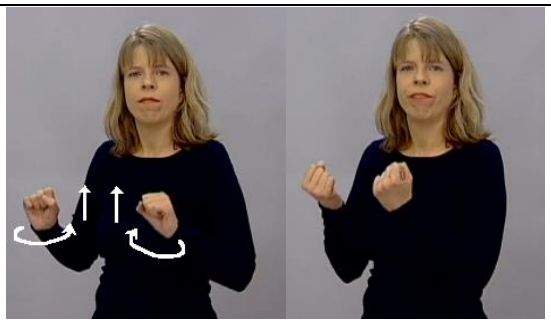
Internal movements in the other joints (the wrist) of the hand(s) comprise shaking, waving or twisting of the hand(s).

[26] Circular path movements can be articulated clockwise or counter clockwise.

Table 7: *Types of internal movement used in DSL*[27]

INTERNAL MOVEMENT	**SIGN EXAMPLES**
Handshape change	VILD 'vild' (from Bent 5a-hand to S-hand)
Rubbing	*PULVER* 'powder'
Shake	HELDIG 'lucky'
Squeeze	BLØD 'soft'
Waving	FLAG 'flag'
Wiggling	BLOD 'blood'
Wrist twist	AKTIV 'active'

Path movements and internal movements can be combined as illustrated in the sign AKTIV 'active' in Example 16 below.



1st segment 2nd segment

Example 16: *The sign AKTIV 'active' which involves both path movement and internal movement.*

The internal movement in the form of handshape change or change in orientation is timed with the beginning and end of signs that involve a path movement too. By this is meant that during the articulation of the sign the handshape changes gradually from the beginning of the path movement and till the end of the path movement. Thus, the onset and end of the path and internal movements occur simultaneously. This is illustrated in the next sign ACCEPTERE 'accept' in Example 17.

[27] The signs written in italic were not part of the data.

Example 17: *The sign ACCEPTERE 'accept' in which path and internal movements are combined and articulated simultaneously.*

With a few exceptions the change in the handshape never occurs only in the beginning or towards the end of a path movement. An exception is the sign AUSTRALIEN 'Australia' (Example 18) in which the change in handshape (internal movement) occurs after the onset of the path movement.

Example 18: *In the sign AUSTRALIEN 'Australia' the internal movement occurs after the onset of the path movement.*

3.1.5 Orientations of the hand(s)

I found evidence for six major directions used in DSL signs. They are given in Table 8. The different orientations can be combined, so that diagonal orientation is possible too.

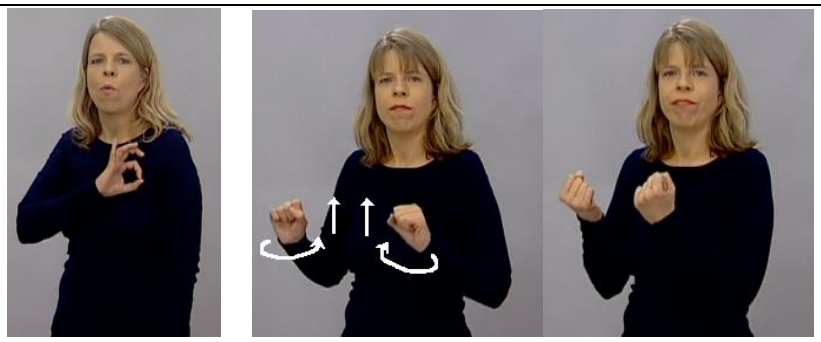
Table 8: *The six major orientations used in DSL.*

ORIENTATION	SIGN EXAMPLES
Up	FØDSELSDAG 'birthday'
Down	DESSERT 'dessert'
Away	ADSKILLE 'separate'
Towards	ADVENT 'advent'
Left	ALVORLIG 'serious'

Right	AMBASSADE ‘embassy’

Whether a one-handed sign is produced with a left or right orientation of the palm depends on whether the signer is right hand or left hand dominant. This means that in one-handed signs the hand can only have an orientation to the left if the signer is right hand dominant, or the hand can only have an orientation to the right if the signer is left hand dominant. In other words, for a right hand dominant signer orientation of the palm to the right would be physically impossible and the other way around.

Furthermore, as has been found for other signed languages, orientation of the palm(s) during signing may remain the same (static orientation) during the production of the sign, or may change (dynamic orientation) during signing. In the following two pictures (Example 19) examples of static (ONKEL ‘uncle’) and dynamic (AKTIV ‘active’) orientation of the palm(s) during the production of a sign are given.



ONKEL ‘uncle’ | 1st segment | 2nd segment | AKTIV ‘active’

Example 19: *Examples of signs with static (ONKEL) and dynamic handshape (AKTIV).*

3.1.6 Mouth actions (non-manual feature)

Ninety-seven percent of the signs in the database were accompanied by some type of mouth action. In the remaining 3% no mouth action occurred, or it was not possible to tell the features of the mouth action as the signer’s hand was in the way.

As anticipated I identified two main types of mouth actions: *Mouthings* and *mouth gestures*. Mouth actions are an integral part of DSL[28], and some manual signs in DSL are distinguished by the mouth action only. This has also been found for other signed

[28] Mouth actions may serve a grammatical function also (section 2.2.2.5).

languages such as HSL (Schmaling 2000), AdaSL (Nyst 2007); Auslan, (RW.ERROR - Unable to find reference:328), NGT, BSL and SSL (Crasborn et al. 2008). Sign pairs in DSL distinguished only by their mouth action will be further investigated in section 3.2.

As is illustrated in Figure 7, the two types of mouth actions can be further divided into three and two subtypes respectively. Each will be described in turn in the following subsections.

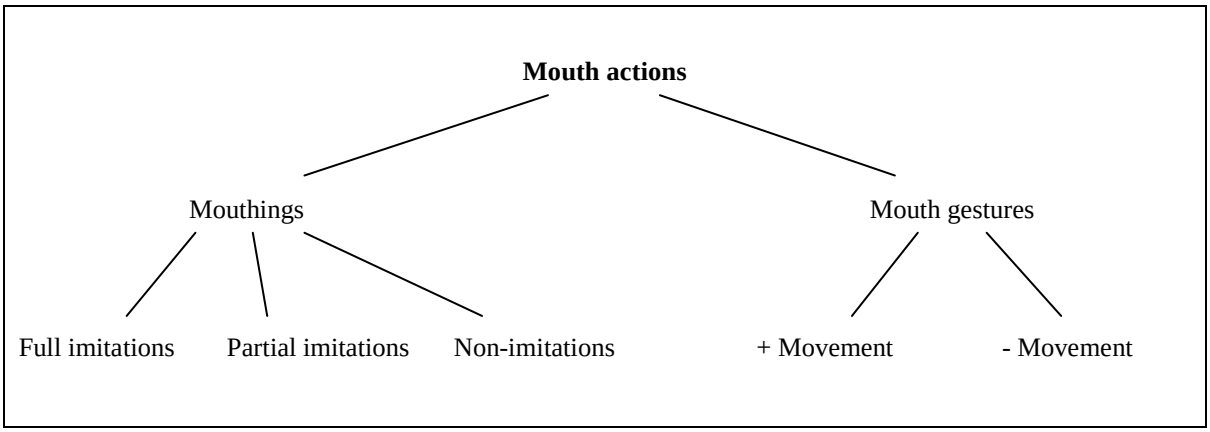


Figure 7: *Types of mouth actions in DSL.*

3.1.6.1 Mouthings

I found evidence of the three subtypes of mouthings in the database. In *Type 1* it seems like the signer is pronouncing the whole of the Danish word that would be the gloss of the meaning of the sign. In *Type 2* the signer seems to be pronouncing only the first syllable of the Danish word that would be the gloss of the meaning of the sign. In *Type 3*, the mouthing does not resemble Danish word by which the sign is glossed but which can be described using Danish phonemes.

In the sign linguistics literature it is common to describe mouthings as silent representations of either whole words or parts of words in the spoken language with which the sign languages co-exists (RW.ERROR - Unable to find reference:328; Crasborn et al. 2008). Both types of mouthings are assumed to have the same meaning as the spoken words they derive from. In Crasborn et al they have been labelled M-type mouth actions (Crasborn et al. 2008). However, in reality without an ultra sound scan of a signer's oral cavity it is difficult to tell how much of the spoken word is actually silently uttered. For example in the mouthing accompanying the manual sign EFTERÅR 'autumn' /ɛfdəɑ:/ it seems as if the signer is imitating the whole Danish word. However, it is difficult to tell

whether the signer is beginning with the front closed-mid vowel /ɛ/ or a front open-mid vowel /e/. The only sound that is visible in this mouthing is the labiodental fricative /f/. In order to be able to fully describe what is happening in the mouth region ultra sound scannings must be included in the analysis. So the headline for each type in Table 9 are tentative.

Mouthings occurred in 88 % of the signs. However, it is not clear how many of the signs obligatorily take mouthings.

Table 9: *Examples of types of mouthings found in the database.*

TYPE 1: Mouthing of whole words		
Mouthing	**Sign**	
Efterår	EFTERÅR	'autumn'
TYPE 2: Mouthing of parts of words		
Mouthing	**Sign**	
Rib	RIBBEN	'ribs'
TYPE 3: Mouthings not derived from Danish		
Mouthing	**Sign**	
bo	HELDIGVIS	'luckily'
bæd	ALLEREDE	'already'
i	HIDSIG	'hot-tempered'
o	HELDIG	'lucky'

Although the online dictionary of DSL lists thirty-five different Type 3-mouthings, I only found evidence of five different mouthings of this type in the database.

3.1.6.2 Mouth gestures

The second type of mouth action is *mouth gestures*. This is a unique set of mouth actions, which occurred in 9 % of the signs in the database, and have no resemblance with words from Danish.

Eighteen different mouth gestures have been identified in previous research on DSL and they have been divided into two subtypes according to whether they include movement of

the mouth or not. I will call them *dynamic* and *static* mouth gestures respectively. In the database I found evidence of only eleven of these mouth gestures.

Type 1 – *Dynamic mouth gestures*.

In this type of mouth gesture there is some kind of movement on the mouth. The lips may vibrate. Or they may make a sucking or chewing motion. The teeth may chatter. Furthermore, the tongue may interact with the mouth in the form of licking the lips, or move from side to side, in and out, or up and down. Examples of dynamic mouth gestures are provided in Example 20.

Moving tongue up and down

Licking the lips

(Not in the database)

Example 20: *Examples of dynamic mouth gestures.*

Type 2 – *Static mouth gestures*

This type of mouth gesture does not involve movement of the lips and/or tongue except in the transition from neutral to final position. This type of mouth gestures includes two kinds of expansion of one or both cheeks, or expansion of the lower lips. By expansion is meant that one or both cheeks or the lower lip is puffed out. One cheek may also be expanded by pressing the tongue on the inside of the cheek like in the sign LADE-SOM-OM ‘pretend’. Furthermore, the signer might bite his/her tongue, or stick the tip or the whole of it out of the mouth. Examples of static mouth gestures are provided in Example 21 below.


Biting the tongue


Puffed out cheek


Puffed out lower lip

Example 21: *Examples of static mouth gestures.*

Mouth gestures occur in 9 % of the signs in the database. The complete set of mouth gestures found in the online dictionary of DSL is listed in Table 10.

Table 10. *Mouth gestures used in DSL (www.tegnsprog.dk)*

MOUTH GESTURES WITH MOVEMENT	MOUTH GESTURES WITH NO MOVEMENT
Chattering of teeth	Bite ones tongue
Lips vibrating	Pout
Long blow	Puffed cheek
Licking the lips	Puffed cheeks
Munching	Puffed lower lip
Short blow	Tip of tongue out
Sucking	Tongue expands cheek
Tongue wiggling quickly from side to side	Tongue out
Tongue wiggling quickly in and out	
Tongue wiggling (tip bent upwards)	

3.1.7 Summary

In the previous subsections the major phonetic features that are used in the production of signs in DSL have been identified. While the online dictionary lists sixty-five different handshapes I only found evidence for fifty-one of them in my database.

The handshapes that were not represented in the database are the following: 4  , Closed 2  , E1  , E2  , F1  , F2  , Flat H  , Hooked H  ,

K2  , M  , Mid  , gO  , T  , and Flat V  . There can be several explanations for this.

One explanation could be that only 516 of the 2,000 signs represented in the dictionary were encoded for the use in this thesis. Furthermore, the ten most frequent handshapes in the database (1-, 5-, B2-, S-, A2-, Bent 5a-, Bent 1-, 9-, A1-, and Flat C-hand) account for 59%, or 308 of the 516 signs, while the next forty-one handshapes identified in the database account for the remaining 41%. This indicates that the remaining forty-one handshapes, as well as those for which I found no examples, are low frequency handshapes.

Another explanation could be that some of the handshapes, E1-, F1- (F2 a variant of F1), M-, and T-handshape, are from the manual alphabet and used in initialised signs which were not the type of signs under investigation in this thesis as they are influenced by Danish.

Furthermore, the Mid-handshape  only occurs in signs that are derived from the MHS (described in section 1.2). It represents the /l/, an alveolar lateral approximant, in signs such as LILLE ‘little’, LÅR ‘thigh’ and JULI ‘July’ which are MHS representations of the spoken Danish words. Like the initialised signs, signs derived from the MHS are not included in the database for this thesis.

As for the number of locations, forty-one were identified. Furthermore, thirteen types of movements (six path movement and seven internal movements), and six types of orientations were identified. Finally, two main types of mouth actions were accounted for. However, how many of these different features are distinctive has yet to be determined and that is the aim of the next section.

3.2 The phonemic status of the different parameters

This chapter explores the distinctive features of the different parameters described in section 3.1. The aim is to abstract a phonemic set for each parameter. This will be done by referring to (near) minimal pairs and sets of signs. That is, looking for sign pairs and sets of signs in which their meaning is distinguished only by a change in one of the parameters (minimal pairs), or sign pairs that not only show a difference in one parameter but also

show slight differences in one of the other parameters (near minimal pairs). Each parameter will be dealt with in separate subsections. Thus section 3.2.1 deals with handshape, section 3.2.2 deals with location, section 3.2.3 deals with movement, and sections 3.2.4 and 3.2.5 deals with orientation and mouth actions respectively.

3.2.1 Handshapes

The phonemic handshapes and their allophonic variations are given in Table 11. The handshape inventory is divided into five columns. The first column lists the 25 phonemic handshapes. The five other columns represent the allophonic variations of the phonemic handshapes, and are categorized according to the configuration of the hand, i.e. *Flat*, *Bent*, and *Other* including the position of the thumb. Some of the phonemic handshapes, e.g. B1, 1, H, and V, have between two and seven allophonic variants.

Note that the position of the thumb is non-contrastive in DSL. On the basis of which part of the hand makes contact with the body, the position of the thumb in some of the handshapes is largely predictable. Furthermore, for some hand shapes such as the 1-hand, B-hand, H-hand, O-hand, and V-hand, the degree of aperture and flexion in the base joints and non-base joints (Appendix 7) is also non-contrastive. One exception to the non-distinctiveness of the flexion of the 1-hand  is the X1-hand  which is considered a separate phonemic handshape in the minimal pair presented in Table 15.

Table 11: *The phonemic handshapes and their allophonic variations in DSL.*

Phonemic HS	**Allophonic variations**			
	Thumb position	Flat configuration and thumb position	Bent configuration	Other configurations

 A1	 A2	 S						
 B1	 B2	 B3	 Fl. B1	 Fl. B2	 Fl. B3	 Bent B3		 Cl. B
 Closed B			 Fl. 9					
 C						 gC		
 D								
 G								
 H1	 H2		 Flat H1	 Flat H2				
 K1						 gC		
 L						 Bent L		
 O								 9
 R								
 V			 Flat V			 Bent V		
								

W								
 X1			 Fl. 1					 Bent H
 X2						 C	 Bent 1	
 Y2	 Y1	 Y3						
 Y1			 Flat 1					 A2
 1	 2 (or 1b)	 I	 Fl. 1			 Bent 1		
 3								
 5	 3					 Bent 5a	 Bent 5b	 Fl. Mid
 Bent 5a	 Bent 3							
 6								
 7								
 8								
 9			 Cl. 2			 Bent 1	 gC	

The degree of flexion in the phonemic handshapes is dependent on the place of articulation and the orientation of the palm(s) and finger(s) during the articulation of a sign. In the following I will provide some examples:

- The V-hand is articulated as a V-hand  , with no flexion in the base and non-base joints (Appendix 7), when the place of articulation is the neutral signing space and the orientation of the finger tips is upwards or to the right (right for right hand dominant signers, left for left hand dominant signers). Sign examples are: DIREKTØR 'manager' (Example 22), RYGE '(to) smoke', SE 'see', and VÆRRE 'worse'.

- The V-hand is articulated as a Flat V-hand  [29] if the orientation of the palm is downwards or towards the signer, and the orientation of the fingers of the articulating hand is downwards or towards the signer. Sign examples are: BESVIME 'pass-out', OPLEVE '(to) experience', STIRRE 'stare' (Example 22),

- The V-hand is articulated as a Bent V-hand  if the orientation of the palm and tip of the fingers of the articulating hand is towards the signer and/or the articulating hand makes contact on or near a part of the body. Sign examples are: COCHLEAR-IMPLANTAT 'cochlear-implant', BEDSTEFORÆLDRE 'grandparents, PASSE-PÅ 'take-care/watch-out', and SKELET 'skeleton' (Example 22).

[29] The illustration of the Flat V-handshape is not a perfect example of that handshape. However, in lack of a better illustration I have used this one. Besides, a picture of the handshape is provided in Example 22.



DIREKTØR	STIRRE	SKELET
'manager'	'stare'	'skeleton'
V-hand	Flat V-hand	Bent V-hand

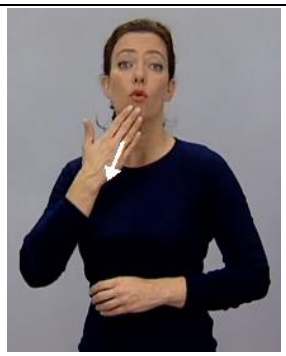
Example 22: *Examples of the different realisations of the V-hand.*

- The B-hand is articulated as a B1-hand  or B2-hand  , i.e. either with or without an extended thumb, when the tip of the fingers, palm of the hand, back of the hand, or the ulnar side of the hand (Appendix 7) is touching a part of, or an area near the body[30] (Example 23). Or when signed in neutral space and the finger tips are oriented upwards or away from the signer.

- The B-hand is articulated as a B3-hand  , with the thumb folded into the palm, if the radial side (Appendix 7) of the hand is in contact with a part of the body during articulation of a sign (Example 23).


DIREKTE	PARKERING
'direct'	'parking'
B1-hand (orientation up)	B1-hand (orientation away)

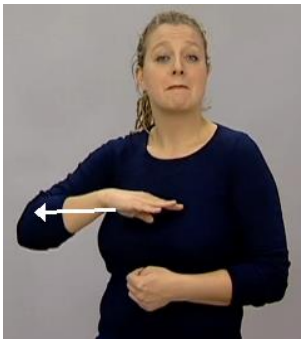
[30] Encompass head, trunk, arm, and hand.



GOD
'good'
B2-hand (tip of fingers)

ÅND
'spirit'
B2-hand (palm)

BEDRAGE
'deceive'
B2-hand (ulnar side of hand)



HERREN
'The Lord'
B3-hand (radial side of the hand)

Example 23: *Examples of the different realisations of the B-hand with regards to thumb position.*

- The B-hand is articulated as a Bent B  if tip of fingers of the dominant hand are in contact with the back of the non-dominant hand[31] (Example 24). Sign examples are: BEMÆRKE, and RØRE-VED.

- The use of the Flat B1-hand  appears to be iconically motivated in most of the signs articulated with these three handshapes in that the shape of the hand either shows a rough shape of the entity it represents or shows the shape the hand would take in real life in the event the handshape describe (Example 24).

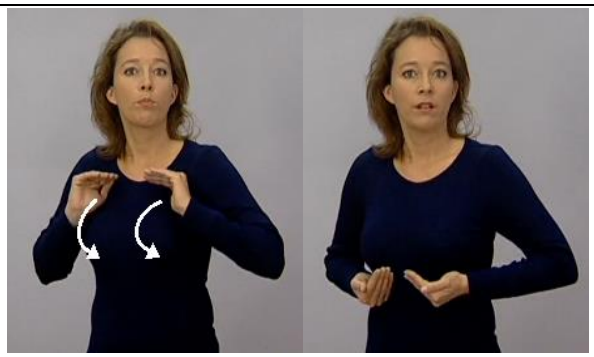
[31] Looking through the online dictionary one will see that five signs using this handshape are articulated in neutral space with tip of fingers oriented downwards. However, as these are initialised signs they have not been included in the analysis.

- The B-hand is articulated as Flat-B2 hand  or a Flat B3-hand  if the sign is signed in neutral space with the tip of the fingers oriented to the left, or the tip of the fingers are in contact with, or near a part of the body. If the radial side of the hand is in contact with a part of the body the Flat-B2 hand  appears to be preferred.

BOLLE

'bun'

Flat B1-hand (iconically motivated)



BRYSTER

'breasts'

Flat B1-hand (iconically motivated)

PÆRE

'pear'

Flat B1-hand (iconically motivated)

DÅB

'baptism'

Flat B1-hand (iconically motivated)

SPARE

'save'

Flat F2-hand (radial side in contact with body)

LUNGEBETÆNDELSE

'pneumonia'

Flat F3-hand (fingertips in contact with body)

Example 24: *Examples of the different realisations of the B-hand with regards to flexion and thumb position.*

- The A-hand  is articulated as an A1 hand  or S-hand  when the palm side of the hand is in contact with a part, or near a part of the body. Or when the sign is articulated in neutral space with knuckles oriented upwards or away from the signer.

- The A-hand  is articulated as an A2 hand  when the radial side of the hand is in contact with, or near an area of the body. Or if the knuckles of the hand are oriented away from the signer. Exceptions are number signs in which the number '1' is included. The A2-hand represents the number 1. These signs are signed in neutral space with the palm of the hand facing towards the signer (Example 25).

ABONNEMENT

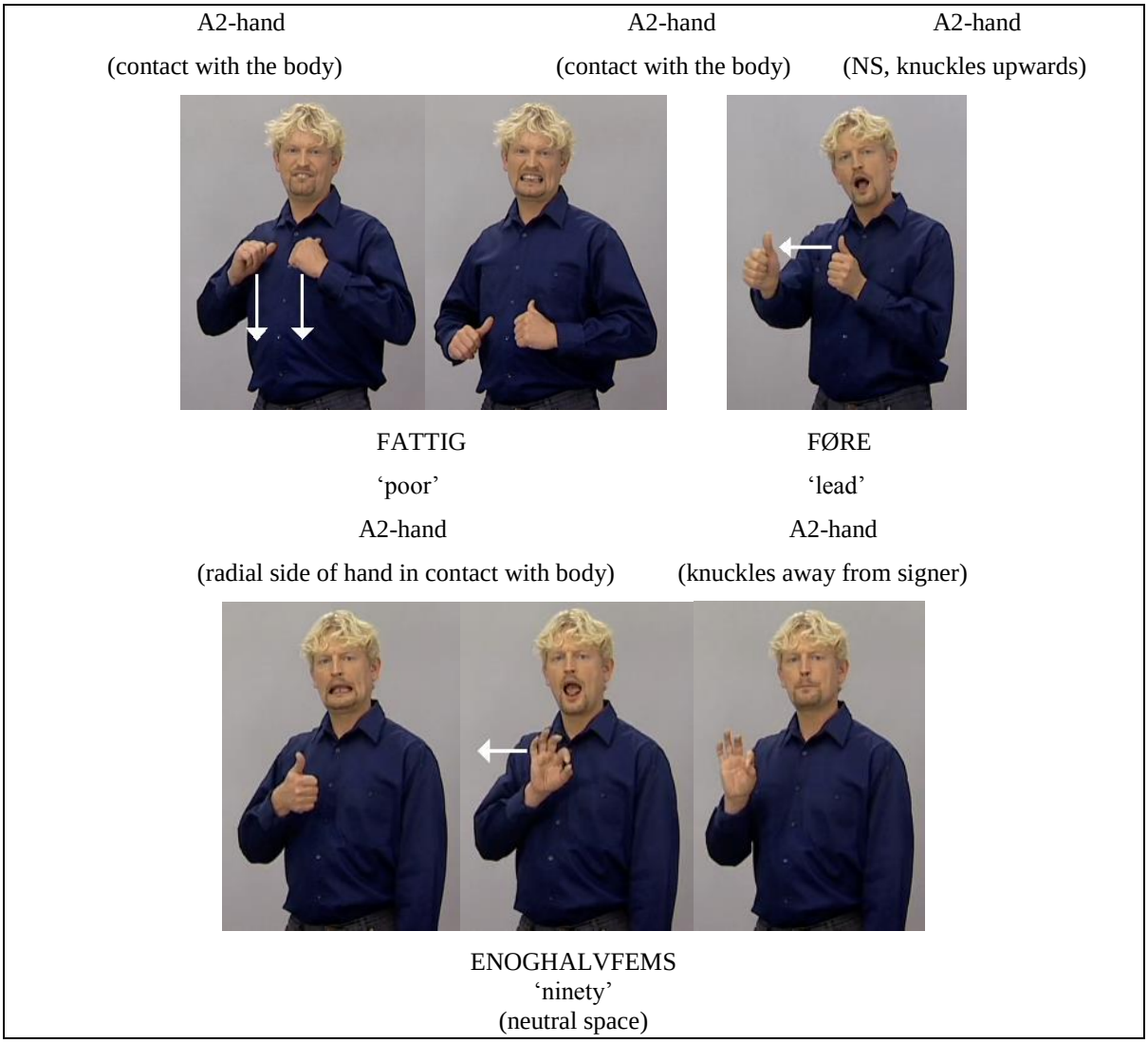
'subscription'

MOSTER

'aunt'

SKYNDE-SIG

'(to) hurry'



Example 25: *Examples of the different realisation of the A-hand (or fist hand).*

3.2.1.1 Phonemic oppositions in handshapes

In the following tables are some minimal pairs, near minimal pairs and sets of signs[32], which show the phonemic contrast for some of the handshapes listed in Table 11.

The two handshapes 5  and Y2  form a suspicious pair. Their hand configuration show similarities as both have at least three extended fingers. The minimal pair, FARLIG 'dangerous' and MÆRKELIG 'strange', presented in Table 12 shows the

[32] Not all examples occurred in the database. Wherever signs not occurring in the database are used as examples, this is mentioned explicitly in the text.

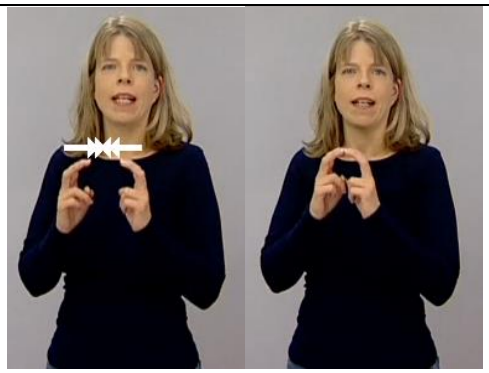
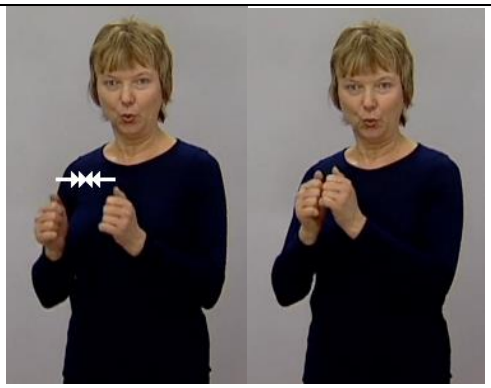
phonemic status of the two handshapes. The signs are almost identical as both are articulated in neutral space in the ipsilateral side of the signer's signing space; both signs involve a repeated path movement away and towards the signer. Finally, both signs have the palm of the articulating hand (here the right hand) facing left, but are produced with the Y3-handshape and the 5-handshape respectively and the meaning of the signs are different.

Table 12: *FARLIG/MÆRKELIG: Minimal pair distinguished only by the handshapes 5-hand and Y2-hand.*

 (Not in the database)	 (Not in the database)
FARLIG 'dangerous' • SIGN TYPE: 1H • **HS: 5** • LOC: Neutral space • MOV: Away and towards (bidirectional) • ORI: Left • MP, M: • CONTACT: No	MÆRKELIG 'strange' • SIGN TYPE: 1H • **HS: Y2** • LOC: Neutral space • MOV: Away and towards (bidirectional) • ORI: Left • MP, MG: Puffed cheek • CONTACT: No

Again we see that the two signs share some of the same features. Both handshapes involve flexion of at least the little finger and ring finger. Both signs are signed in neutral space in front of the signer. In both signs the palms of the hands are facing each other and the hands move towards each other.

Table 13: *BATTERI/HUND: Minimal pair distinguished only by the handshapes Bent V and A1.*

 1st segment 2nd segment	 1st segment 2nd segment (Not in the database)
BATTERI ‘battery’ • SIGN TYPE: 2H BAL • **HS: Bent V** • LOC: Neutral space • MOV: DH right, NDH left (repeatedly) • ORI: DH left, NDH right • CONTACT: Yes	HUND ‘dog’ • SIGN TYPE: 2H BAL • **HS: A1** • LOC: Neutral space • MOV: DH right, NDH left (repeatedly) • ORI: DH left, NDH right • CONTACT: Yes

In the following tables (Table 14 to Table 20) the different sign pairs are distinguished by only the handshape. All other parameters (location, movement, and orientation) are the same in each pair.

Table 14: *SAMMEN/GRUPPE: Minimal pair distinguished only by the handshapes B2-hand and C-hand.*

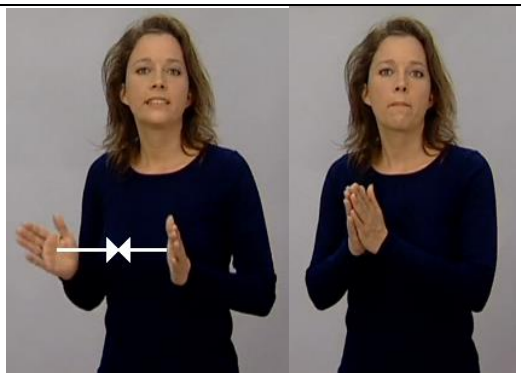
 1st segment 2nd segment	 1st segment 2nd segment
SAMMEN ‘together’ (Not in the database) • SIGN TYPE: 2H BAL • **HS: B2** • LOC: Neutral space • MOV: DH right, NDH left • ORI: DH right, NDH left • CONTACT: Yes	GRUPPE ‘group’ (Not in the database) • SIGN TYPE: 2H BAL • **HS: C** • LOC: Neutral space • MOV: DH right, NDH left • ORI: DH right, NDH left • CONTACT: Yes

Table 15: *BAKTERIE/SAMTALE: Minimal pair distinguished only by the handshapes X1-hand and 1-hand.*

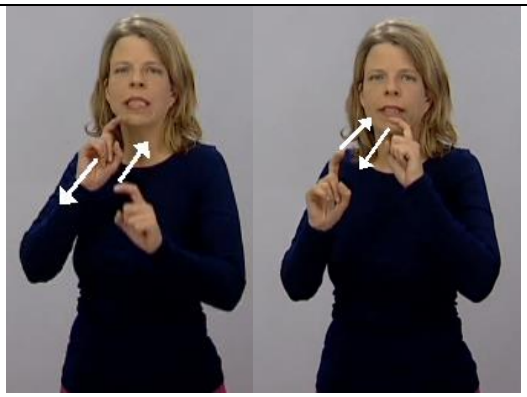
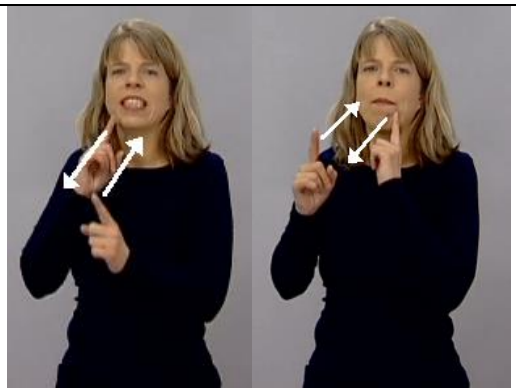
	
BAKTERIE ‘bacteria’ • SIGN TYPE: 2H BAL • **HS: X1** • LOC: Near mouth • MOV: Away and towards (bidirectional, alternate) • ORI: DH left, NDH right • CONTACT: No	SAMTALE ‘conversation’ • SIGN TYPE: 2H BAL • **HS: 1** • LOC: Near mouth • MOV: Away and towards (bidirectional, alternate) • ORI: DH left, NDH right • CONTACT: No

Table 16: *LØVE/SKALDET: Minimal pair distinguished only by the handshapes Bent 5b-hand and Flat B2-hand.*

LØVE 'lion' (Not in the database) • SIGN TYPE: 1H • **HS: Bent 5b** • LOC: Near the head • MOV: Towards signer • ORI: Towards signer • CONTACT: No	
SKALDET 'bald' (Not in database) • SIGN TYPE: 1H • **Flat B2** • LOC: Near the head • MOV: Towards signer • ORI: Towards signer • CONTACT: No	

Table 17: *LAND/SØ: Minimal pair distinguished only by the handshapes B2-hand and 5-hand.*

	
LAND 'land' • SIGN TYPE: 1H • **HS: B2** • LOC: Neutral space • MOV: Circular (horizontal plane) • ORI: Downwards • CONTACT: No	SØ 'lake' (Not in the database) • SIGN TYPE: 1H • **HS: 5** • LOC: Neutral space • MOV: Circular (horizontal plane), wiggling of fingers (internal) • ORI: Downwards • CONTACT: No

Table 18: *FORBEREDE/HVID: Minimal pair distinguished only by the handshapes Flat mid-hand and Flat B3-hand.*

 1st segment 2nd segment	 1st segment 2nd segment
FORBEREDE 'prepare' • SIGN TYPE: 1H • **HS: Flat mid** • LOC: Chest (IL) • MOV: Down (rep.) • ORI: Towards signer • CONTACT: Yes	HVID 'white' (Not in the database) • SIGN TYPE: 1H • **HS: Flat B3** • LOC: Chest (IL) • MOV: Down (rep.) • ORI: Towards signer • CONTACT: Yes

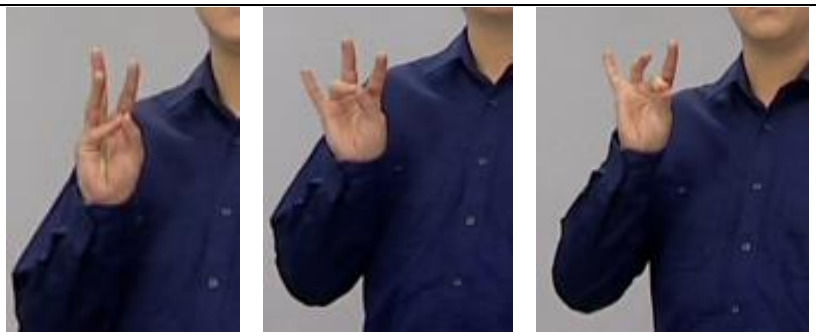
Table 19: *DJÆVEL/HARE: Minimal pair distinguished only by the handshapes 1-hand and H1-hand.*

	
DJÆVEL 'devil' • SIGN TYPE: 1H • **HS: 1** • LOC: Head • MOV: HSC (internal) • ORI: Away from signer • CONTACT: Yes	HARE 'hare' • SIGN TYPE: 1H • **HS: H1** • LOC: Head • MOV: HSC (internal) • ORI: Towards signer • CONTACT: Yes

Table 20: *HAT/KONGE: Minimal pair distinguished only by the handshapes B1-hand and Bent 5a-hand.*

	
HAT 'hat' • SIGN TYPE: 1H • **HS: B1** • LOC: Head • MOV: HSC (internal) • ORI: Towards signer • CONTACT: Yes	KONGE 'king' • SIGN TYPE: 1H • **HS: Bent 5a** • LOC: Head • MOV: HSC (internal) • ORI: Towards signer • CONTACT: Yes

The handshapes 6-hand, 7-hand, and 8-hand are phonemic (Example 26). With a few exceptions for the 8-hand, they only occur in number signs and in number incorporated signs.



6-hand 7-hand 8-hand

Example 26: *The phonemic handshapes 6-hand, 7-hand, and 8-hand. They are only used in number signs and number incorporated signs.*

In number incorporated signs the number handshape replaces the handshape that is normally used in the articulation of the sign. Not all signs can be modified for number. Number incorporation is limited to signs that express *time* (hour, month, and year), *currency*, *age* and *the floor level of a building*. An example is the sign ETAGE 'floor'

which in its basic form is articulated with a B2-hand  , but when a specific floor is referred to a number handshape is used instead (Example 34).

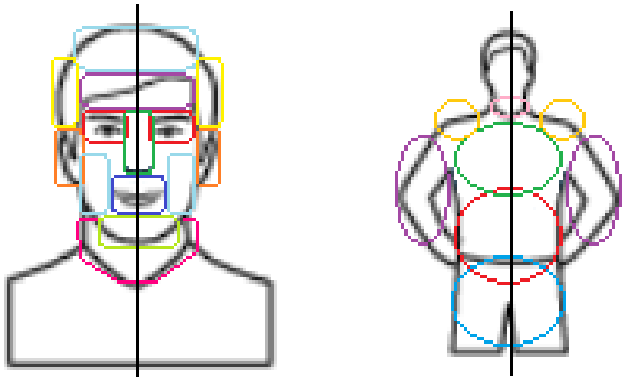
SYVENDE-SAL

'7th-floor'

Example 27: *An example of a number incorporated sign: ETAGE 'floor'.*

3.2.2 Locations

The phonemic locations and their range of allophonic variation are presented in Figure 8. Based on the findings in the database I claim that all forty-one locations are distinctive. In one-handed signs with only one location it appears that if the sign is articulated on the ipsilateral side, the location is restricted to the area from the mid sagittal line and leftwards and vice versa if the sign is articulated on the contralateral side. However, any area from the mid sagittal line to either side appears to be allophonic.

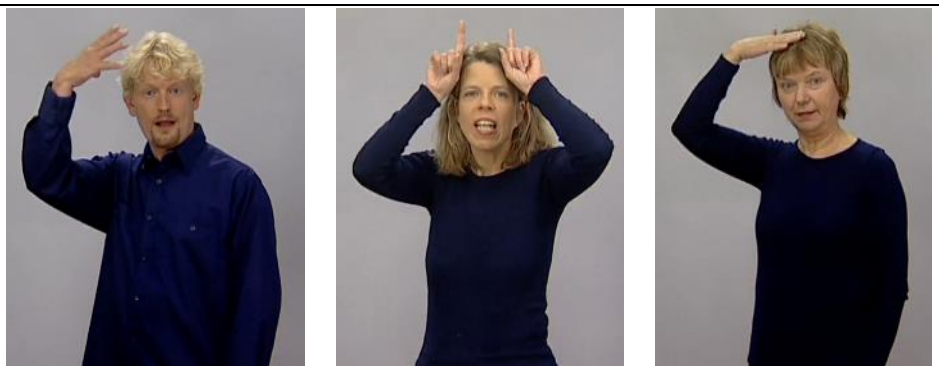


Head Body

Figure 8: *Phonemic locations (the ipsilateral side is to the left of each figure and contralateral side is to the right.*

For a number of signs the choice of location appears to be largely predictable. In the following I will provide some examples.

Signs that are articulated on or near the top of head appear to be iconically motivated. In some of the signs the location refers to a certain referent, a thing, which is typically placed on the head or is on the head Example 28.



BRUSER 'shower' | DJÆVEL 'Devil' | HAT 'hat'

Example 28: *Iconic use of the location 'top of head'.*

In other signs the location on or near the head (temple) refers to a mental process (Example 29).

VIDE 'know' | TÆNKE 'think' | KONCENTRERE 'koncentrate'

Example 29: *Location 'head' referring to mental processes.*

Some of the signs articulated on or near the mouth appear to be related to verbal actions or functions of the mouth (Example 30). This has also been attested for NGT (Van der Kooij 2002).



FORTÆLLE ‘tell’ SIGE ‘say’ SNAKKE ‘talk’


SPISE ‘eat’ DRIKKE ‘drink’

Example 30: *Location ‘mouth’ referring to verbal actions.*

As has also been attested for NGT (Van der Kooij 2002), some of the signs that are articulated on or near the ears express functions and activities related to the ears Example 31.


ØRERING ‘ear ring’ DØV ‘deaf’

Example 31: *Location ‘ear(s)’ referring to activities or function related to that area.*

Similar motivations for choice of location can be described for signs articulated on or near the location 'eye': SE 'see', STIRRE 'to stare', GRÆDE 'cry'.

Signs articulated on or near the locations 'chest' appear to be related to emotional states and feelings such as BEHERSKE-SIG 'control-one-self', ELSKE 'love', JALOUSI 'jealousy', and MODIG 'brave'.

Signs articulated on or near the locations 'stomach' appear to be related activities or functions of that area: ABORT 'abortion', GRAVID 'pregnant', FØDE 'give-birth', and SULTEN 'hungry'.

I did not find any specific patterns for the use of neutral space. More research is needed to give a full description of the use of this area.

3.2.2.1 Phonemic oppositions in locations

In the following tables are some minimal pairs, near minimal pairs and sets of signs[33] which show the phonemic contrast in the different locations illustrated in Figure 8.

All four sign examples in Table 21 have the same handshape, the Bent 5a-hand  , and orientation but differ in location. Articulating these signs does not involve movement of the hand other than the transitional movement from neutral position of the hand, which is at the level of the stomach (like the left hand in the third sign KVINDE 'woman'), and to the place on, or near the body in which the signs are articulated.

Table 21: *Sets of signs distinguished only by the places of articulation 'top of head', 'eye', and 'chest (IL)'.*

KONGE 'king' (Not in the database) • SIGN TYPE: 1H • HS: Bent 5a • **LOC: Head (top)** • MOV: None • ORI: Towards signer • CONTACT: Yes	

[33] Not all examples occurred in the database. Wherever signs not occurring in the database are used as examples, this is mentioned explicitly in the text.

KVINDE 'woman' (Not in the database) • SIGN TYPE: 1H • HS: Bent 5a • **LOC: Chest (IL)** • MOV: None • ORI: Towards signer • CONTACT: Yes	
KLOVN 'clown' (Not in the database) • SIGN TYPE: 1H • HS: Bent 5a • **LOC: Nose** • MOV: None • ORI: Towards signer • CONTACT: Yes	(No picture available)

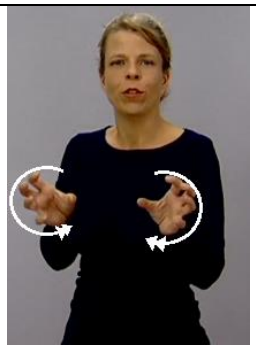
In the following tables (Table 22 to Table 25) the different sign pairs are distinguished by only the place of articulation. All other parameters (handshape, movement, and orientation) are the same in each pair.

Table 22: *Sets of signs distinguished only the places of articulation 'neutral space', 'cheek', 'top of head', 'the side of the nose', and 'earlobe'.*

BORDTENNISBOLD 'Ping Pong ball' (Not in the database) • SIGN TYPE: 1H • HS: 9 • **LOC: Neutral space** • MOV: None • ORI: Left • CONTACT: No	
HONNING 'honey' (Not in the database) • SIGN TYPE: 1H • HS: 9 • **LOC: Cheek** • MOV: None • ORI: Left • CONTACT: Yes	

HÅR 'hair' (Not in the database) • SIGN TYPE: 1H • HS: 9 • **LOC: Head (top)** • MOV: None • ORI: Left • CONTACT: Yes	
OLIE 'oil' (Not in the database) • SIGN TYPE: 1H • HS: 9 • **LOC: Nose (side)** • MOV: Shake (internal) • ORI: Left • CONTACT: Yes	
ØRERING earring' (Not in the database) • SIGN TYPE: 1H • HS: 9 • **LOC: Ear (earlobe)** • MOV: None • ORI: Left • CONTACT: Yes	

Table 23: *FJERNSYN/RADIO: Near minimal pair distinguished by the places of articulation 'neutral space' and 'ears'.*

	
FJERNSYN 'television' • SIGN TYPE: 2H BAL • HS: Bent 5a • **LOC: Neutral space**	RADIO 'radio' (Not in the database) • SIGN TYPE: 2H BAL • HS: Bent 5a • **LOC: Ears**

• MOV: Wrist twist (Internal, mirror) • ORI: Away from signer • CONTACT: No	• MOV: Wrist twist (Internal, parallel) • ORI: Towards signer • CONTACT: No

Table 24: *FORKØLET/PROSTITUTION: Minimal pair distinguished only by the places of articulation 'nose' and 'neck'.*

 1st segment 2nd segment	 1st segment 2nd segment
FORKØLET '(to have) a cold' • SIGN TYPE: 1H • HS: G • **LOC: Nose** • MOV: Squeeze (internal) • ORI: Towards signer • CONTACT: Yes	PROSTITUTION 'prostitution' (Not in the database) • SIGN TYPE: 1H • HS: G • **LOC: Neck (C)** • MOV: Squeeze (internal) • ORI: Towards signer • CONTACT: Yes

Table 25: *BODYGUARD/ENGEL: Minimal pair distinguished only by the places of articulation 'neutral space' and 'near the shoulders'.*


BODYGUARD 'bodyguard' • SIGN TYPE: 2H BAL • HS: A2 • **LOC: Neutral space** • MOV: Down (arch)

- ORI: First away from signer then DH left, NDH right
- CONTACT: No

ENGEL 'Angel'

- SIGN TYPE: 2H BAL
- HS: A2
- **LOC: Shoulders to neutral space**
- MOV: Down (arch)
- ORI: First away from signer then DH left, NDH right
- CONTACT: No

3.2.3 Movements

Six main directions in which the hand(s) can move have been identified as phonemic. These are: Up, down, left, right, away from and towards the signer.

3.2.3.1 Phonemic oppositions in movement

Evidence for the phonological relevance of the different movements, and their phonemic status are provided in the following minimal and near minimal pairs, and sets of signs.

Table 26: *FAST/AFHOLDE: Minimal pair distinguished only by the movement patterns 'single downward movement' and 'repeated downwards movement'.*

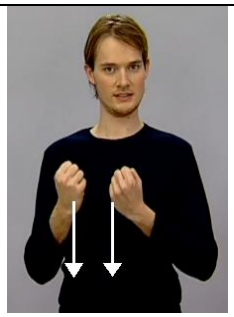
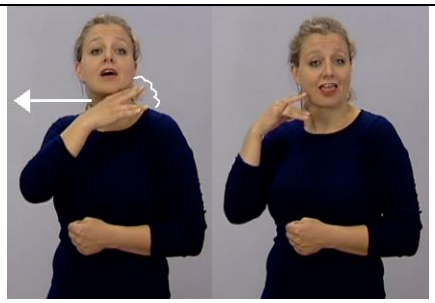
	
FAST 'fixed' (Not in the database) • SIGN TYPE: 2H BAL • HS: A1 • LOC: Neutral space • **MOV: Down** • ORI: Towards signer • CONTACT: No	AFHOLDE 'hold' • SIGN TYPE: 2H BAL • HS: A1 • LOC: Neutral space • **MOV: Down (+repetition)** • ORI: Towards signer • CONTACT: No

Table 27: *GLAD/VAND: Minimal pair distinguished only by the movement pattern 'right' and 'away'.*

	
GLAD 'happy' • SIGN TYPE: 1H • HS: 5 • LOC: Chin (under) • **MOV: Right, (path), fingers wiggling (internal)** • ORI: Down • CONTACT: Yes	VAND 'water' (Not in the database) • SIGN TYPE:1H • HS: 5 • LOC: Chin • **MOV: Away (path), fingers wiggling (internal)** • ORI: Towards signer • CONTACT: No

Other sign pairs that are distinguished only by direction of path movement are given in Example 32 and Example 33.

HØJ 'high/tall'

Movement up

LAV 'low'

Movement down

Example 32: *Signs that are distinguished only by the path movements 'up' and 'down'.*

LÅNE

'borrow'

Movement towards signer

SMUTTE

'leave'

Movement away from the signer

Example 33: *Signs that are distinguished only by the path movements 'towards' and 'away'*

3.2.4 Orientations

Six main directions in which the palm(s) and finger(s) can be oriented are phonemic. These are: Up, down, left, right, away from and towards the signer. Minimal pairs that differ in orientation parameter only are presented in the following tables.

In Table 28 the only difference between the two signs is the orientation of the hands. Both signs are two-handed balanced signs, signed with a B2-handshape moving downwards in neutral space.

Table 28: *I-DAG/BLIVE-HJEMME: Minimal pair distinguished only by the orientations 'up' and 'down'.*

	
I DAG 'today' (Not in the database) • SIGN TYPE: 2H BAL • HS: B2 • LOC: Neutral space • MOV: Down (+repetition) • **ORI: DH and NDH up** • CONTACT: No	BLIVE-HJEMME 'stay-home' (Not in database) • SIGN TYPE: 2H BAL • HS: B2 • LOC: Neutral space • MOV: Down (+repetition) • **ORI: DH and NDH down** • CONTACT: No

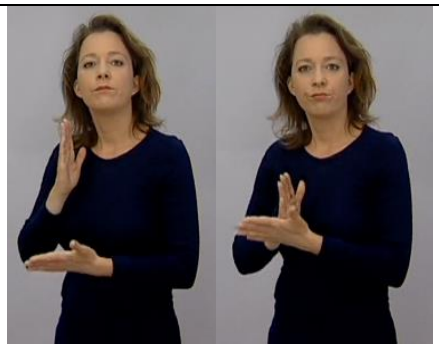
The signs in Table 29 are distinguished by the change in orientation of the hands during the articulation of the signs. Both signs are articulated with the Bent 5a handshape near the head. In the sign KONCENTRERE 'concentrate' the hands change from being oriented away from the signer to being oriented towards the signer. In the sign VILD 'wild' it is the other way around.

Table 29: *KONCENTRERE/VILD: Minimal pair distinguished only by the combination of the orientations 'away > towards' and 'towards > away'.*

 1st segment 2nd segment	 1st segment 2nd segment
KONCENTRERE 'concentrate' • SIGN TYPE: 2H BAL • HS: Bent 5a	VILD 'wild' • SIGN TYPE: 2H BAL • HS: Bent 5a

• LOC: Near head • MOV: Wrist twist, mirror, (internal) • **ORI: First away from, then towards signer** • CONTACT: No	• LOC: Near head • MOV: Wrist twist, mirror, (internal) • **ORI: For towards, then away from signer** • CONTACT: No

Table 30: *BESTEMT/SAMMEN: Minimal pair distinguished only by the orientations 'up' and 'right''.*

 1st segment 2nd segment	 1st segment 2nd segment
BESTEMT 'certain' (Not in the database) • SIGN TYPE: 2H BAL • HS: B2 • LOC: DH on palm on NDH • MOV: Down (path) • ORI: DH left, NDH up • CONTACT: Yes	SAMMEN 'together' (Not in the database) • SIGN TYPE: 2H BAL • HS: B2 • LOC: Neutral space • MOV: Hands toward each other, mirror (path) • ORI: DH left, NDH right • CONTACT: Yes

3.2.5 Mouth actions

In each sign pair in Table 31 to Table 35, the manual components of the signs are formally identical. They are manual homonyms. The meaning of the signs is disambiguated by the non-manual component. That is, they are disambiguated by the mouth action. I have not found any examples of sign pairs with different mouth gestures, but I have found several examples where the sign pairs are disambiguated by different mouthings. However, it is only possible to give a partial description of the mouthing used in these sign pairs. But it is clear that they are different.

3.2.5.1 Phonemic oppositions in mouthings

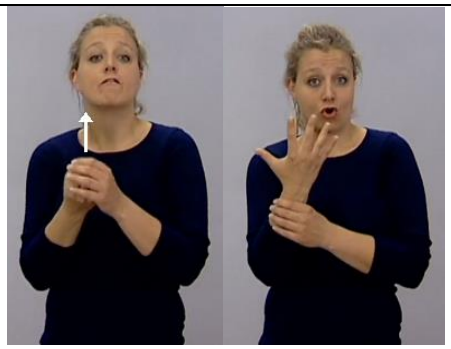
In the first sign pair in Table 31 both signs are two-handed unbalanced signs. They are articulated with a handshape change from an O-hand to a 5-hand in the dominant hand, and

a C-hand in the non-dominant hand. The palms of the hands, in both signs, are oriented towards the signer. Furthermore, both signs are articulated in neutral space with an upward movement and spreading of the fingers. During the articulation of the signs the hands are in contact. The signs are disambiguated by their mouthing.

In the sign for FORÅR 'spring' one can tell that the signer starts her mouthing with a labiodental fricative (see picture of the signer's head), although one cannot tell whether it is voiced or voiceless. It appears as if her mouthing ends in a rounded open back vowel [ɒ] although this is only a tentative suggestion.

In the sign for CHAMPAGNE 'champagne' it is not clear whether the signer starts her mouthing with the closed front vowel [i] or an alveolar or post alveolar fricative, but one can tell that she shifts to a bilabial (see picture of the signer's head[34]) and then to a vowel like mouth configuration.

Table 31: *FORÅR/CHAMPAGNE: Minimal pair distinguished only by the mouthing.*

 1st segment 2nd segment 	 1st segment 2nd segment 
FORÅR 'spring' • SIGN TYPE: 2H UNBAL	CHAMPAGNE 'champagne' (Not in the database) • SIGN TYPE: 2H UNBAL

[34] For clearer examples I shall refer the reader to the video clip s FORÅR and CHAMPAGNE in the online dictionary.

• DH: From O-hand to 5-hand • NDH: C • LOC, POA: DH, back, NDH, palm • MOV: UP (path) + HSC (internal) • ORI: Towards signer • **MP, M:** • CONTACT: Yes	• DH: From O-hand to 5-hand • NDH: C • LOC, POA: DH back, NDH palm • MOV: UP (path) + HSC (internal) • ORI: Towards signer • **MP, M:** • CONTACT: Yes

In the second sign pair in Table 32, both signs are articulated with one hand and the signs each consist of the following components: They are articulated with a B2-hand and the palms of the hands, in both signs, are oriented downwards. Furthermore, both signs are articulated in neutral space with circular horizontal movement that runs counter clockwise.

In the sign LAND 'land' it appears that the signer pronounces a silent alveolar lateral approximant [l]. In the picture of the signer's head one can see the position of the tongue after its release from the alveolar ridge. This is followed by what appears to be a front open-mid or front open vowel, but it is difficult to tell what else is pronounced.

In the sign HAVE 'garden' one can tell that the signer produces a front open vowel followed by a labiodental fricative (see picture of the signer's head).

Table 32: *LAND/HAVE: Minimal pair distinguished only by the mouthing.*

 	 
LAND 'land' • SIGN TYPE: 1H • HS: B2 • LOC: Neutral space • MOV: Circular (horizontal plane) • ORI: Down • **MP, M:** • CONTACT: No	HAVE 'have' • SIGN TYPE: 1H • HS: B2 • LOC: Neutral space • MOV: Circular (horizontal plane) • ORI: Down • **MP, M:** • CONTACT: No

In the third sign pair Table 33 in both signs are two-handed balanced signs articulated with the A1-handshape oriented towards the signer. The arms are crossed and touching at the wrists, and in both signs the hands are moving downwards. Although one cannot tell the details in the mouthings one can see that they are different from each other.

Table 33: *ADVOKAT/KOMMUNE: Minimal pair distinguished only by the mouthing.*

 1st segment 2nd segment	 1st segment 2nd segment
ADVOKAT 'lawyer' • SIGN TYPE: 2H BAL • HS: S • LOC: DH and NDH (wrist) • MOV: Down • ORI: Towards signer • **MP, M:** • CONTACT: Yes	KOMMUNE 'municipality' • SIGN TYPE: 2H BAL • HS: S • LOC: DH and NDH (wrist) • MOV: Down • ORI: Towards signer • **MP, M:** • CONTACT: Yes

In Table 34 both signs are one-handed signs and are articulated with a 3-handshape on the contralateral sign of the signers' chest. The palm of the hand is oriented towards the signers. The hands are tapping the chest. One can see from the pictures that the mouthings are different in each sign although the details of the mouthings are difficult to describe.

Table 34: *PREMIERE/AMATØR: Minimal pair distinguished only by the mouthing.*

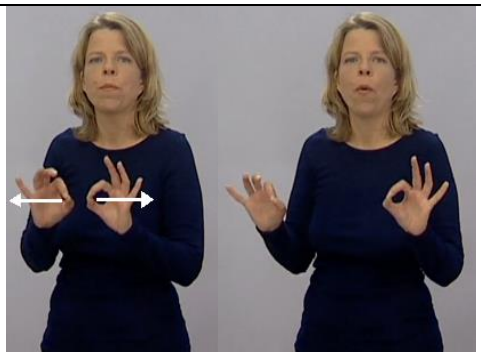
	
PREMIERE ‘premiere’ (Not in the database) • SIGN TYPE: 1H • HS: 3 • LOC: Chest (CL) • MOV: Tapping (Internal) • ORI: Towards signer • **MP, M:** • CONTACT: Yes	AMATØR ‘amateur’ • SIGN TYPE:1H • HS: 3 • LOC: Chest (CL) • MOV: Tapping (Internal) • ORI: Towards signer • **MP, M:** • CONTACT: Yes

Finally, in Table 35, the signs are both two-handed balanced signs articulated with the 9-handshape with the palms facing away from the signer. The movement is a mirror path movement where the right hand moves to the right and the left hand moves to the left.

In the sign HELDIGVIS ‘luckily’ the mouthing appears to start with a bilabial and ends in a closed-mid back vowel [o].

In the sign SNOR ‘string’ it is not possible to tell what the first part of the mouthing is, but it seems like the signer pronounces the rounded closed-mid back vowel [o] and ends in either an open-mid front vowel [ɛ].

Table 35: *HELDIGVIS/SNOR: Minimal pair distinguished only by the mouthing.*

 1st segment 2nd segment	 1st segment 2nd segment

HELDIGVIS 'luckily' • SIGN TYPE: 2H BAL • HS: 9 • LOC: Neutral space • MOV: DH right, NDH left (mirror) • ORI: Away from signer • **MP, M:** • CONTACT: No	SNOR 'string' • SIGN TYPE: 2H BAL • HS: 9 • LOC: Neutral space • MOV: DH right, NDH left (mirror) • ORI: Away from signer • **MP, M:** • CONTACT: Yes

3.2.6 Manual sign type as a distinctive feature

Whether a sign is articulated with one hand or both hands is for some signs a distinctive feature in DSL as I will show in the next couple of examples. This has also been attested for HSL (Schmaling 2000) and NGT (RW.ERROR - Unable to find reference:413). I also found several signs in which the number of hands articulating the sign is not a distinctive feature. Examples of both are presented in the tables below. The sign pairs are not from the database although they are retrieved from the online dictionary which has also been the source for the signs in the database.

In the first sign pair, FRIKADELLE/RADIO (Table 36), every manual parameter is the same. That is, both signs are articulated using the Bent 5a-handshape near the ear(s) (i.e. the hand(s) are not in contact with the part of the body). The orientation of the palm(s) of the hand(s) is towards the signer. Furthermore, an internal movement is used in the form of twisting the wrist joint. These two signs are distinguished only by the number of hands used in the articulation. That is, the presence or absence of the non-dominant hand is the distinguishing feature in these two signs.

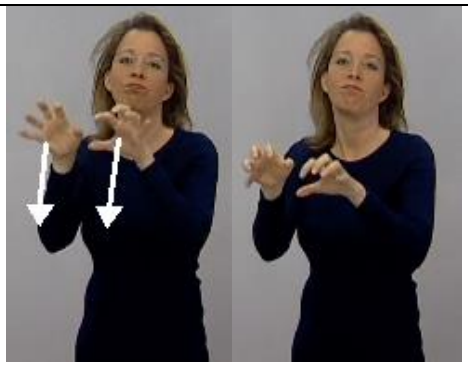
Table 36: *FRIKADELLE/RADIO*: *Minimal pair distinguished only by the number of hands used in the articulation of the signs.*

FRIKADELLE 'meatball' (Not in the database) • **SIGN TYPE: 1H** • HS: Bent 5a • LOC: Ear • MOV: Wrist twist, mirror (internal) • ORI: Towards signer • MP, M: Fadel • CONTACT: No	RADIO 'radio' (Not in the database) • **SIGN TYPE: 2H BAL** • HS: Bent 5 a • LOC: Ears • MOV: Wrist twist, mirror (internal) • ORI: Towards signer • MP, M: Radio • CONTACT: No

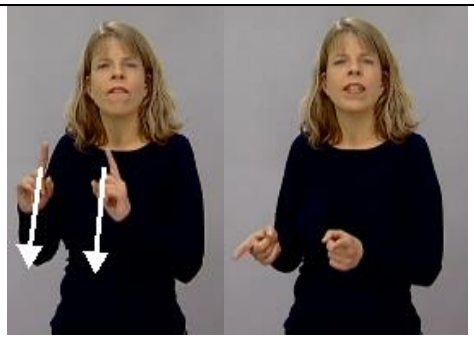
In the second sign pair, SOGN/BESÆTTE (Table 37), both signs are articulated in the neutral space with the Bent 5a-handshape oriented first away from the signer and then downwards as a result from the downward arched path movement.

Table 37: *SOGN/BESÆTTE: Minimal pair distinguished only by the number of hands used in the articulation of the signs.*

 1st segment 2nd segment	 1st segment 2nd segment
SOGN 'parish' (Not in the database) • **SIGN TYPE: 1H** • HS: Bent 5a • LOC: Neutral space • MOV: Down arch (path) • ORI: First away, then down • MP, M: • CONTACT: No	BESÆTTE 'occupy' (Not in the database) • **SIGN TYPE: 2H BAL** • HS: Bent 5 a • LOC: Neutral space • MOV: Down arch (path) • ORI: First away, then down • MP, MG: Short blow • CONTACT: No

In this last example (Table 38) both signs are articulated in neutral space with the 1-handshape. The palm of the right hand is facing left and in both signs the path movement is a downward movement.

Table 38: *SKAL/HVORDAN: Minimal pair distinguished only by the number of hands used in the articulation of the signs.*

 1st segment 2nd segment	 1st segment 2nd segment
SKAL 'MUST' (Not in the database) • **SIGN TYPE: 1H** • HS: 1 • LOC: Neutral space • MOV: Down arch (path) • ORI: Left • MP, M: Sal • CONTACT: No	HVORDAN 'how' (Not in the database) • **SIGN TYPE: 2H BAL** • HS: 1 • LOC: Neutral space • MOV: Down arch (path) • ORI: Left • MP, M: Vdan • CONTACT: No

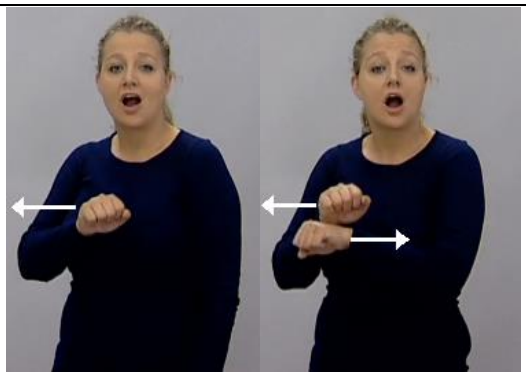
3.2.6.1 Allophonic variations in manual sign types

Based on findings in the database and on my own knowledge of the language I found several examples of signs which could be articulated either as a one-handed sign or as a two-handed sign[35]. The signs are:

- ALDRIG 'never' (Example 34)
- *AMBULANCE 'ambulance'*
- *BURDE 'should'*
- CHEF 'boss'
- *FINDE-UD-AF 'find-out'*
- INDHOLD 'contents'
- *KASTE 'throw'*
- *KAT 'cat'*
- LYKKELIG 'happy'

[35] The signs written in italic were not from the database.

- *MANGLE 'lack'*
- *OVN 'oven'*
- *REJE 'shrimp'*
- *REN 'clean'*
- *SLEM 'bad'*



ALDRIG

'never'

Example 34: *Example of allophonic variation in manual sign types.*

3.3 Types of manual signs

As expected, I identified two main types of manual signs in the database: 230 signs were articulated with only one hand, while 284 sign were articulated using two hands. I will differentiate between one-handed and two-handed signs respectively throughout the thesis. The remaining two signs in the database were compound signs. They will not be dealt with in this thesis.

An overview of the different types of manual signs used in DSL is presented in Figure 9. The categorisation of the two different sign types is based on whether one or two hands are involved in the articulation of the sign. As shown in Figure 9 the two-handed signs can be further divided into two types based on the hand configuration on both hands. In one type the non-dominant hand has the same hand configuration as the dominant hand. In the other type the hand configuration of the non-dominant hand is different from the hand configuration of the dominant hand. In their research on NGT Van der Hulst (Van der Hulst 1993; RW.ERROR - Unable to find reference:413) and Van der Kooij (Van der Kooij 2002) distinguish between *balanced* and *unbalanced* two-handed signs. I will use these terms in this thesis.

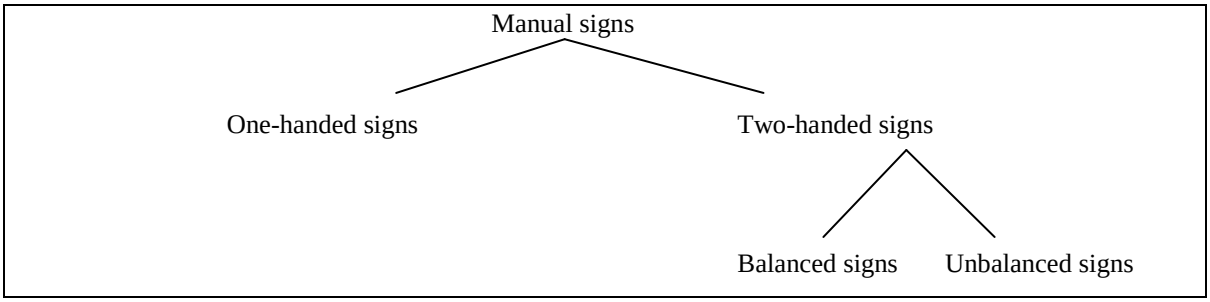


Figure 9: *Types of manual signs in DSL.*

3.3.1 One-handed signs

As mentioned in the introduction to this section (3.3) 45% or 230 of the 516 signs in the database were articulated with one hand. In other words, only one hand is active in this type of manual sign. I will use the term dominant hand. Which hand is the dominant hand depends on whether the signer is right or left handed. It is important to note, however, that '*…the choice of the hand in one-handed signs is never distinctive…*' (RW.ERROR - Unable to find reference:413).

As is evident from the examples in Example 35, one-handed signs can be articulated either in the neutral signing space[36], near a point on the body, or on the body.

ALARM	FALSK	KVINDE
'alarm'	'false'	'woman'
Neutral signing space	Near a point on the body (ear)	On the body (chest)

Example 35: *The different places of articulation used in one-handed signs.*

[36] As mentioned previously the neutral signing space has been described as an area that ranges from the signer's throat to a little above the signer's waist.

Figure 10 below illustrates the distribution of one-handed signs according to different locations. The majority of one-handed signs, 48%, are articulated on, or near the head. Another 41% are articulated in the neutral signing space (NS). Only 10% are signed on, or near the trunk, and 1% is signed on the arm.

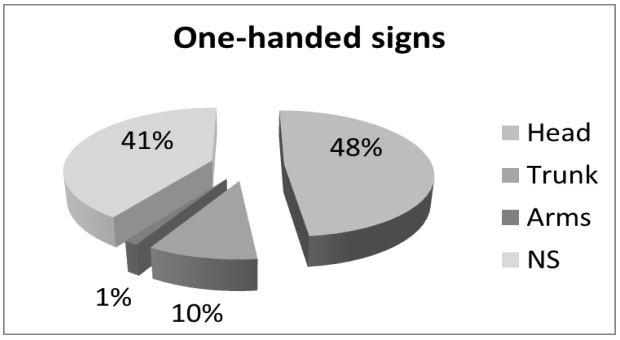


Figure 10: *The distribution of one-handed signs according to location.*

3.3.2 Two-handed signs

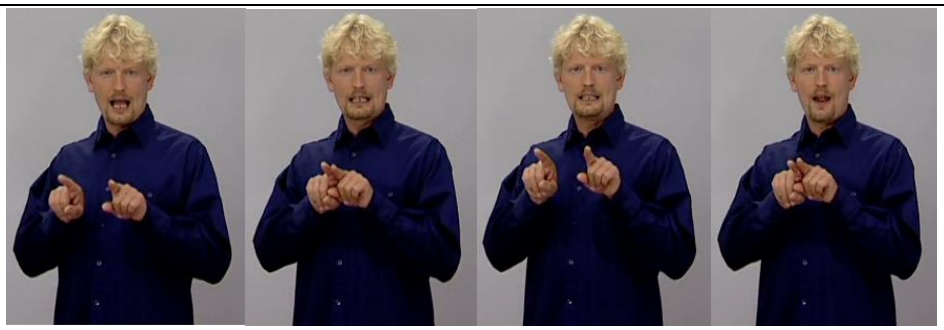
As mentioned in section 2.2.2.7, Battison (Battison 1978) formulated two conditions that were intended to account for the possible formations of the dominant hand and non-dominant hand in two-handed signs, as well as for the constraints in their formation. His study was based on sign formation in ASL two-handed signs. In the following analysis of the two-handed signs that were found in the database, I will investigate whether these conditions apply to two-handed signs in DSL also.

3.3.2.1 Two-handed balanced signs

Of the 516 manual signs in the database 42% or 216 of them were two-handed balanced signs. In this type of sign both hands are used as articulators. The configuration of the non-dominant hand is identical to that of the dominant hand. Thus, the term *balanced* refers to the use of the same handshape, and/or location and orientation in both hands (Van der Kooij 2002). The non-dominant hand is said to copy or behave like a mirror image of the dominant hand (RW.ERROR - Unable to find reference:413; Schmaling 2000). In the sign linguistics literature balanced signs have also been referred to as *symmetric (Stokoe, Casterline & Croneberg 1965),* or *double handed signs* (Johnston 1989a; Schembri 1996; Schmaling 2000).

Two-handed balanced signs can be further divided into four subtypes according to how the two hands move in relation to one another. In three of the signs both hands are equally active and use the same movement pattern. If both hands are active there are three ways in which the hands can move. I will use the terms *mirror*, *parallel* and *alternate* movement respectively following Schmaling (Schmaling 2000). In the following each of the four types will be described and examples will be provided.

In the first type, the signs are articulated with a mirror movement pattern which means that the non-dominant hand copies the movement of the dominant hand and moves simultaneously and symmetrically. For example when the dominant hand moves to the right, the non-dominant moves to the left and vice versa. The signs in Example 36 are articulated with mirror movement.



ALLIGEVEL

'anyways'

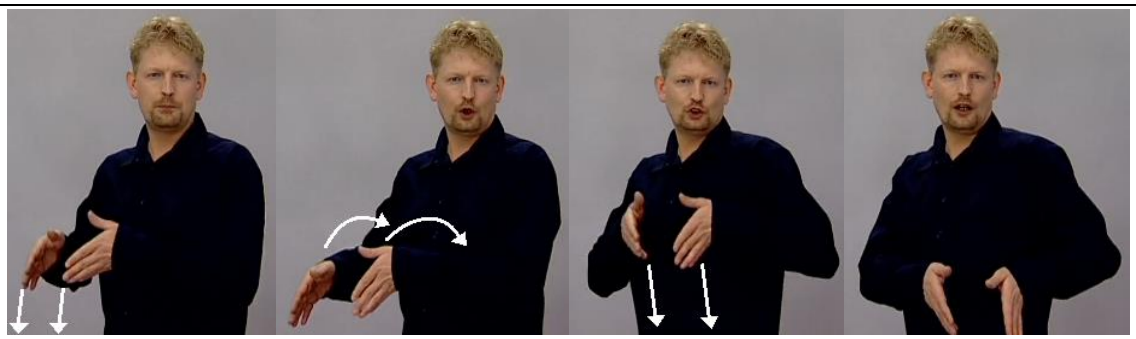
UDVIKLE

'develop'

Example 36: *Two-handed balanced signs articulated with mirror movement.*

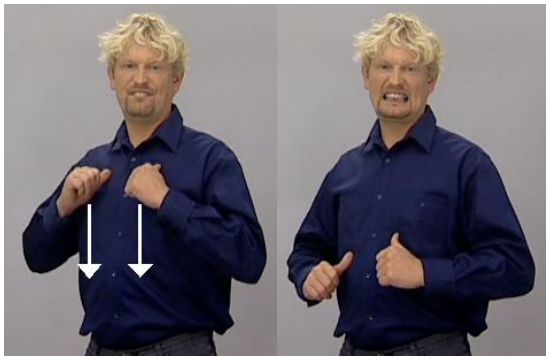
Other signs which are articulated with mirror movement are: BÆLTE ‘belt’, CHEF ‘boss’, FORKLARE ‘explain’, GRUPPE ‘group’, HELDIGVIS ‘luckily’, SAMMEN ‘together’, and SNOR ‘string’.

In the second type, the signs are articulated with a parallel movement pattern which means that the non-dominant hand copies the movement of the dominant hand and moves simultaneously and synchronically. For example, if the dominant hand moves to the right the non-dominant hand does so too. The signs in Example 37 are articulated with parallel movement.



BUKSER

‘pants’



FATTIG

‘poor’.

Example 37: *Two-handed balanced signs articulated with parallel movement*.

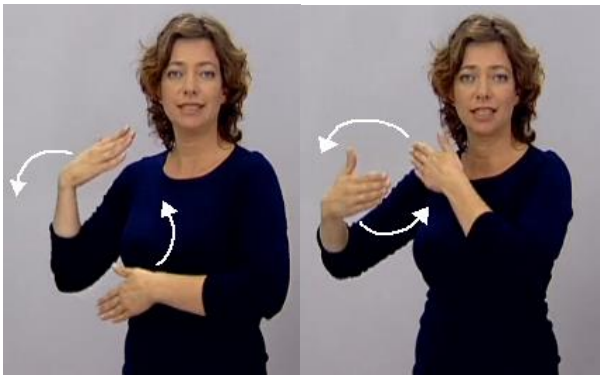
Other signs which are articulated with parallel movement are: FORHOLD ‘conditions’, FORSKE ‘(to) research’, HVORDAN ‘how’, REJSE ‘travel’, UNG ‘young’, and VOLDSOM ‘violent’.

In the third type, the signs are articulated with an alternate movement pattern which means that the non-dominant hand copies the movement of the dominant hand but one

hand moves after the other. The signs in Example 38 are articulated with alternate movement.

BAKTERIE

'bacteria'



TRADITION

'tradition'

Example 38: *Two-handed balanced signs articulated with alternate movement.*

Other signs which are articulated with alternate movement are: BAGE 'bake', BALLADE 'trouble', BYGGE 'build', CYKEL 'bicycle', KOGE 'boil', KOMBINERE 'combine', PAKKE 'pack', PLEJE '(to) nurse', and VANDRE 'hike'.

Finally, in the fourth type the dominant hand acts on the non-dominant hand. That is, the non-dominant hand is used as a place of articulation for the dominant hand (Example 39).

ÆG

'egg'

ALTID

'always'

Example 39: *Two-handed balanced signs in which the dominant hand act on the non-dominant hand.*

3.3.2.2 Two-handed unbalanced signs

Of the 516 manual signs in the database 13% or 67 of them were two-handed unbalanced signs. As in two-handed balanced signs, both hands in unbalanced signs are used as articulators, although they have different handshapes. Furthermore, the non-dominant hand serves as place of articulation for the dominant hand.

An example of such a sign in DSL is provided in Example 40. In this example the handshape of the dominant hand is a Bent V-hand, and the handshape in the non-dominant hand is an S-hand. The movement is a short repeated movement where the base of the palm on the dominant hand touches the thumb side, or radial side, of the non-dominant hand.

Example 40: *The sign KONTROL 'control' where the dominant hand acts on the non-dominant hand.*

Figure 11 below illustrates the distribution of two-handed signs according to different locations. The majority of two-handed signs, 39%, are articulated in neutral space. Another 30% and 19% are articulated on the trunk and hand. Only 12% are articulated on the head, and less than 1% are articulated on the arm.

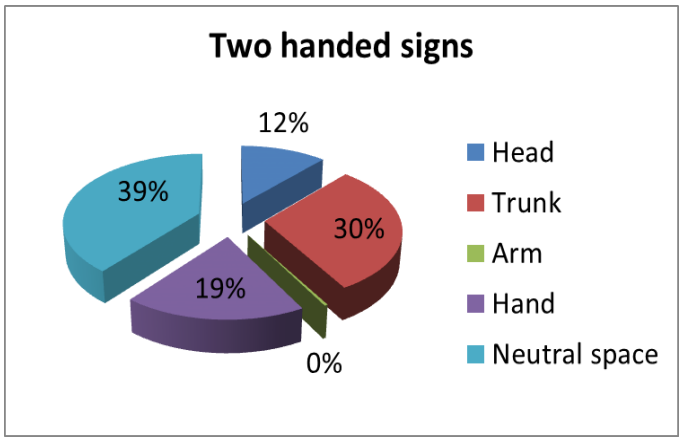


Figure 11: *The distribution of two-handed signs according to location.*

In Battison's Dominance Condition, mentioned in section 2.2.2.7, he claims that if the hands in two-handed sign are different, then the non-dominant hand is passive and the movement in the sign is articulated in the dominant hand (Battison 1978), and this is true for the sign in Example 40. He also claims that that the non-dominant hand can only have

one of the following seven handshapes: A  , S  , B  , 5  , G[37]  , C  , and O  .

Although the Dominance Condition holds true for many of the 67 unbalanced signs in the database, I have found counterevidence to parts of Battison's claim. Firstly, there are four two-handed unbalanced signs in my database in which the non-dominant hand is also specified for movement. The four signs are the following: FORMÅL 'purpose', FLYGTE 'flee', ALDRIG 'never', BISTAND 'social security', and EFTERÅR 'autumn'.

As is evident from the picture sample in Example 41 below, the dominant hand and non-dominant hand are specified for two different handshapes in this sign. The dominant hand articulates the 5-handshape, while the non-dominant hand articulates the A2-hand. According to Battison this would mean that the movement is articulated in the dominant and that the non-dominant hand is passive in this sign. However, as one can see both hands move in a downward straight line in the neutral signing space.

EFTERÅR

'autumn'

Example 41: *Counterevidence to Battison's Dominance Condition.*

Secondly, I have found evidence that the non-dominant hand in unbalanced signs can have more than the seven handshapes proposed by Battison (Battison 1978). That is, I found that the non-dominant hand can have the following handshapes (in the order of

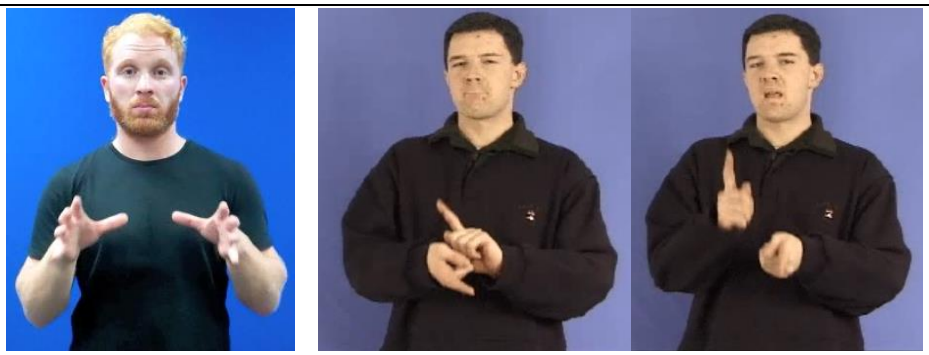
[37] In this case what is a G handshape in Battison's study is a 1-hand in Auslan (RW.ERROR - Unable to find reference:328) and DSL.

frequency of occurrence): B2  , B1  , 5  , S  , Bent 5a  , H1  , B3  , C  , Closed B  , Flat B1  , and Flat B2  .

3.4 Other sign types

3.4.1 Multi-channel signs

Multi-channel signs are described as signs composed of both manual (handshape, location, movement and orientation) and non-manual components, forming "*a single integrated sign*" (RW.ERROR - Unable to find reference:328). This means that in this type of sign both are obligatory (Brennan 1992). The following two examples are from Auslan (Example 42) "which are regularly accompanied by particular mouth gestures" (RW.ERROR - Unable to find reference:328). The sign REALISE is described as being produced with a mouth gesture resembling "*a silent articulation of the syllable 'pah'*" (RW.ERROR - Unable to find reference:328).



BIZARRE REALISE

Mouthing: 'Pah'

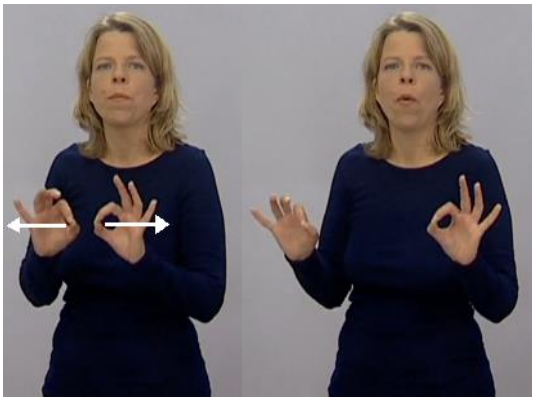
Example 42: *Examples of multi-channel signs in Auslan* (http://www.auslan.org.au/dictionary)

Examples from DSL seem to include signs such as ALLEREDE 'already' and HELDIGVIS 'luckily' (Example 43). In the sign ALLEREDE the mouth action has been described as resembling a silent articulation of the syllable 'bæd' (www.tegnsprog.dk 2011).

ALLEREDE

'already'

Mouthing: Appears to start with a bilabial and ending in a dental fricative[38].



HELDIGVIS

'luckily'

Mouthing: Appears to start with a bilabial and ending in a rounded close-mid back vowel[39].

Example 43: *Examples of multi-channel signs in DSL.*

However, Johnston & Schembri write (RW.ERROR - Unable to find reference:328):

It is not clear how many of these signs obligatorily take a non-manual component. Discussions with native signers thus far suggest that not all appear to agree on whether certain non-manual features are actually obligatory for particular multi-channel signs.

[38] In existing research on DSL this mouthing is usually described as the pronunciation of '*bæd'* (RW.ERROR - Unable to find reference:424).

[39] In existing research on DSL this mouthing is usually described as the pronunciation of '*bo'* (RW.ERROR - Unable to find reference:424).

A further discussion of this type of sign is beyond the scope of this thesis, but it is an area that needs further investigation in future research.

3.4.2 Non-manual signs

Non-manual features usually co-occur with manual signs. However, there are some non-manual features that occur on their own although this type of sign is rare (RW.ERROR - Unable to find reference:328). While some non-manual features are identical to conventional gestures found in spoken languages other seems to be unique to signed languages.

I did not find any examples of non-manual signs in the DSL database. However, from my own knowledge of the language I know that signers of DSL use a repeated wrinkling of the nose. Although wrinkling the nose is a gesture also found within non-signing communities it looks different and has a meaning different from the meaning of the *repeated* nose-wrinkle used in DSL. In non-signing communities wrinkling ones nose is typically an indication of dislike or disapproval. There is typically only a single contraction along the bridge of the nose, which is held for a few seconds. We see this type of nose wrinkle used in the Danish Deaf community too. However, in DSL I have observed a second type of nose wrinkling in which the contraction along the bridge of the nose is not as tense as in the first type. Furthermore, the movement is repeated. I have asked about its meaning and it appears that it can either be used as a type of response meaning something close to ‘Yes, I agree’, ‘Agree’, ‘Yes, you are right’, and ‘Yes, I know what you mean’. Or it can be used as a minimal response to confirm that you are following the conversation.

From a discussion at sign language workshop (Sign Linguistics Corpora Network in Stockholm June 2010) that I have attended I know that this use of nose wrinkle is found in other signed languages too such as Swedish Sign Language. It would be interesting to investigate this aspect of DSL and other signed languages further, but more examples are needed before one can make a systematic analysis of this phenomenon.

4 Conclusion

The aim of this thesis has been threefold: First, I have examined the phonetics and phonology of Danish Sign Language and shown that the phonological structure of DSL is comparable to findings from research on the phonological structure of other signed languages. I have identified the inventory of the handshapes, locations, movements, orientations and some of the mouth actions that are used in DSL. Secondly, I have explored the distinctive features of the different parameters in the inventory by referring to minimal pairs and near minimal pairs and investigated possible allophonic variants.

On the basis of the database at hand I will tentatively suggest the inventory of phonemic parameters found in DSL.

Of the fifty-one handshapes I found in the data twenty-five of them were phonemic. I base this on the fact that the position of the thumb is non-distinctive and is largely predictable based on which part of the hand is in contact with the body during the articulation of a given sign. Furthermore, allophonic variation in handshapes such as B-hand and V-hand can largely be predicted according to their orientation and if the signs are articulated in neutral space, or on or near a point on the body.

Based on the findings in the database forty-one locations appear to be distinctive. I found that in one-handed signs with only one location, it appears that if the sign is articulated on the ipsilateral side, the location is restricted to the area from the mid sagittal line and leftwards and vice versa if the sign is articulated on the contralateral side. However, any area within the mid sagittal line to either side appears to be allophonic.

Six phonemic movements as well as orientations were also accounted for.

The two types of mouth actions were identified as distinctive features. However, more research is needed in this area as it is not clear how many of these signs obligatorily take these non-manual components.

Finally, I have described the manual sign types used in DSL. As have been found in sign languages such as Auslan, HSL, and NGT, I have shown that there are three types of signs. These are one-handed signs and two main types of two-handed signs: *Two-handed balanced signs* and *two-handed unbalanced* signs. Referring to Battison's (Battison 1978) proposed conditions for sign formation in two-handed signs I found counter evidence to his *Dominance Condition* in which he claims that a) if the hands in two-handed sign are

different, then the non-dominant hand is passive and the movement in the sign is articulated in the dominant hand (Battison 1978). He further claims that b) the non-dominant hand can only have one of the following seven handshapes: A  , S  , B  , 5  , G[40]  , C  , and O  .

Although the Dominance Condition holds true for most of the unbalanced signs found in the database, I found counterevidence to both the a) and the b) part of Battison's claim. Firstly, there are four two-handed unbalanced signs in the database in which the non-dominant hand is also specified for movement. The four signs are the following: FORMÅL 'purpose', FLYGTE 'flee', ALDRIG 'never', BISTAND 'social security', and EFTERÅR 'autumn' (section 3.3.2.2).

Secondly, I found that the non-dominant hand in unbalanced signs can have more than the seven handshapes proposed by Battison (Battison 1978): (in the order of frequency of occurrence): B2  , B1  , 5  , S  , Bent 5a  , H1  , B3  , C  , Closed B  , Flat B1  , and Flat B2  .

4.1 Suggestions for future research

This study is only an initial description of the structure of signs in DSL on the phonemic level. Further studies are needed and more data need to be taken into account. This means including depicting signs, initialised signs, MHS derived signs, and fingerspelled signs.

The decision not to include initialised signs (signs based on the manual alphabet which is based on the Latin alphabet used in Danish orthography), and signs derived from the Mouth-Hand System was primarily based on the fact that these signs are influenced by or manual representations Danish words and therefore not part of the native core lexicon of DSL. However, it seems that some of these signs have become lexicalised and integrated in the core lexicon. It would be interesting to investigate how native signers perceive these signs, i.e. if they are aware that the signs originate from these artificial sign systems.

[40] In this case what is a G handshape in Battison's study is a 1-hand in Auslan (RW.ERROR - Unable to find reference:328) and DSL.

Furthermore, As mentioned in section 1.2 the use of fingerspelling is not as widespread in DSL as in ASL, and DSL users seem to prefer to coin new signs rather than using the manual alphabet to fingerspell the Danish (or English) words. It would be interesting to study this phenomenon of DSL sign formation in future research and I believe that the study of the phonetics and phonology DSL can provide additional and valuable insight into the possible structures of human language. Moreover, this study will contribute to the understanding of the linguistic variation and similarities existing not only among sign languages but among languages in general.

Resumé på dansk

Forskning i dansk tegnsprogs fonetik og fonologi er begrænset. Dette speciale er den første beskrivelse af dansk tegnsprogs fonetik og fonologi. Målet har blandt andet været at identificere og gøre rede for de fonetiske segmenter, der bruges opbygning af manuelle tegn i sproget. Disse inkluderer håndformen, artikulationssted, bevægelse, orientering og de mønstre munden antager under artikulationen af et tegn. Derefter har det været målet at argumentere for hvilke af disse segmenter er fonemiske.

Desuden er der gjort rede for de forskellige typer manualle tegn, der findes i dansk tegnsprog. Disse inkluderer tegn, der er artikuleret med én hånd (enhåndstegn) og tegn, der er artikuleret med to hænder (tohåndstegn). Af sidst nævnte type er der fundet to varianter, som er karakteriseret ud fra om begge hænder bruger samme håndform (balanced[41]) eller forskellige håndformer (unbalanced[42]) i hver hånd.

Jeg har modbevist en påstand, fremsat at Battison (Battison 1978), om at den ikke-dominante hånd i unbalanced tegn skulle være uden bevægelse i disse tegn. Desuden har jeg modbevist at den ikke-dominante hånd skulle have et begrænset antal af håndformer den kan antage.

Som opsummering af dette speciale kan nævnes, at det hermed er bevist at dansk tegnsprog strukturelt viser mange ligheder med andre tegnsprog.

[41] Af praktiske årsager har jeg bibeholdt de engelske termer.
[42] Af praktiske årsager har jeg bibeholdt de engelske termer.

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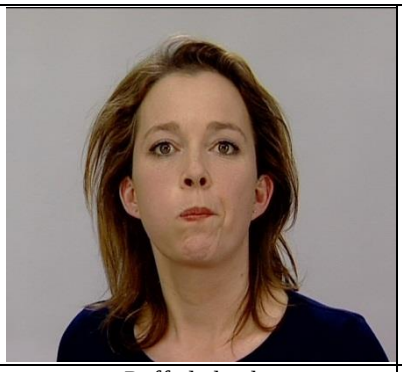
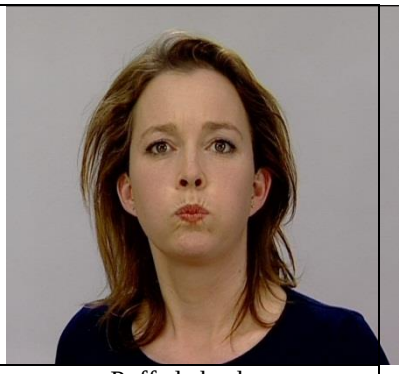
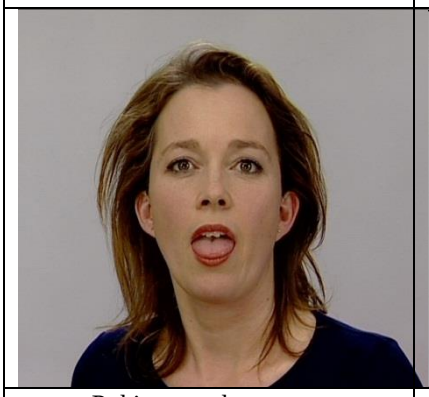
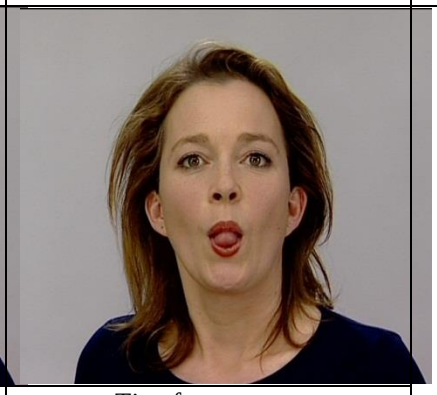
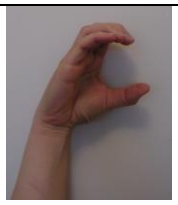
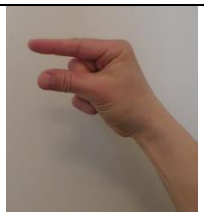
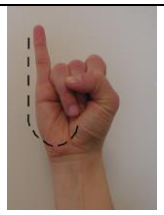
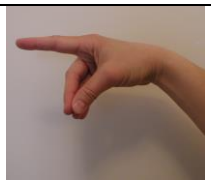
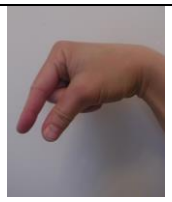
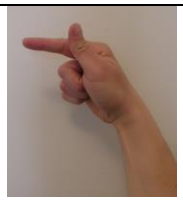
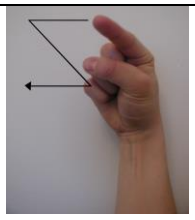
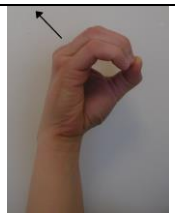
Appendix 1 – Mouth gestures in Danish Sign Language

An overview of the static mouth gestures used in DSL.

		
Bite ones tongue	Puffed cheek	Puffed cheeks
		
Puffed lower lip	Pout	Tongue expands one cheek
		
Poking out the tongue	Tip of tongue out	

Appendix 2 – The manual alphabet in Danish Sign Language

				
Aa	Bb	Cc	Dd	Ee
				
Ff	Gg	Hh	Ii	Jj
				
Kk	Ll	Mm	Nn	Oo
				
Pp	Qq	Rr	Ss	Tt
				
Uu	Vv	Ww	Xx	Yy
				
Zz	Ææ	Øø	Åå	

Appendix 3 – Numeral signs in Danish Sign Language

		
1	2	3
		
4	5	6
		
7	8	9

Appendix 4 – Handshape conversion chart

No. of HSs	Handshape	Labels used in this thesis	SignPhon codes	HamNoSys symbols
1		1	C3	
2		Flat 1	C6	
3		1+th.	-	-
4		Closed 2	G4	
5		3	E2	
6		Bent 3	E7	
7		Closed 3	G14	
8		4	F3	
9		5	F2	
10		Bent 5a	F8	

11		Bent 5b	F10	
12		6	K17	-
13		7	K16	-
14		8	K15	
15		9	K1	
16		Flat 9	K4	
17		Flat open 9	L3	
18		A1	A1	
19		A2	A2	
20		B1	B1	
21		B2	B2	
22		B3	B3	

23		Bent B3	B9	
24		Closed B	I5 (Closed beak)	
25		Flat B1	B4	
26		Flat B2	B5	
27		Flat B3	J6	-
28		C	J2	
29		Flat bC	J4	
30		gC	C11?	
31		D	-	
32		E1	B9	
33		E2	B10	
34		F1	-	-

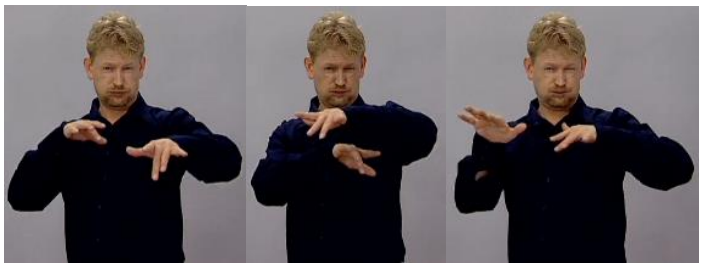
35		F2	K5 (F)	-
36		G	H4	
37		H1	D3	
38		H2	-	-
39		H3	D2	
40		Bent H	D7	
41		Flat H	D4	
42		Hooked H	D12	
43		I	C17	
44		Bent 1	G17	
45		K1	E17	-

46		K2	E1	
47		L	C2	
48		Bent L	C13	
49		M	A15	
50		Mid	C16	
51		Flat mid	F17	
52		O	I1	
53		gO	G1	
54		R	D17	
55		S	A3	
56		T	C4	
57		V	E3	

58		Bent V	E9	
59		Flat V	-	-
60		W	K18	
61		X1	C9	
62		X2	C8	
63		Y1	C18	
64		Y2	E15	
65		Y3	E16	

Appendix 5 – Example sentence with depicting signs

The pictures that are right next to each other form one sign. The picture standing alone forms one sign. Thus, there are six signs in total.



MYLDRE

'swarm'[43]

JEG

'I'

KØRE-BIL-FREM

'drive-car-forward'[44]

HELDIGVIS

'luckily'

[43] The three pictures make up a whole sign in which the movement is a circular path movement. The right hand moves counter clockwise and the left hand moves clockwise. There is also an internal movement in the handshape in for form of wiggling fingers.

[44] In this picture sequence the facial expression of the signer changes from indicating that he is searching for something to indicating surprise or relief.

P-PLADS

'parking place'

PARKERING

'parking'

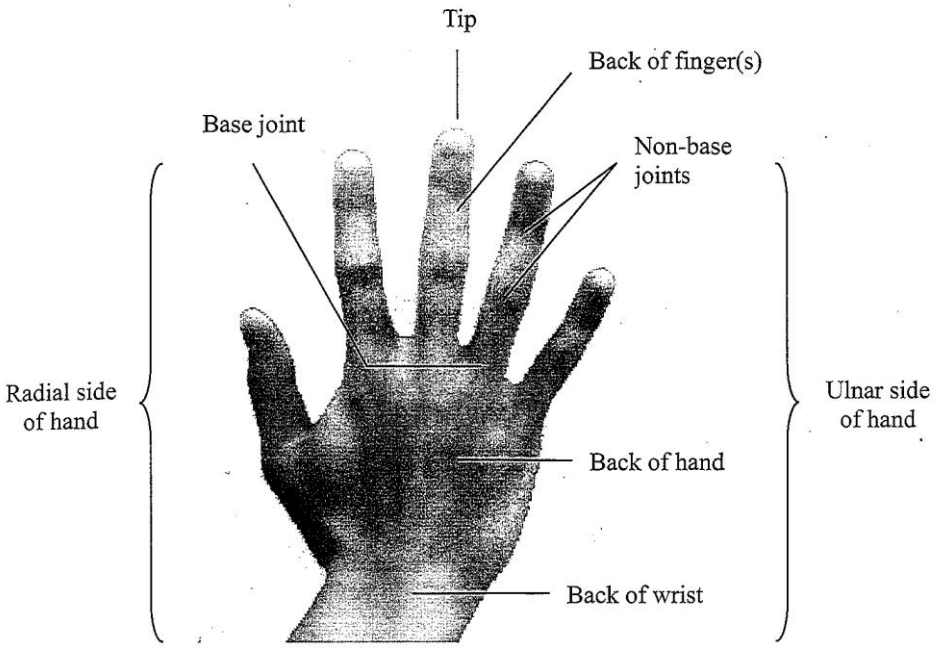
'Der var mange mennesker, men heldigvis fandt jeg en parkeringsplads til bilen.' (Kristoffersen & Troelsgård 2010)

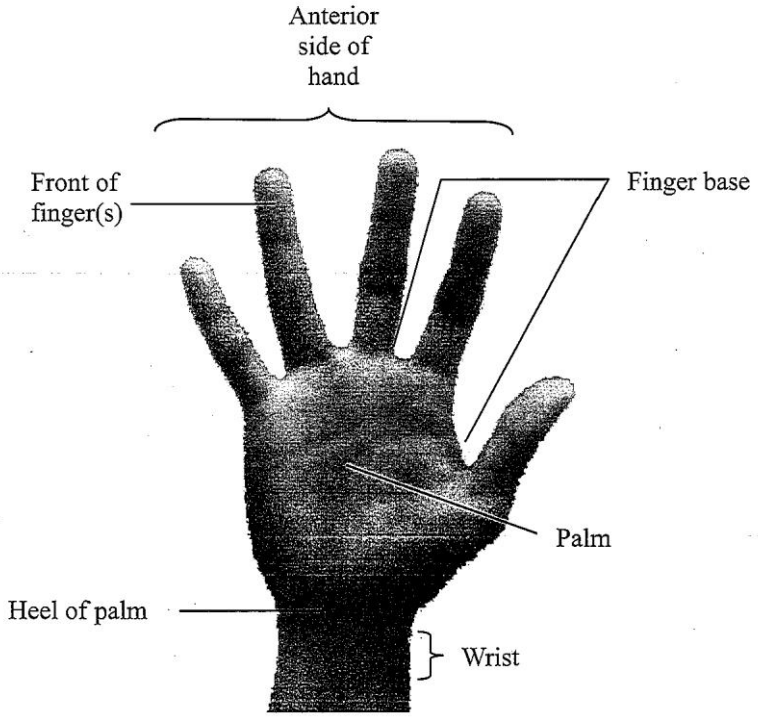
'There were a lot of people, but luckily I found a parking place for the car.'

Appendix 6 – Stimulus

This picture was used as stimulus when asking DSL users about how the sign for CRANE is articulated.

Appendix 7 – Hand specifications





(Tang 2007:13)

Appendix 8 – CD containing the excel file with the encoded signs