HamNoSys – Hamburg Notation System for Sign Languages
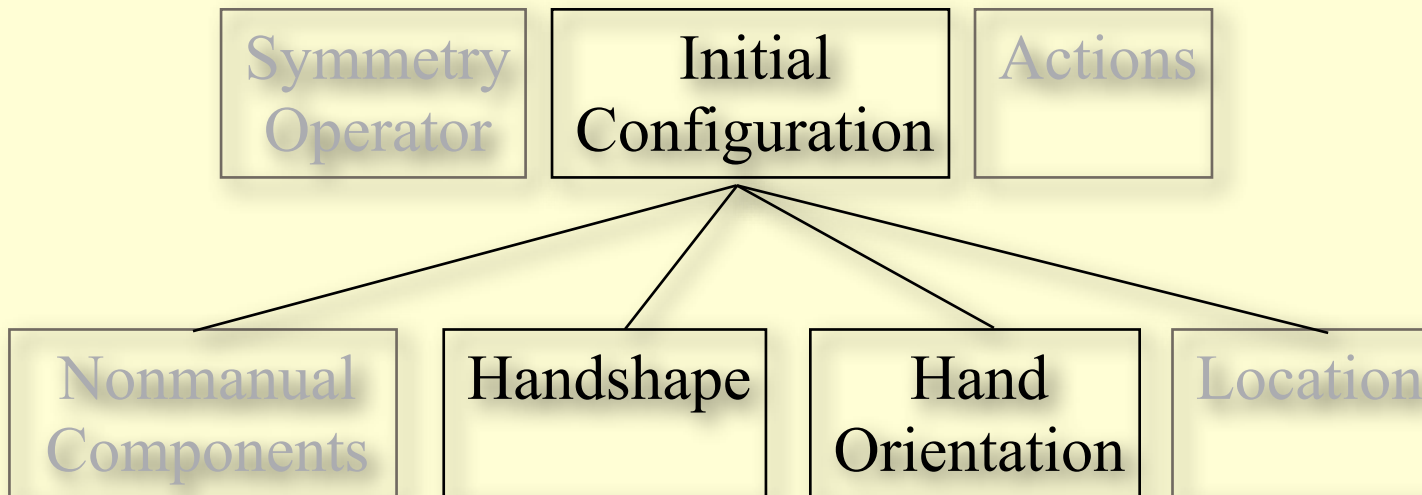
█ Thomas Hanke

   █ Institute of German Sign Language…

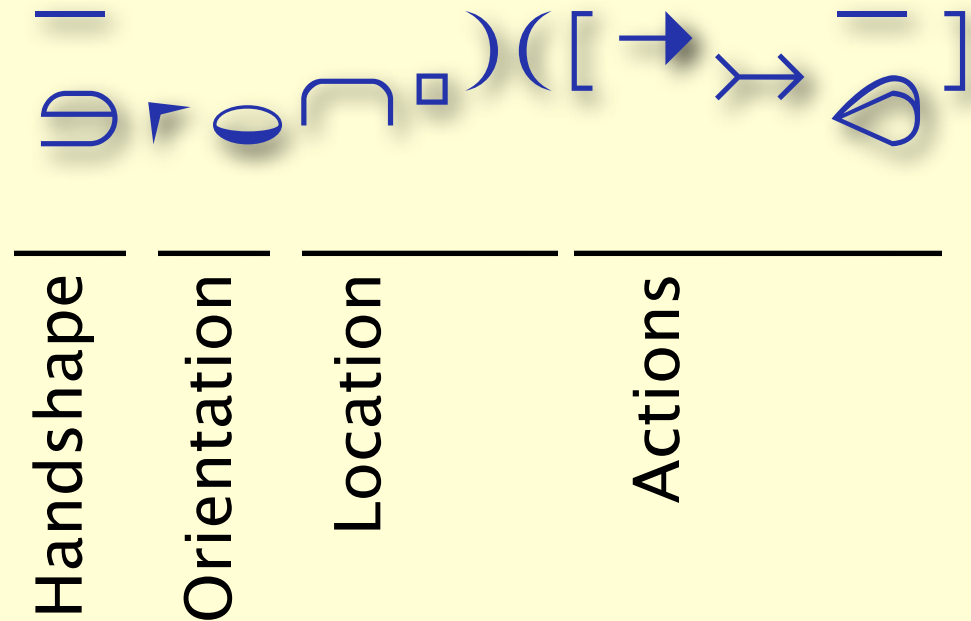   █ mailto:Thomas.Hanke@sign-lang.uni-hamburg.de

Slides version 2007-11-14

HamNoSys

- Alphabet with a symbol inventory of ~210 characters
- Overall Structure

```
        Symmetry        Initial          Actions
        Operator     Configuration

  Nonmanual      Handshape      Hand        Location
  Components                 Orientation
```

HamNoSys Structure: DGS Example

HAMBURG

Handshape | Orientation | Location | Actions

Joints

DIP: distal interphalangeal

distal ph.

middle ph.

Fingers (phalanges)

PIP: proximal ip

proximal ph.

MCP: metacarpophalangeal

Metacarpus (metacarpals)

CMC: carpometacarpal

Carpus

ulna   radius

Options for Defining Handshapes

- Manual Alphabet (fingerspelling)
- Joint Positions
- Iconic Names
- Derivation from Basic Types by Movement
- Derivation from Basic Types by Systematic Modifications
- Arbitrary Codes

- HamNoSys combines these principles

Handshape Descriptions

- Describes several 100 handshapes
- Very precise ↔ relatively coarse
  - Precise in contacts or oppositions
  - Coarse wrt joint angles in open handshapes
- Level of detail motivated by sign language phonology

Basic Handshapes

▌ Six open handshapes
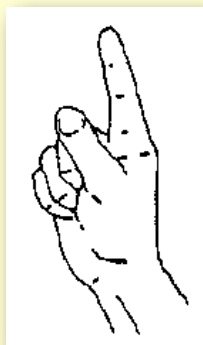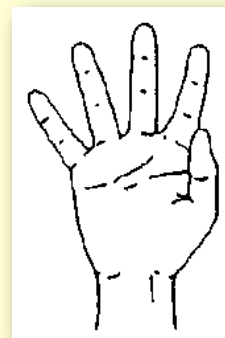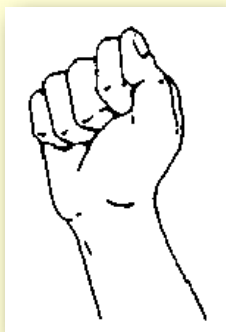
Basic Handshapes (2)

- …and six thumb combinations
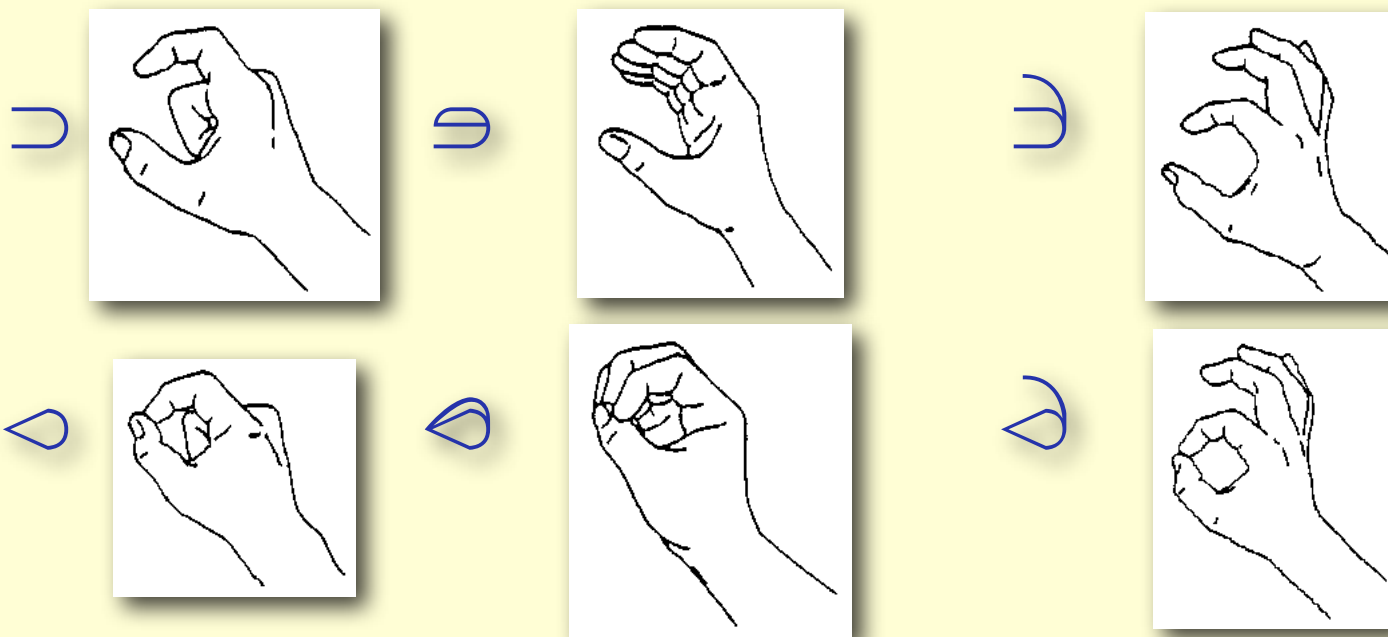
Handshapes from Basic Handshapes

- plus thumb position
- plus bending
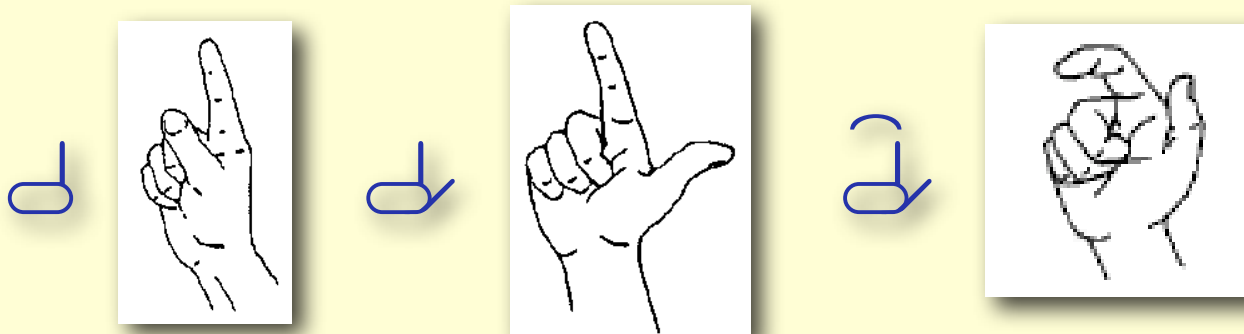
Thumb Positions
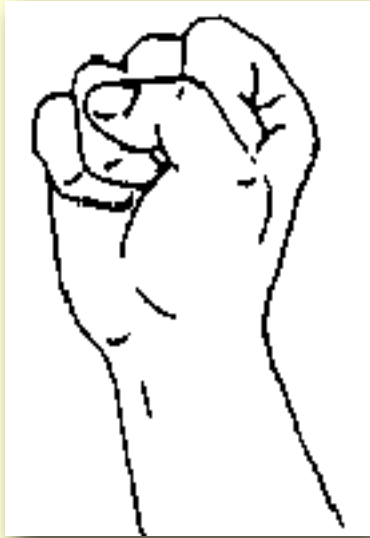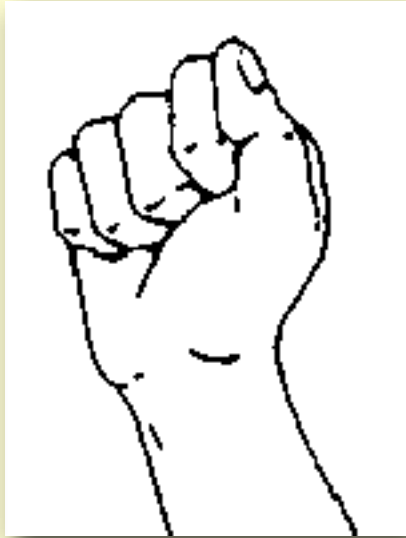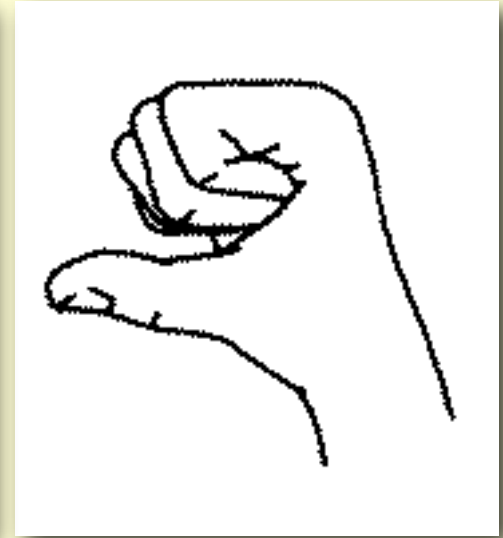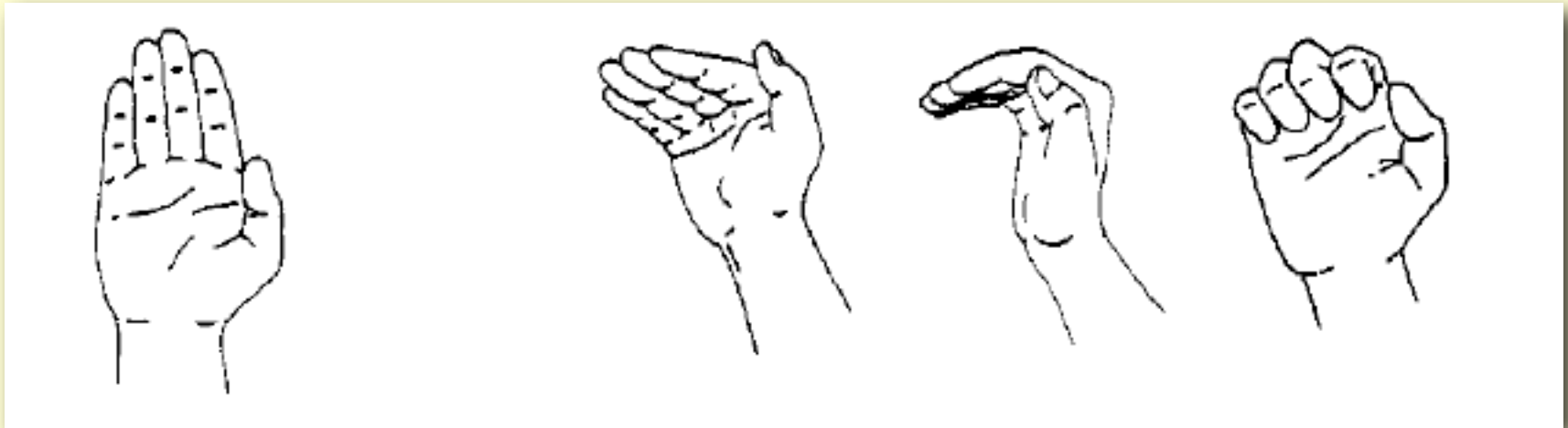
Bending

Width of Opening in Thumb Combinations
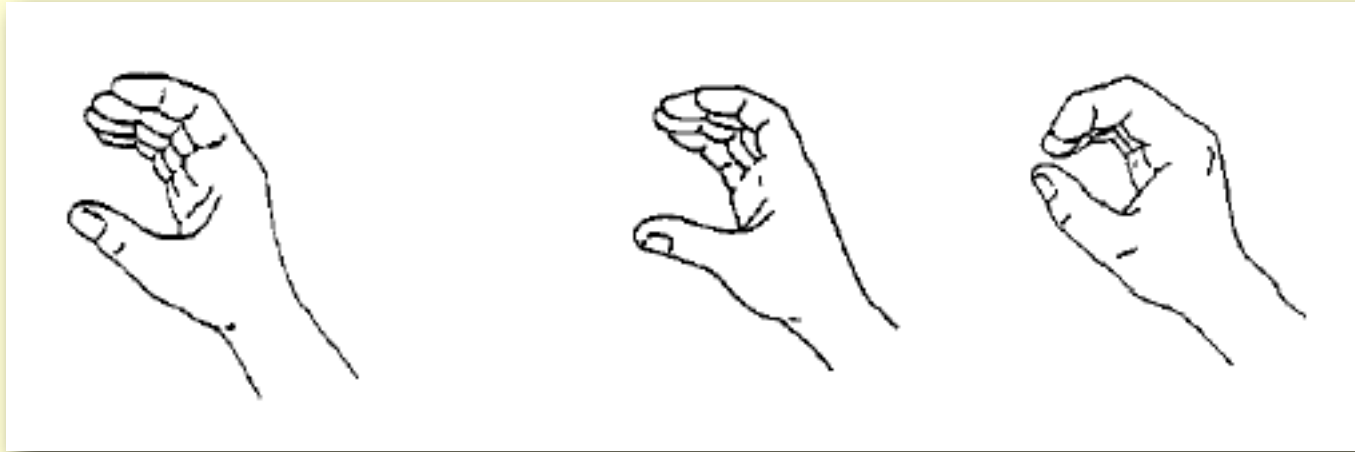
Thumb Combinations: Bending of Selected Fingers

Finger Specifications Override Defaults
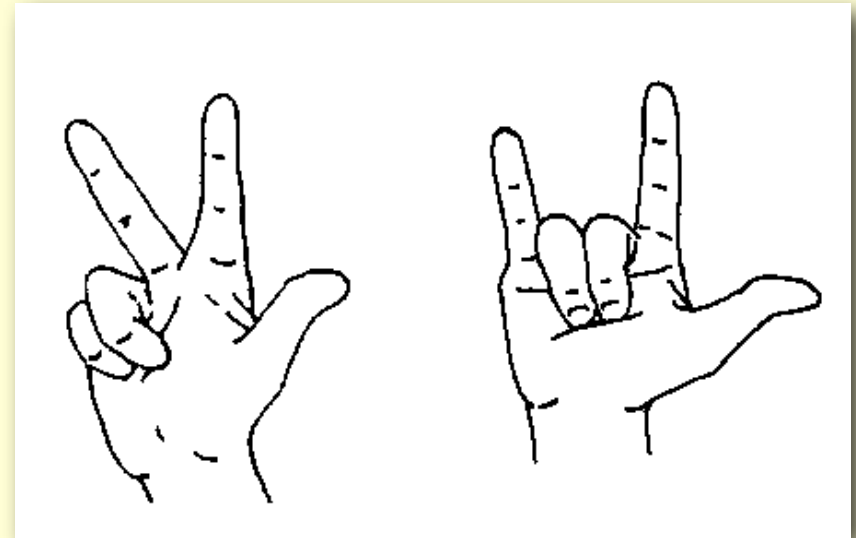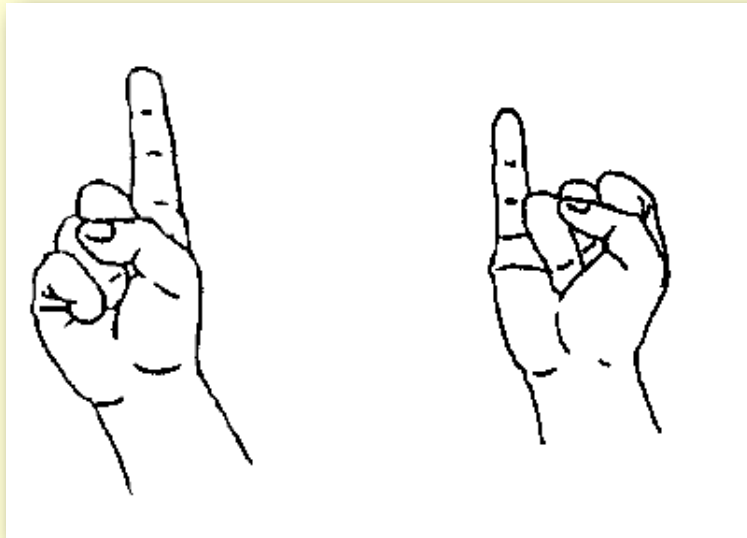
Fingers are numbered from 1–Thumb to 5–little finger/pinky

Finger Specifications Allow Individual Bending
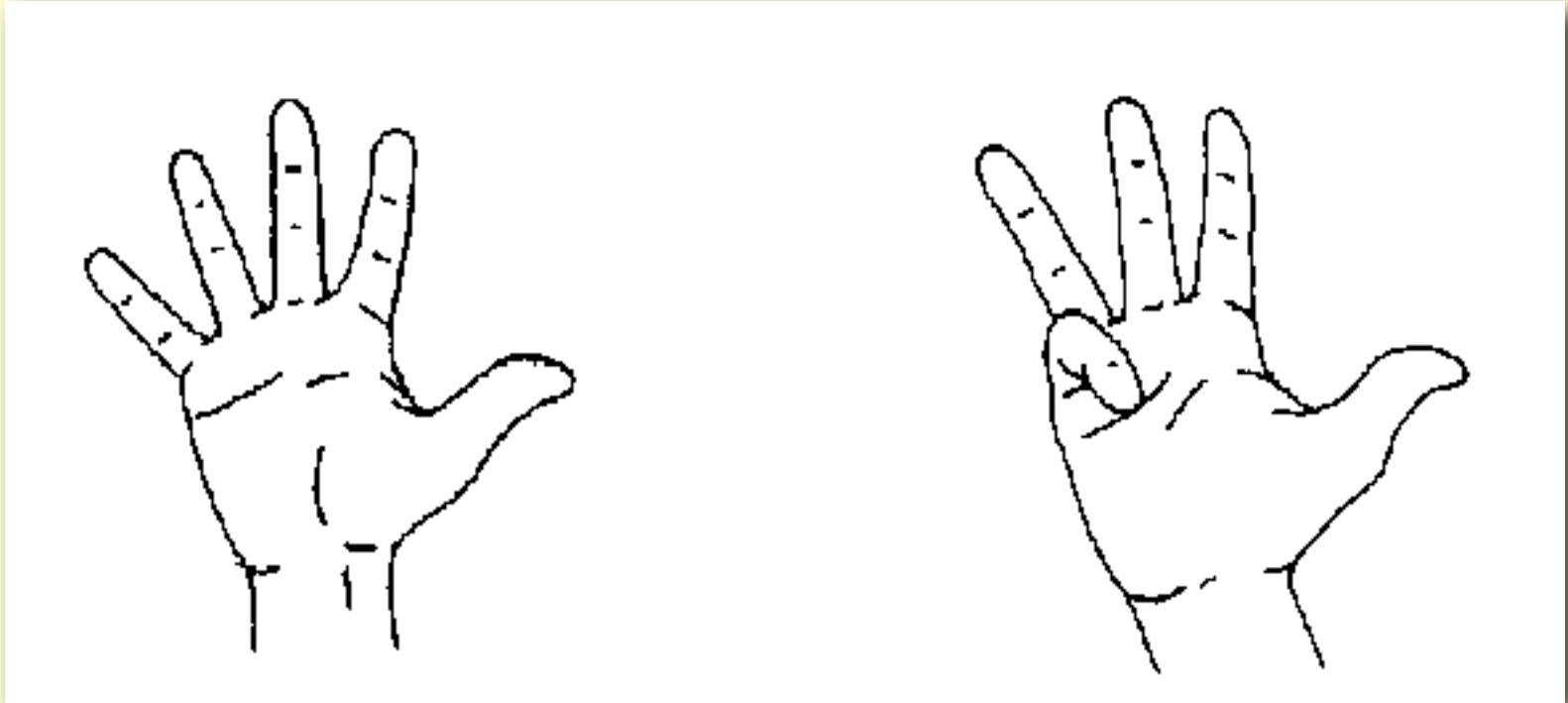
For this, additional bending operators exist:

■ Fist Position

■ Fist Position with unbent distal joint

■ $\widehat{\bigcirc}$ = $\widehat{\bigcirc}$
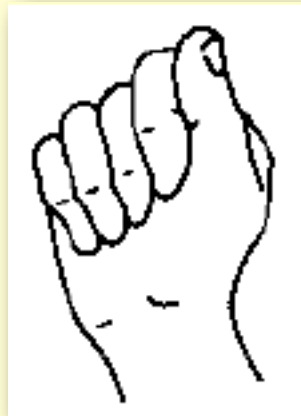
For thumb combinations, finger specifications specify the selected fingers
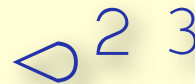
Handshapes: Finger Parts

- Crossing Fingers are notated as:
  - Lower Finger > Point of Contact > Upper Finger
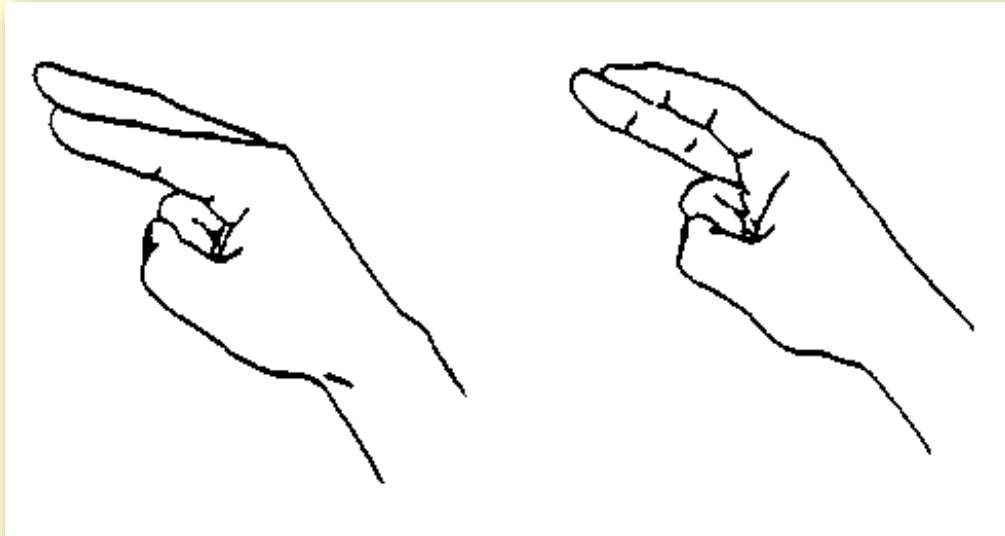
	Finger Tip
	Finger Nail
	Finger Pad
	Middle Joint
	Base of Finger
	Side of Finger

Thumb inbetween Fingers

$\bigcirc$ $\bigcirc^2 \backslash ^3$ $\bigcirc^3 \backslash ^4$ $\bigcirc^4 \backslash ^5$ $\bigcirc \backslash$

Hand Orientation

- 3D Info split into 2 parameters:
  - Extended Finger Direction
    - Defines the Orientation of the Hand Axis
  - Palm Orientation
    - For a given extended finger direction, defines palm orientation

Primary (Extended Finger) Directions
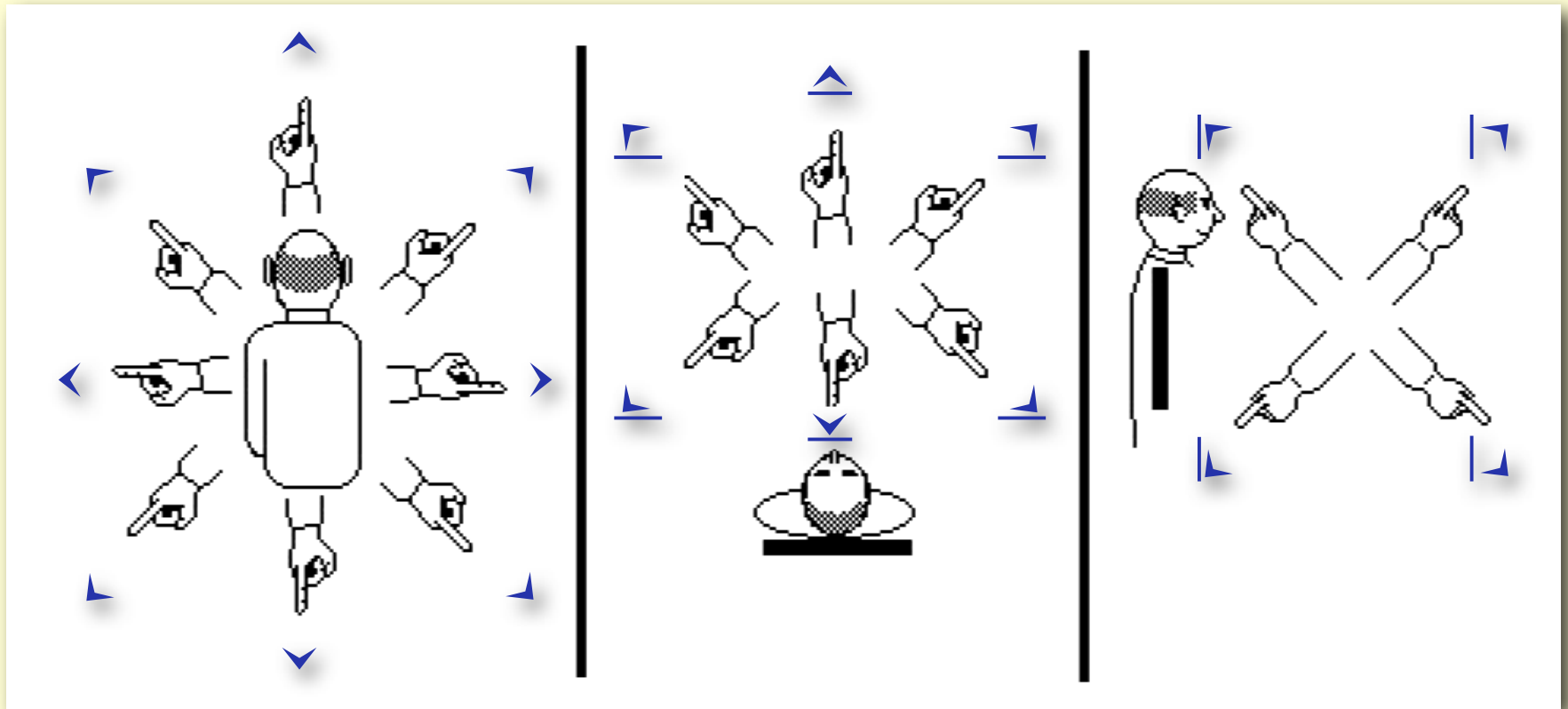
Secondary Directions

	away from the body, up and to the left
	away from the body, up and to the right
	away from the body, down and to the left
	away from the body, down and to the right
	towards the body, up and to the left
	towards the body, up and to the right
	towards the body, down and to the left
	towards the body, down and to the right

Palm Orientation
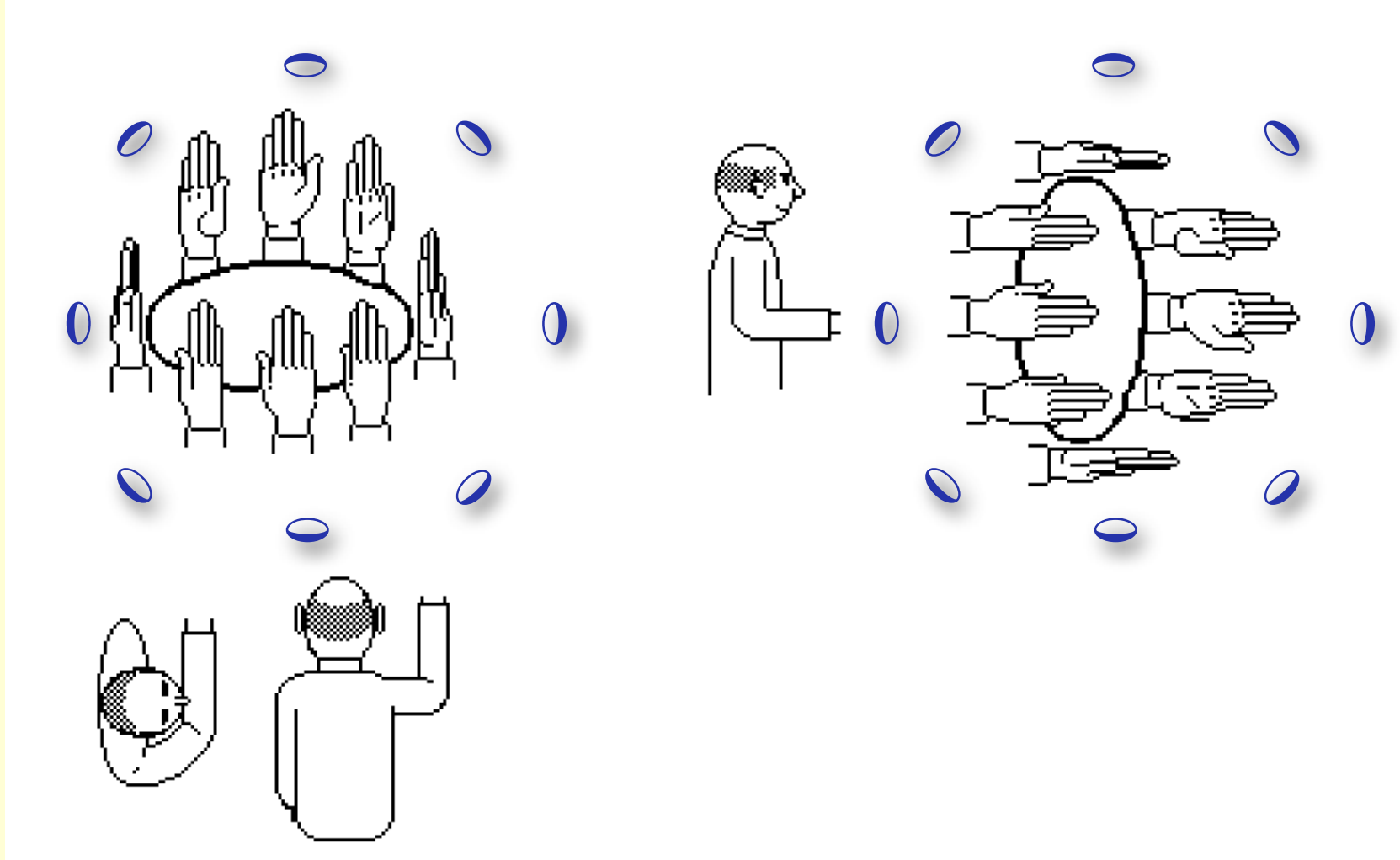
■ The black side of the symbol represents the palm!

Example

⬆	⬯	Palm up
	⬭	Palm right
◀	⬯	Palm up
	⬭	Palm away from body
▲	⬯	Palm towards body
	⬭	Palm right

Rule of Thumb for Palm Orientation

- If I can name a direction as downwards, upwards, leftwards or rightwards, then the corresponding symbol is to be used.

Locations I: Head

		left to	left side of	center of	right side	right to
◯	head	▫◯	◼◯	◯	◯◼	◯▫
◯̄	above the head	▫◯̄	◼◯̄	◯̄	◯̄◼	◯̄▫
⌐	forehead	▫⌐	◼⌐	⌐	⌐◼	⌐▫
⋏	nose	▫⋏	◼⋏	⋏	⋏◼	⋏▫
⋏̱	below nose		◼⋏̱	⋏̱	⋏̱◼	
👄	mouth *(see detail page)*	▫👄	◼👄	👄	👄◼	👄▫
◡	chin	▫◡	◼◡	◡	◡◼	◡▫
⊍	below chin		◼⊍	⊍	⊍◼	
)(	neck	▫)(	◼)(	)(	)(◼	)(▫

Dienstag, 30. Juni 2009

Locations II: Mouth

	left to	left side of	center of	right side of	right to
mouth	□	■		■	□
teeth		■		■	
upper lips		^ ■	^	^	
upper teeth row		^ ■	^	^	
upper surface of the tongue		^ ■	^	^	
blade of the tongue	□	■		■	□
lower surface of the tongue		˅ ■	˅	˅	
lower teeth row		˅ ■	˅	˅	
lower lips		˅ ■	˅	˅	

UHH

Locations III: Pairy head locations

		left to the left	left	between the two	right	right to the right
～	eye brows	□～	■～	～	～■	～□
◠̂◦◦	upper eye lids	□◠̂◦◦	■◠̂◦◦		◠̂◦◦■	
◦◦	eyes	□◦◦	■◦◦	◦◦	◦◦■	◦◦□
◡◦◦	lower eye lids		■◡◦◦		◡◦◦■	
𝄐	ears	□ 𝄐	■ 𝄐		𝄐 ■	𝄐 □
𝄑	earlobes	□𝄑	■𝄑		𝄑 ■	𝄑 □
}	cheeks	□ }	■ }		} ■	} □

Locations IV: Trunk

		left to the left	left	between the two	right	right to the right
	top of shoulder	□	■		■	□

		left to	left side of	center of	right side of	right to
	shoulder line	□	■		■	□
	breast line	□	■		■	□
	belly line	□	■		■	□
	abdominal line	□	■		■	□

Locations V: Upper arm (of the opposite side)

		front side	back side	right side	left side
	upper arm				
	elbow				

Locations VI: Lower arm

		right and left hand		right hand		left hand	
		handback side	palm side	ulnar side	radial side	ulnar side	radial side
	finger tip						
	fingernail, finger pad						
	middle joint of finger (PIP)						
	base joint of finger (MCP)						
	hand (metacarpals)			5l	1l	5l	1l
	ball of thumb						
	wrist joint (CMC)						
	forearm						

Locations VII: Lower extremities

Locations: If you ever need more detailed positions

- Combine two neighbouring regions:

- Resulting region slightly overlaps with constituents

Locations: Distance from the Body (notated after the location symbol)
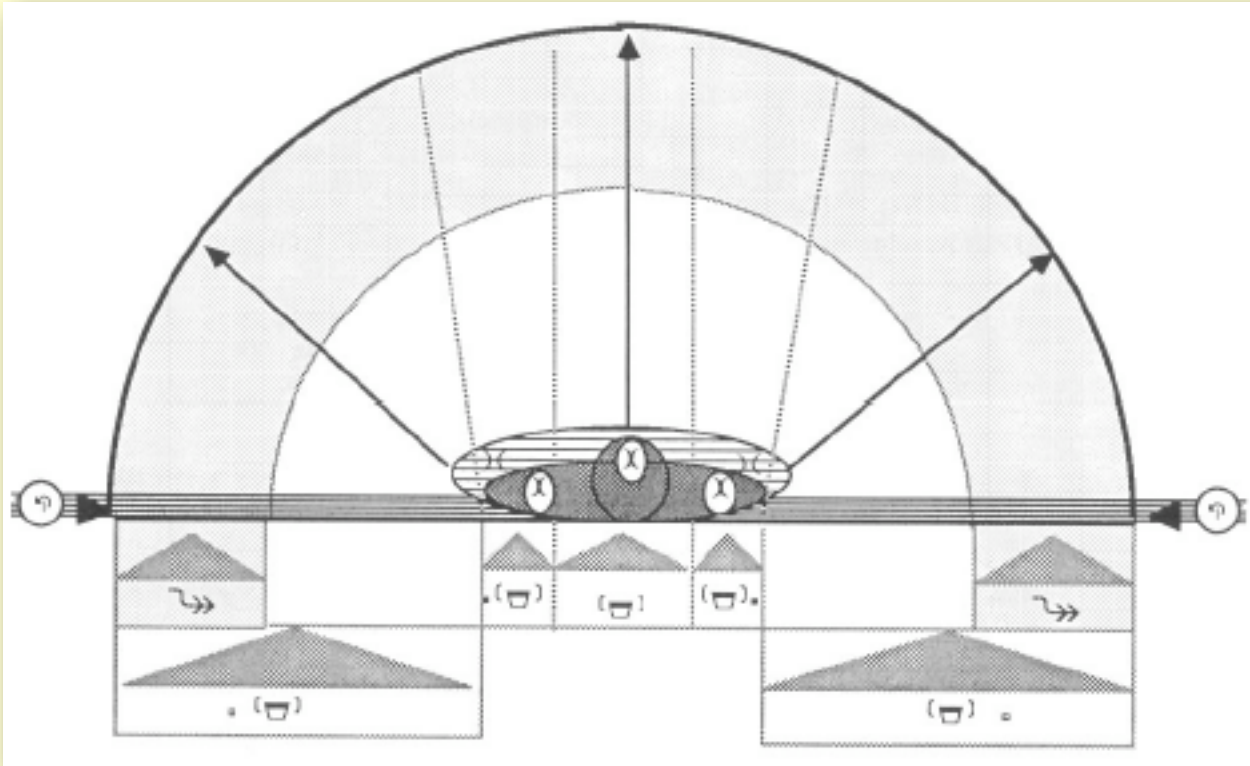
↰	behind the body
)(	contact with body part
)(	close to body part
	standard distance
↝	maximum distance (extended arm)

- Standard distance depends on size of region, the smaller the region, the closer standard distance is

Movements I

- Absolute Movements (with target)
  - Direction and Size are redundant
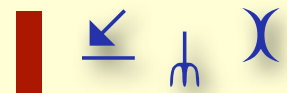
- Relative Movements
  - Direction and Size determine end point of the movement

Movements II

- Path Movements (optionally with target)
  - Straight Movements
  - Curved Movements
  - Wavy and Zigzag Line Movements
  - Circular Movements and derived forms
- In–place Movements
  - Replacement of handshape and/or orientation
  - Fingerplay
  - Wrist/forearm movements
- Nonmanual Movements
  - Head Movements etc.

Straight Movements
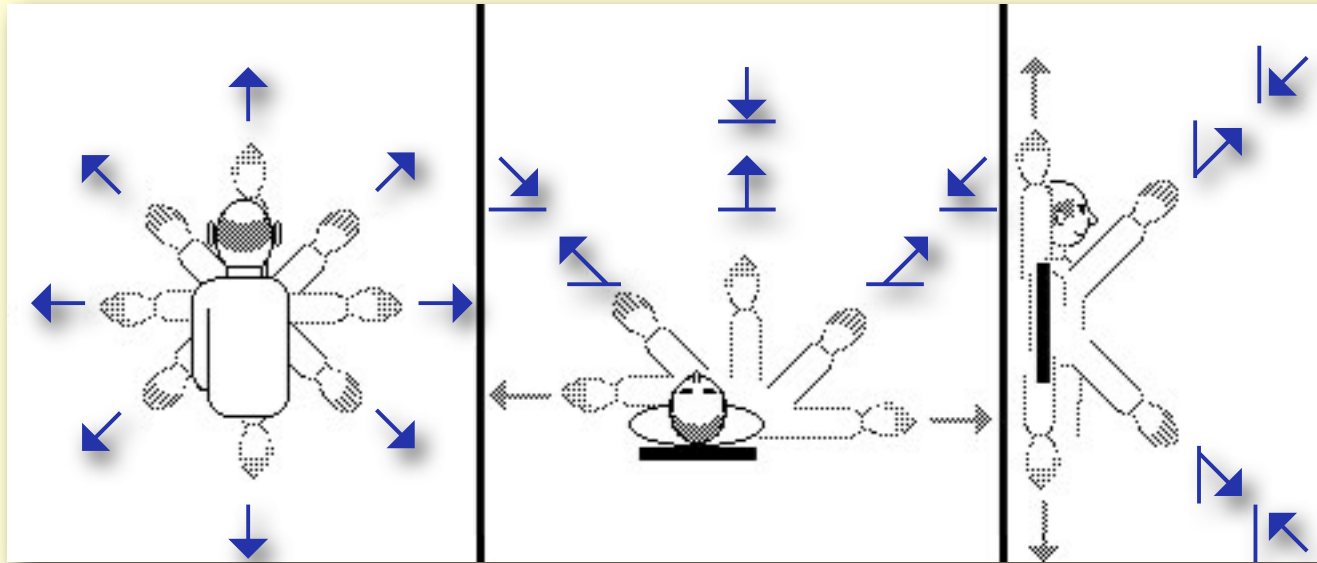
- Schema identical with that for extended finger direction
- Size specifiers: ⟶ small ⟶ standard ⟶ large

Curved Movements
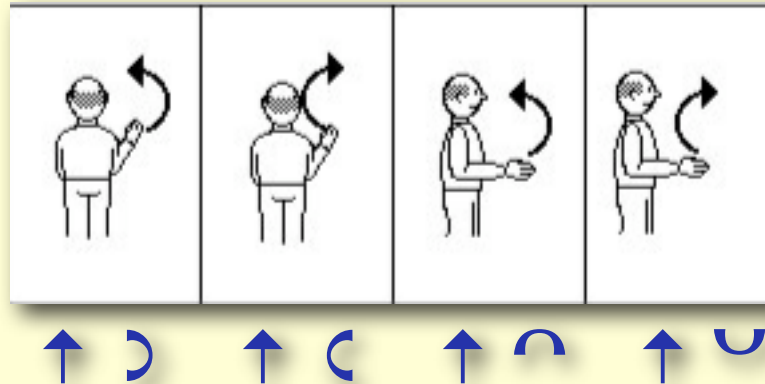
- Described by the movement arrow connecting start and end point (the chord) plus the direction of the arc

- Size specifiers under the movement arrow determine the length of the movement

- Size specifiers under the arc determine the amount of curvature

Mnemonic: Direction of the Curves

		⊃ rightw.	⊂ leftw.	∩ upw.	∪ downw.
↘ ↑ ↗ ↙ ↓ ↘ ↖ ↙ ↘		rightw.	leftw.	upw.	downw.
↑ ↓		rightw.	leftw.	away	towards
← ↖ ↗ ↘ ↙		away	towards	upw.	downw.

- If you can name the arc direction as rightwards, leftwards, upwards, downwards, then use the corresponding symbol.

- In the other cases, interpret the symbol as if it had a straight line added.

Wavy and Zigzag Movements

- Described by the movement arrow connecting start and end point (the chord) plus manner and direction of the oscillation

- Size specifiers under the movement arrow determine the length of the movement

- Size specifiers under the oscillation symbol determine the size of the oscillation

  - Zigzag line to the right, zags are pointing downwards and upwards, their size increases over time
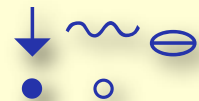
  - Long way line downwards, small bows to the left and right

Circular Movements

- Main symbol determines orientation in space and movement direction ↻ ↺ ↻ ↺

- Size specifier under the circle symbol determines the circle radius

- Optional specification of a starting point

- If not whole-numbered turns, specify end point as well: (a 270° turn)

- Spiral movements:

- Elliptic shape movements:

Circular Movement Symbols I

- Same planes model as for straight movement symbols

- ↺ ↻ ↻ ↺ ↻ ↺
- ↑ ↓ ← → ⊥ ⊥

- The arrows represent the direction of the normal vector to the circle described by the symbol above.

UH

Circular Movement Symbols II

- Here are the symbols for the diagonals:
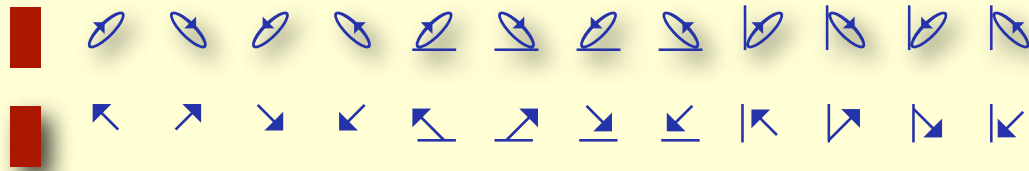
- (Once again, the arrows represent the direction of the normal vector to the circle described by the symbol above).

- The circle is drawn from that perspective where it is NOT visible as a circle, but as a back and fro movement.

- The elliptic form of the glyph can be understood by moving the perspective a bit to the right, upwards, or backwards.

- The arrow is positioned on that part of the circle that is closer to the reader.

U H

Elliptic Shape Movements

■ ↻⊖ : Elliptic shape (read football) in the plane in front of the signer, the football lying on its side

■ Symbols: ⬭⬭⊖⬭

■ ⬭ : The longer axis goes from top to bottom (or body to front in the case of circle symbols in the horizontal plane.

In-place Movement

- Replacement of handshape and/or orientation

  ꤬ ... ↦ ꤬   ⌢⊙ ... ↦⊙

  - but cf. relative orientation

- Fingerplay in open handshapes ꤅ ... ꤅

- Finger crumbling in closed handshapes ⬯...꤅

- Wrist and forearm movements
  - wrist nodding, indefinite number of repetitions
    - up–down (WINKEN/WAVE) ↕
    - left–right (WER/WHO) ↔
  - Forearm rotation, indefinite number of repetitions
    - turns (SPIEGEL/MIRROR) ᴪ
  - Single rotation in wrist joint (RÜHREN/STIR)
    - to the right ↻
    - to the left ↺
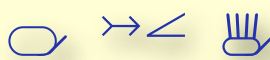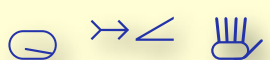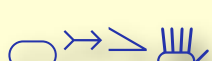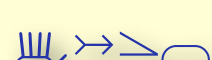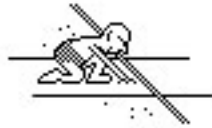
Handshape Changes: Rolling Fingers in or out one after the other

	Index finger extends first (2345)
	Thumb extends first (12345)
	Index finger extends first, thumb last (23451)
	Little finger extends first (54321)
	Little finger bends first (54321)
	Thumb bends first (12345)

UH

Movement Modality

(image)	fast	✳	(image)	stoppage at start	⌐•
(image)	slow	—	(image)	sudden stop	‖
(image)	tense	✦			

⬇ ✳

Fast downward movement

Brushing & Bouncing Movement

■ Brushing Movement: Contact in the middle of a path

          KAUFEN (BUY)

■ Bouncing Movement

          Movement to the palm and small backwards movement (bounce)

          Movement in signing space with sudden stop and small backwards movement (bounce)

Repetitions

- $+$ repeated once
- $++$ repeated twice
- $\#$ repeated a couple of times
- $\nrightarrow$ repeated once, 2nd iteration starting where first ended
- $\nrightarrow\nrightarrow$ repeated a couple of times, each iteration starting where previous ended
- $\nleftrightarrow$ repeated in reversed direction
- $\sim$ hands flip roles in 2nd iteration

Combining Actions

- Sequential Actions
  - Action1 Action2
  - ↑ → ↓ ←   (↑ → ↓ ←)+

- Cotemporal Actions
  - [Action1 Action2]
  - [↥ ↻ ⊞]

- Fusion (fused sequential)
  - < Action1 Action2 >
  - ⟨ ← ∪ → ∩ → ∪ ⟩
       ∘

Two-handed Movements

- Two hands in motion: symmetry applies
  - Dominant (right) hand to be described
  - Symmetry operator determines copy to nondom hand
  - Exceptions can be described if necessary
  - Symmetry operators inventory:
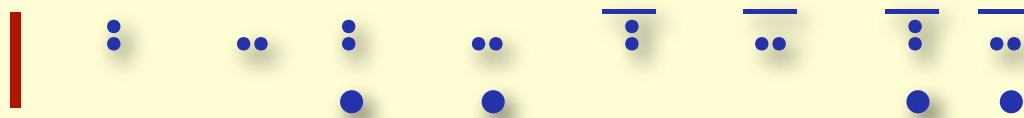
Symmetries

- Palm orientations always laterally equal (i.e. e.g. thumbs pointing to e.o.)

- Extended finger directions: Left and right flipped by $\cdot\cdot$ etc., otherwise they remain the same.

- Movements and locations see next slides

Symmetries: Movement

symbol flips the marked directions:	left/right	up/down	away from / towards body
(symbol)			
(symbol)	✔		
(symbol)		✔	
(symbol)	✔	✔	
(symbol)			✔
(symbol)	✔		✔
(symbol)		✔	✔
(symbol)	✔	✔	✔

Two-handed Locations

- Same notation as in the one–handed case
  - Hands side by side (with a certain distance)
  - Nondom hand on the opposite side of the body
- Hands tied together
  - Hands side by side contacting each other, without contact to the body
  - Same as before, but with contact to the body
- Separate notations
  - Nondom with reference to the body, dom positioned relative to nondom
- Contact specified in more detail
  - This form also allows one hand on top of the other

Contacts in Hand Configurations

- In addition to)()(the following symbols are available:
  - ◊ Interlocking
  - × Crossing

Exceptions from Symmetry Rules

- can be described by means of [dominant ≠ nondominant]:
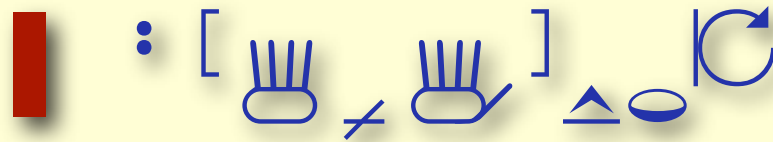
Mixed Case: Both hands involved, only one in movement

- With symmetry symbol, but movement description like $[..._{\neq} \oslash]$

- No symmetry symbol, but $[..._{\neq}...]$ for handshape/direction (and optionally location), e.g.

  - ⬡$[_{\langle 0 \neq \rangle}]$ ⬮ ↙ ⌣

- Permutation of roles of dom/nondom
  - with symmetry symbol: $[\oslash _{\neq}...]$
  - without: ⌀ instead of symmetry symbol

"Sign Sentences" in HamNoSys

- HamNoSys primarily describes single signs.
- Extension to sentences limited to
  - sequential execution of signs
  - sentence boundary markers

- ≠ sequential execution (fusion, compound)
- ,   sequential execution
- .   sentence boundary, neutral facial expression
- ?! sentence boundary, with some facial expression
- ⊔ place holder for sign-level facial expression

Relative Orientation

■ Shorter and more natural notation

■ BALL (BALL)

■ HAUS (HOUSE)

■ KASTEN (BOX)

■ WELLEN (WAVES)

Spatial co-reference

- First use of a location can be labelled: ⊡

- Later reference to that location: ①

- Symbols: ⊡②③④⑤①②③④⑤

- Different labels just for convenience, not semantic difference

- Example:

Left & right vs. ipsi- & contralateral

▌ Standard HamNoSys describe right–handed signing, all left/right directions are to be mirrored for left–handed signing.

▌ Exception: Strings marked with Я.

Underspecification

- ⊻ = {⊻ | ⊻ | ⊻ | ⊻ | ⊻ | etc.}

- ⊘ relaxed handshape or copy of dominant handshape

- ⊙ = {⊙ | ⊙ | ⊙}
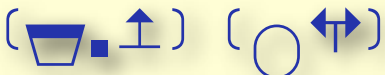
- ⊽ = {⊽ | ⊽⧵⊽ | ⊽⧵⊽ | etc.}

- ◁⊳○((← →)╫)╫
  - small repeated left–right movement, repeatedly executed somewhere in the head region

Nonmanuals in HamNoSys

- For every movement, the hand being the default articulator can be substituted by other body parts:
- This does not allow, however, the notation of small facial movements:
  - No symbols for opening and closing
  - Not all parts of the face are available as symbols
- Mouth pictures cannot be captured in enough detail with HamNoSys

Instead: Multi-Tier Representation

- HamNoSys as the master tier
- Other tiers are synchronised to the manual part tier:
  - Shoulders
  - Body
  - Head
  - Gaze
  - Facial Expression
    - Eye Brows
    - Eye Lids
    - Nose
  - Mouth
    - Mouth Picture (derived from spoken language)
    - Mouth Gesture