Phonology 2013 10 November 2013

WHAT HANDSHAPE TELLS US ABOUT ACTIVE VERSUS INACTIVE ARTICULATORS

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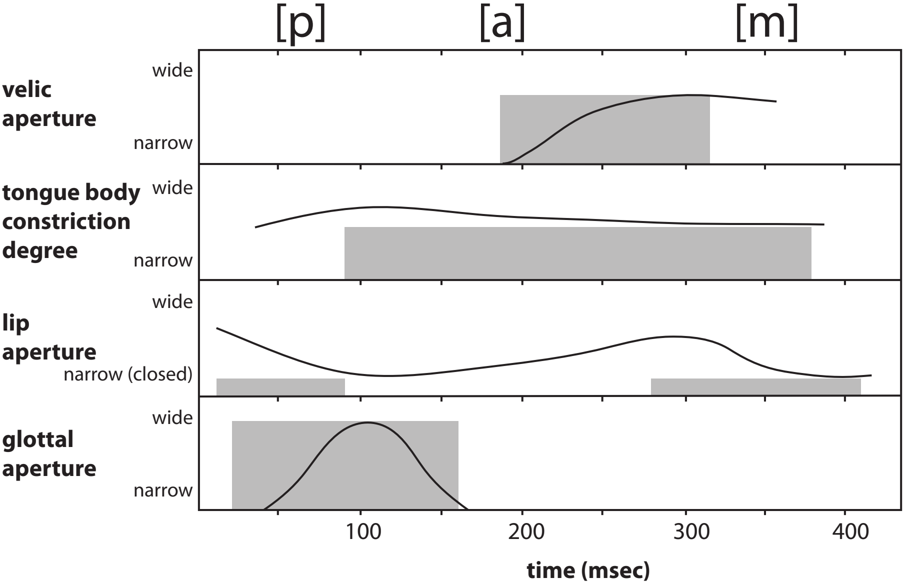
Goals of this talk

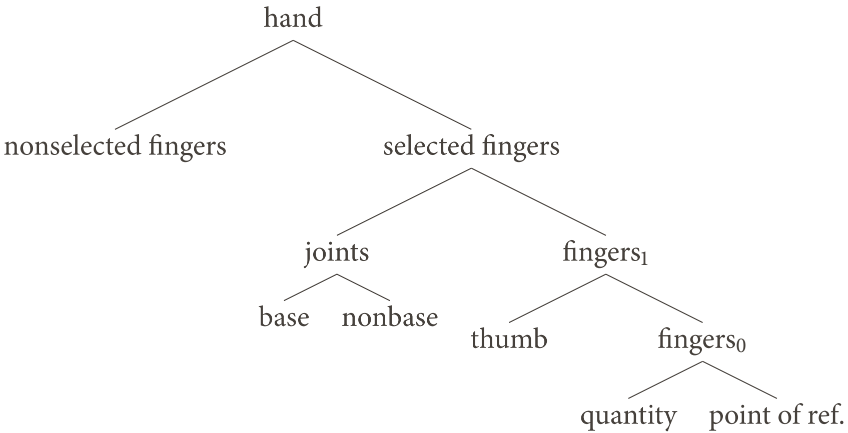
1. Translate models of spoken language articulatory phonology to handshape
2. Provide an explicit method of phonetic implementation for handshape
3. Use this model to make predictions about variation in handshape



adapted from (Browman and Goldstein, 1992, pp28)

Sign language phonology

Handshape portion from the Prosodic Model



(Brentari, 1998)

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- are described as the most salient fingers for a given handshape,
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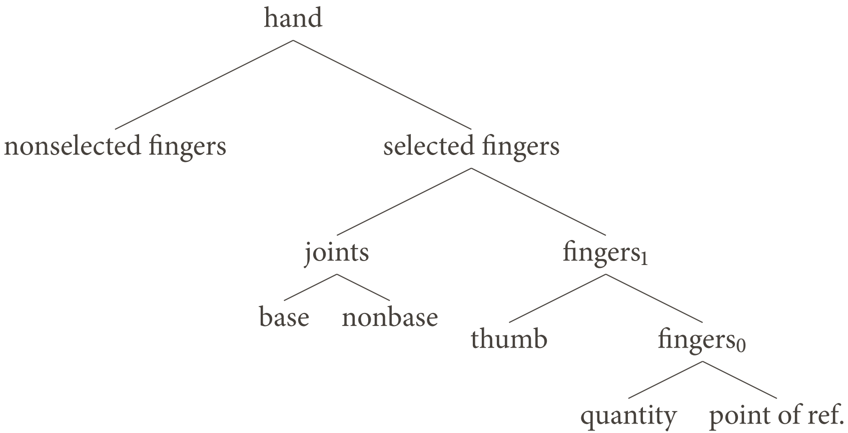
There is independent evidence for their existence:

- restrictions on handshapes in signs,
- selected fingers contact the body,
- selected fingers are preserved in compounds.

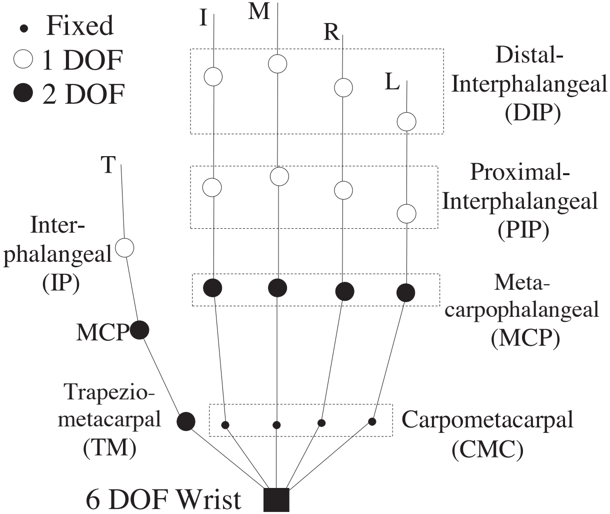
Handshape portion from the Prosodic Model



(Brentari, 1998)

Handshape tract variables

Degrees of freedom



Erol et al. (2005)

The articulatory model of handshape

group	joint	tract variable	values
selected fingers	MCP	SF-MCP	-15–90°
	PIP	SF-PIP	0–90°
	MCP	SF-ABDUCTION	[±ABDUCTED]

Broadly compatible with phonological models Sandler (1989); Brentari (1998) among others; as well as phonetic models like Johnson and Liddell (2011a,b); Liddell and Johnson (2011a,b).

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nonselected fingers	all	NSF	[±FLEXED]

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Predictions

General hypotheses

1. Because gestures are dynamic, signing does not consist of static, sequential handshapes, but rather articulator gestures which blend into each other.

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1. Because gestures are dynamic, signing does not consist of static, sequential handshapes, but rather articulator gestures which blend into each other.
2. The hand configuration of a specific segment will vary in predictable ways based on the surrounding context.

Specific hypotheses

1. The nonselected (nonactive) fingers are more frequently the targets of coarticulatory pressure (vs. selected (active) fingers).

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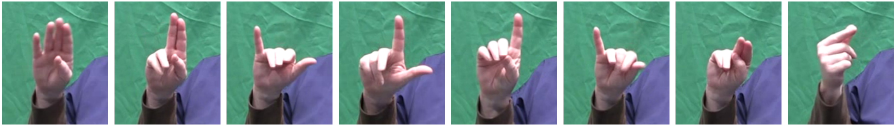
1. The nonselected (nonactive) fingers are more frequently the targets of coarticulatory pressure (vs. selected (active) fingers).
2. The selected fingers are the sources of coarticulatory pressure.

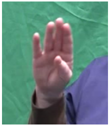
Case study: B-U-I-L-D-I-N-G

B-U-I-L-D-I-N-G; half speed

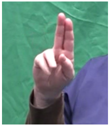


-B- -U- -I- *-L- *-D- -I- -N- -G-

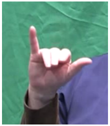
B-U-I-L-D-I-N-G; half speed



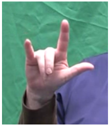
-B-



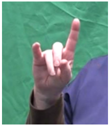
-U-



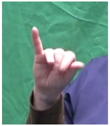
-I-



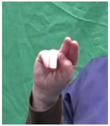
-L-



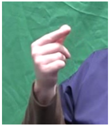
-D-



-I-

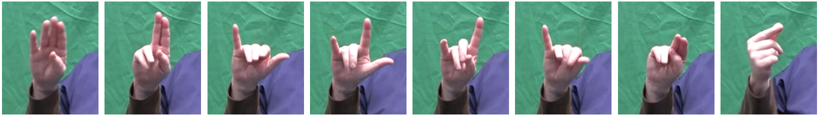


-N-

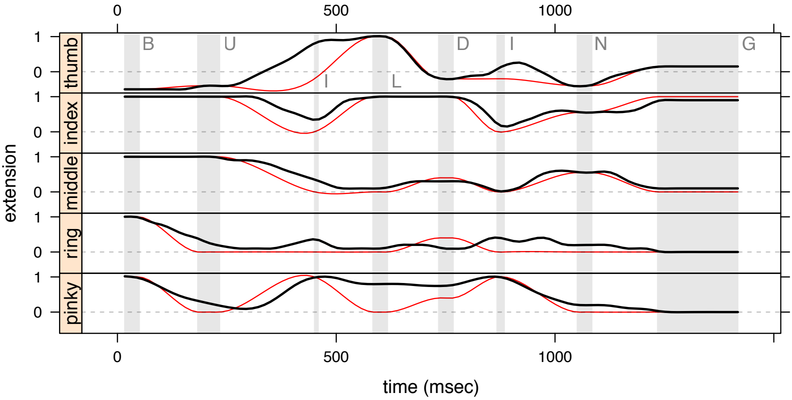


-G-

Gestural score for B-U-I-L-D-I-N-G



-B- -U- -I- -L- -D- -I- -N- -G-



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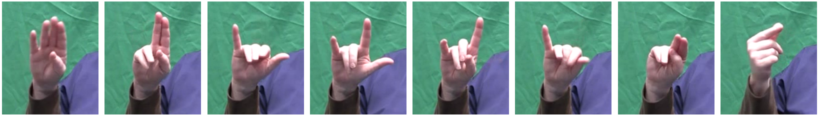
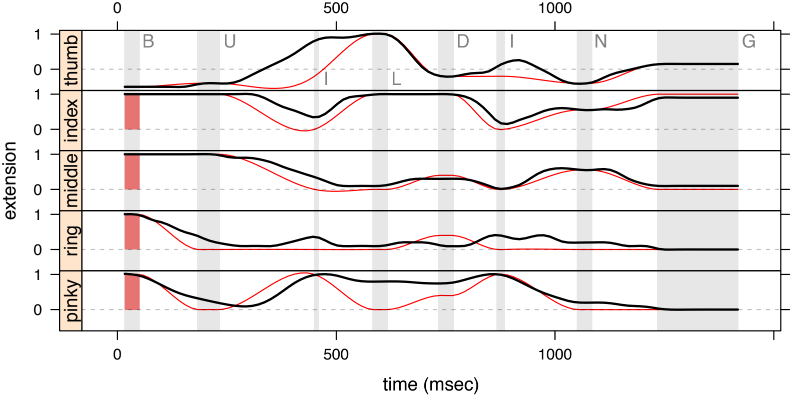


-B- -U- -I- -L- -D- -I- -N- -G-



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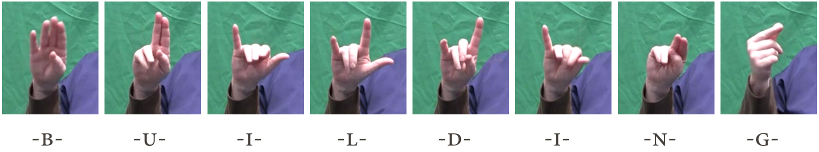
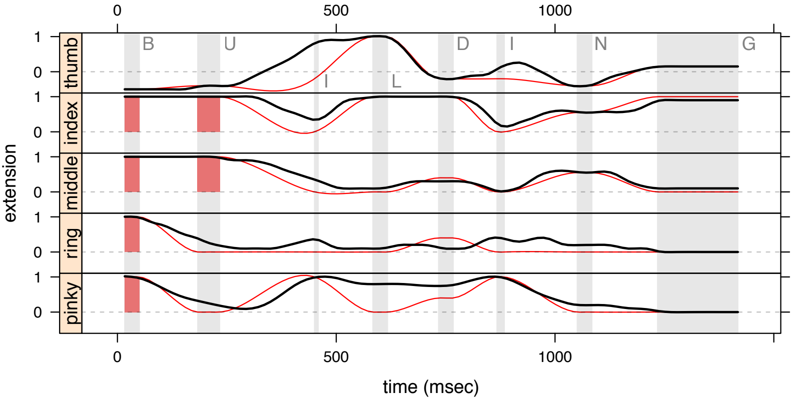
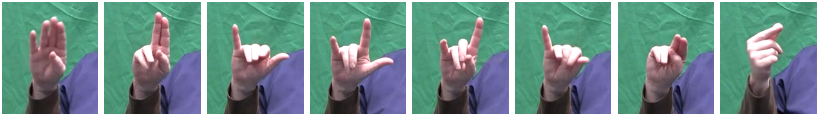
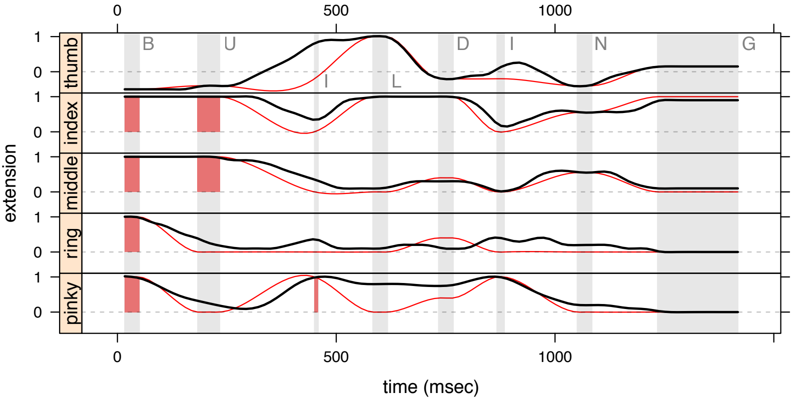




Gestural score for B-U-I-L-D-I-N-G



-B- -U- -I- -L- -D- -I- -N- -G-



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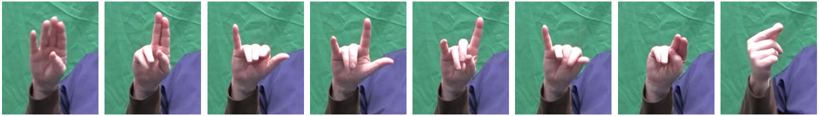

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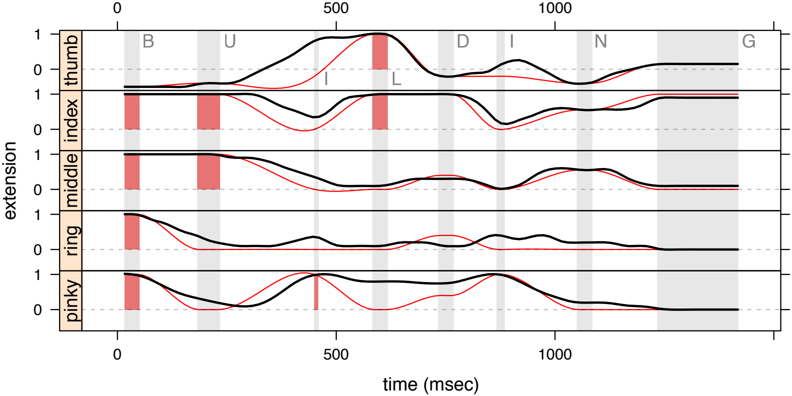

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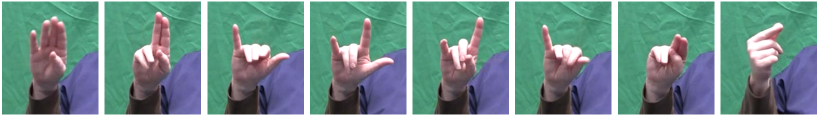

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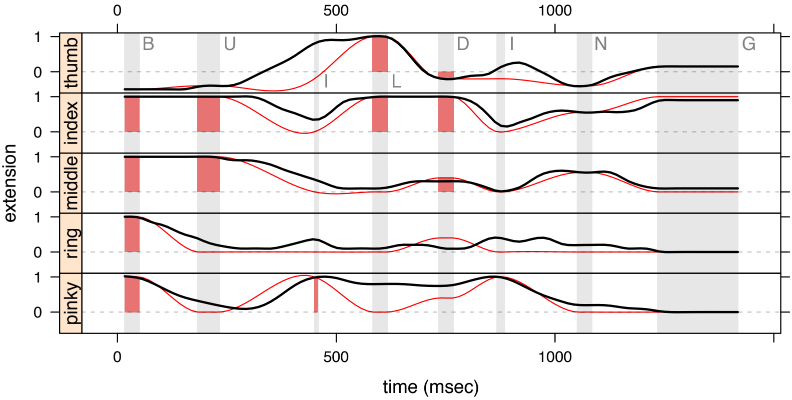

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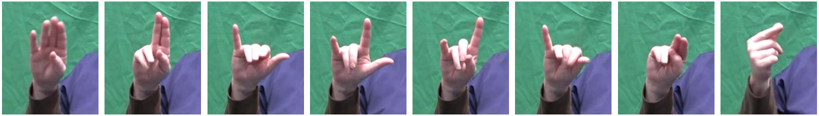

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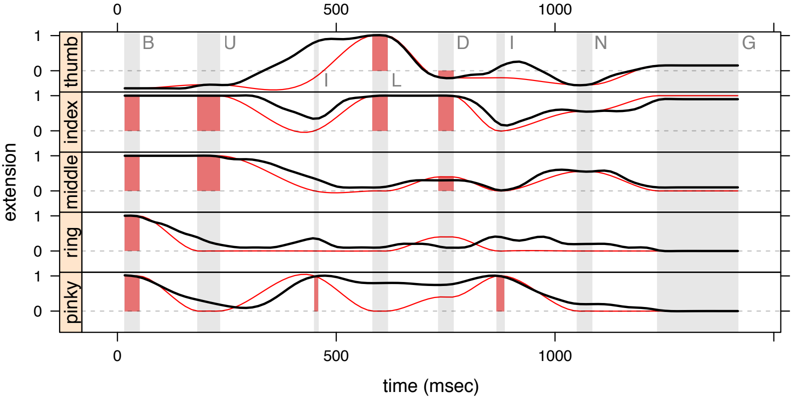

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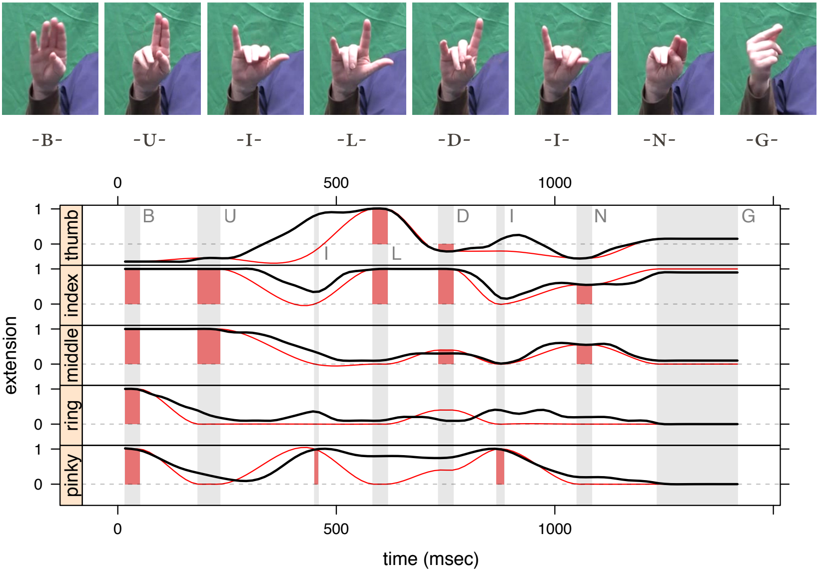

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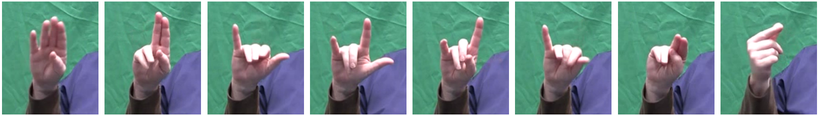

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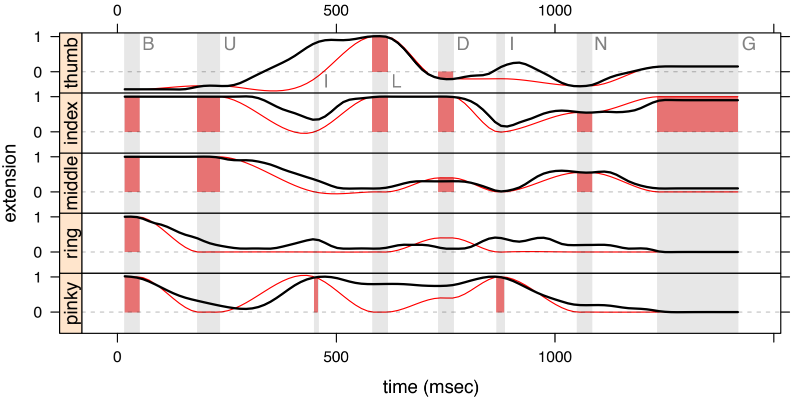

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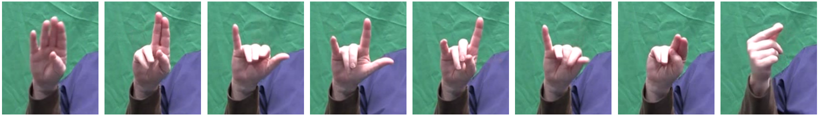

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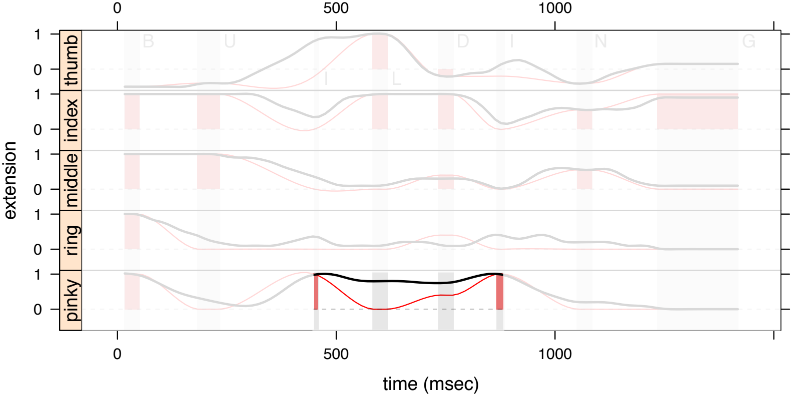


Pinky extension coarticulation

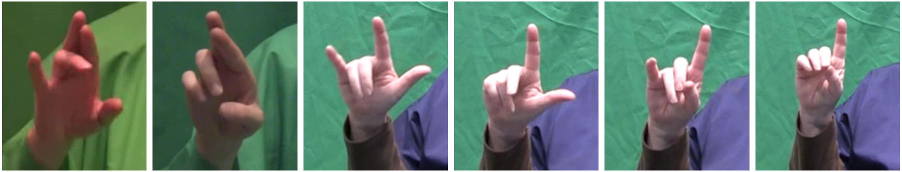
Data collection

- 4 native signers, 1 early learner (4 coded so far) produced
- 600 words
- repeating each word twice
- being recorded by 2 or 3 video cameras
- recording at 60 FPS
- for a total of 21,453 letters

Pinky extension

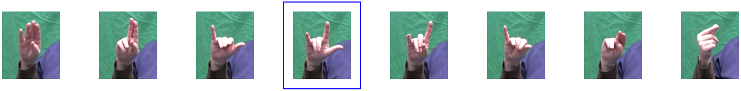
A still image of each letter was annotated for pinky extension, defined as:

- The tip of the pinky was above the plane perpendicular to the palmar plane, at the base of the pinky finger (the MCP joint).
- The proximal interphalangeal joint (PIP) was more than half extended.

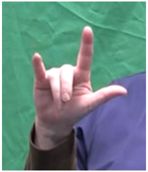


-R- [+ext] -R- [−ext] -L- [+ext] -L- [−ext] -D- [+ext] -D- [−ext]

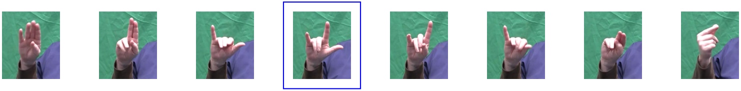
What affects the -L- handshape?



-B- -U- -I- -L- -D- -I- -N- -G-



What affects the -L- handshape?



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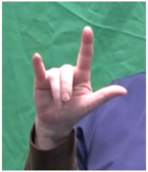


↑

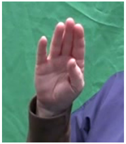
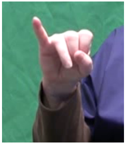
current handshape

-B-, -C-, -F-, -I-, -J-, or -Y-;

-A-, -S-, -E-, or -O-; other

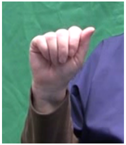
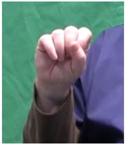
What affects the -L- handshape?

current handshape groups

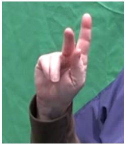
Extended (and selected) pinky:

-B-, -C-, -F-, -I-, -J-, or -Y-

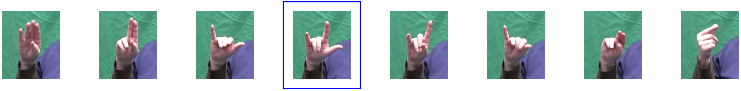
Flexed and selected pinky:

-A-, -S-, -E-, or -O-



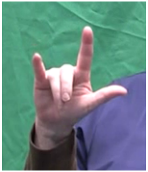

other

What affects the -L- handshape?



-B- -U- -I- -L- -D- -I- -N- -G-

word type
name; noun;
non-English



current handshape
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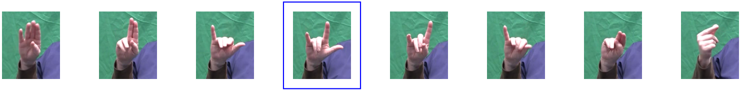


-B- -U- -I- -L- -D- -I- -N- -G-

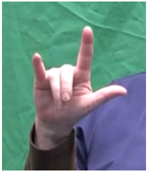
local transition time

zscore of log(time)

word type

name; noun;

non-English



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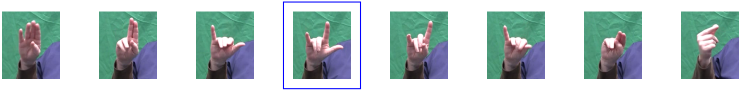

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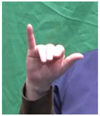


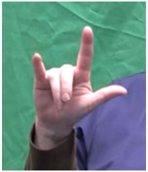
previous handshape

-B-, -C-, or -F-;

-I-, -J-, or -Y-;

other;

word boundary



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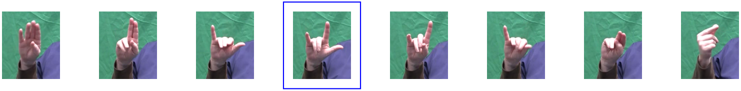

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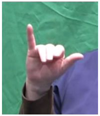

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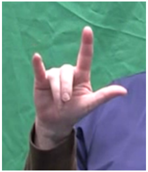

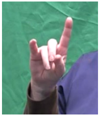

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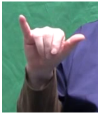
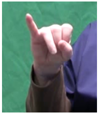
current handshape

-B-, -C-, -F-, -I-, -J-, or -Y-;

-A-, -S-, -E-, or -O-; other

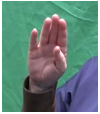
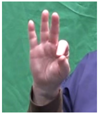
What affects the -L- handshape?

previous/following handshape groups

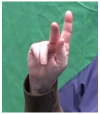
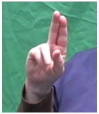
Extended pinky (alone):

-I-, -J-, or -Y-

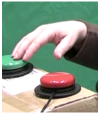
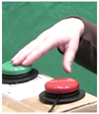



Extended pinky (with other fingers):

-B-, -C-, or -F-

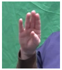
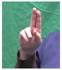
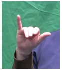



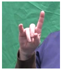
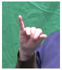
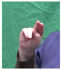
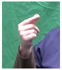
other

word boundary

What affects the -L- handshape?

-B- -U- -I- -L- -D- -I- -N- -G-

local transition time

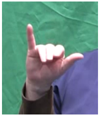
zscore of log(time)

interaction → ← *interaction*

word type

name; noun;

non-English



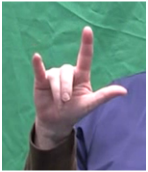
previous handshape

-B-, -C-, or -F-;

-I-, -J-, or -Y-;

other;

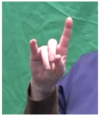
word boundary



current handshape

-B-, -C-, -F-, -I-, -J-, or -Y-;

-A-, -S-, -E-, or -O-; other



following handshape

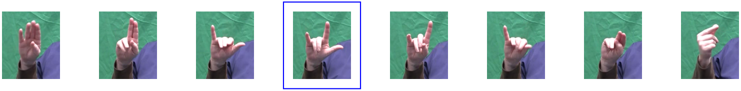
-B-, -C-, or -F-;

-I-, -J-, or -Y-;

other;

word boundary

What affects the -L- handshape?

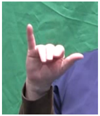


-B- -U- -I- -L- -D- -I- -N- -G-

local transition time
zscore of log(time)

interaction *interaction*

word type
name; noun;
non-English



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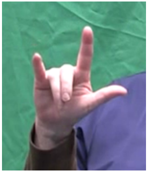
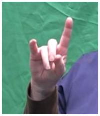
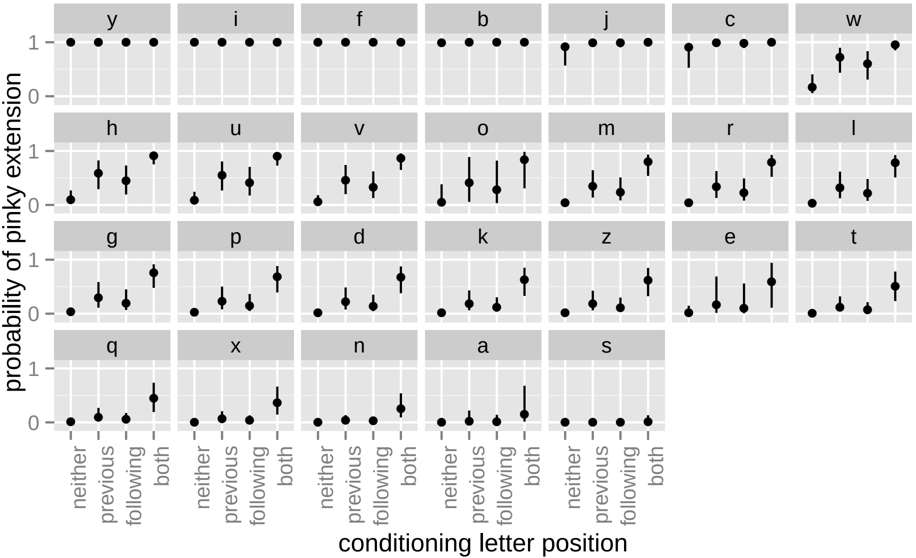


current handshape
-B-, -C-, -F-, -I-, -J-, or -Y-;
-A-, -S-, -E-, or -O-; other

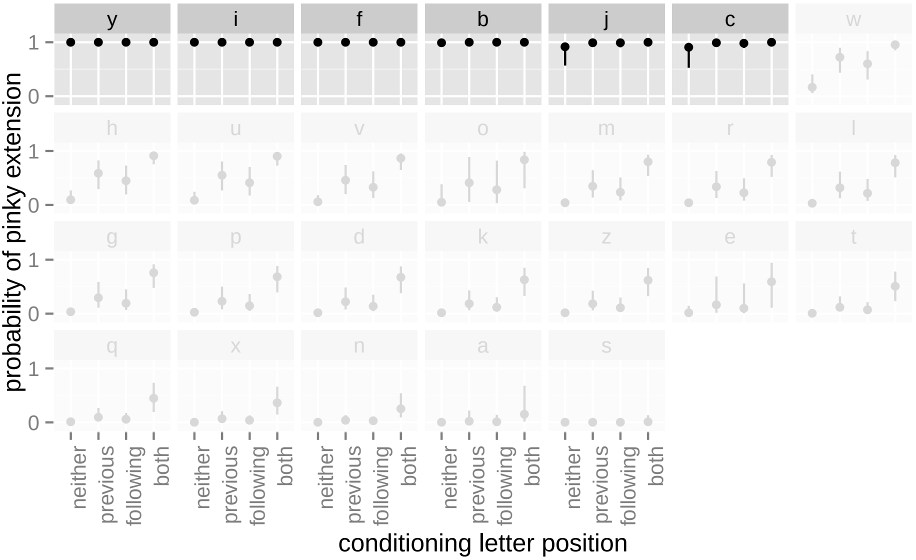


following handshape
-B-, -C-, or -F-;
-I-, -J-, or -Y-;
other;
word boundary

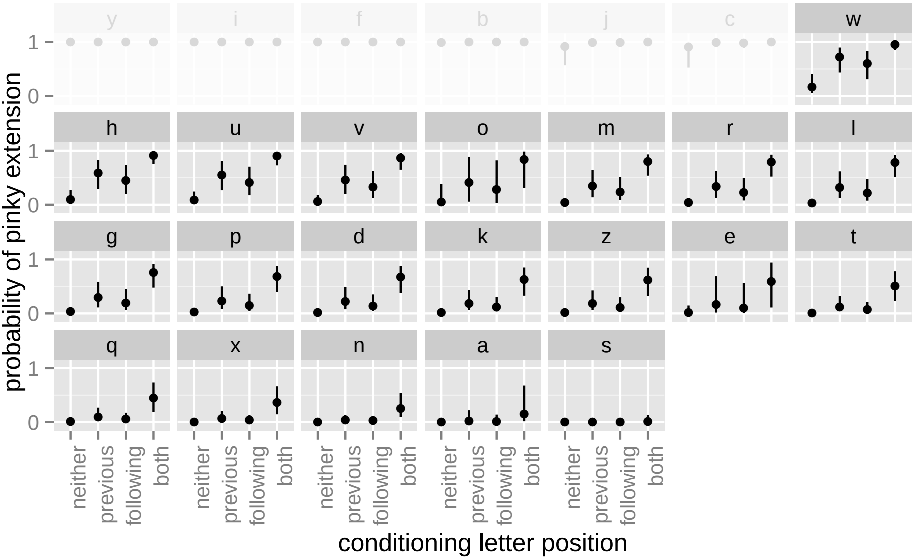
Model predictions around -I-, -J-, or -Y-



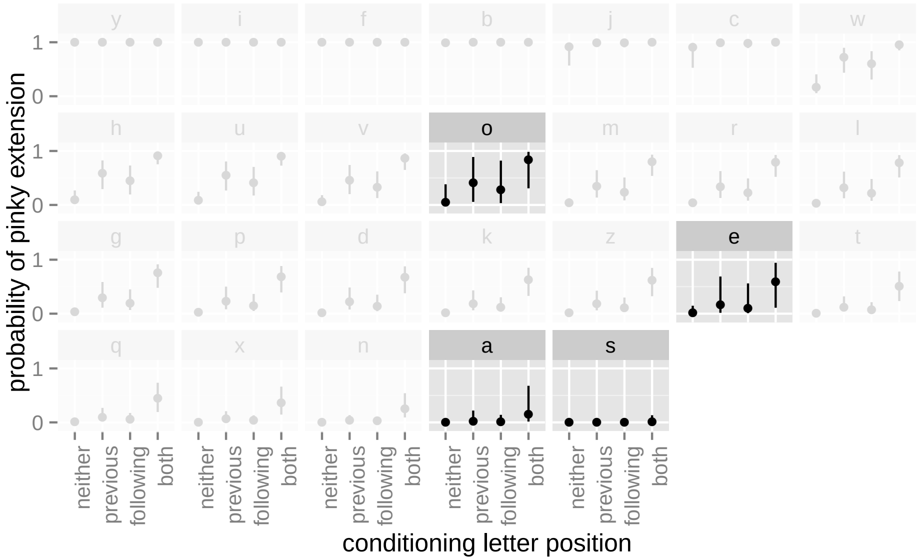
Model predictions around -I-, -J-, or -Y-



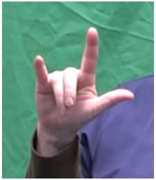
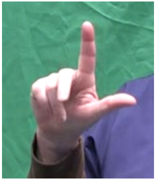
Model predictions around -I-, -J-, or -Y-



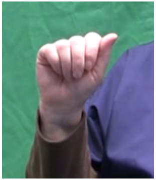
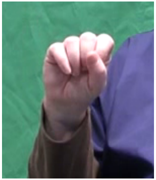
Model predictions around -I-, -J-, or -Y-



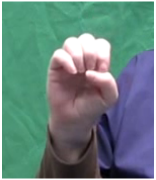
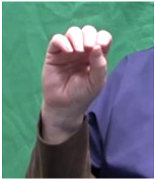
What's special about -A-, -S-, -E-, and -O-?

Flexed and nonselected pinky:
-L- with and without pinky extension

Flexed and selected pinky:
-A- and -S- have nearly no pinky extension

Flexed and selected pinky:
-E- and -O- both are close to the edge of our coding scheme for pinky extension.

Conclusions

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    3.1 The nonselected (nonactive) fingers are more frequently the targets of coarticulatory pressure (vs. selected (active) fingers).

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   3.1 The nonselected (nonactive) fingers are more frequently the targets of coarticulatory pressure (vs. selected (active) fingers).
   3.2 The selected fingers are the sources of coarticulatory pressure.

I must also acknowledge the contributions of many who contributed in ways big and small:

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Andy Gabel, Rita Mowl, Drucilla Ronchen, and Robin Shay

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