

Pinky Extension Coarticulation in ASL Fingerspelling

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Background

There has been much work on coarticulation in speech, however fingerspelling has been explored less (Hoopes, 1998; Tyrone et al. 1999; Jerde et al. 2003).

Using a new data set of ASL fingerspelling, we have annotated pinky extension as a first step to look for coarticulation on a larger scale.

This study contributes to:

- › sign phonology generally
- › articulatory theories of language production

Questions

1. Do segments with pinky extension specified phonologically in their handshape, exhibit phonetic pinky extension in their hand configuration?
2. Do segments without phonological pinky extension exhibit phonetic pinky extension?
3. What environments condition this phonetics-phonology mismatch? Preceding segment? Following segment? &c.
4. Do all handshapes with an extended pinky condition coarticulation equally?

Method

Apogee Identification

1. We recorded nearly 3 hours of 2 native ASL signers fingerspelling a total of 1,200 words and 7,317 apogees.
2. We coded the video by identifying the apogee of each letter that was fingerspelled. We defined apogee as the time when the velocity of the articulators approached zero. This usually corresponded with the most canonical hand configuration and provides us with a point to analyze variation in hand configuration between apogees.
3. We extracted still images, then hand coded pinky extension for each of these apogees.

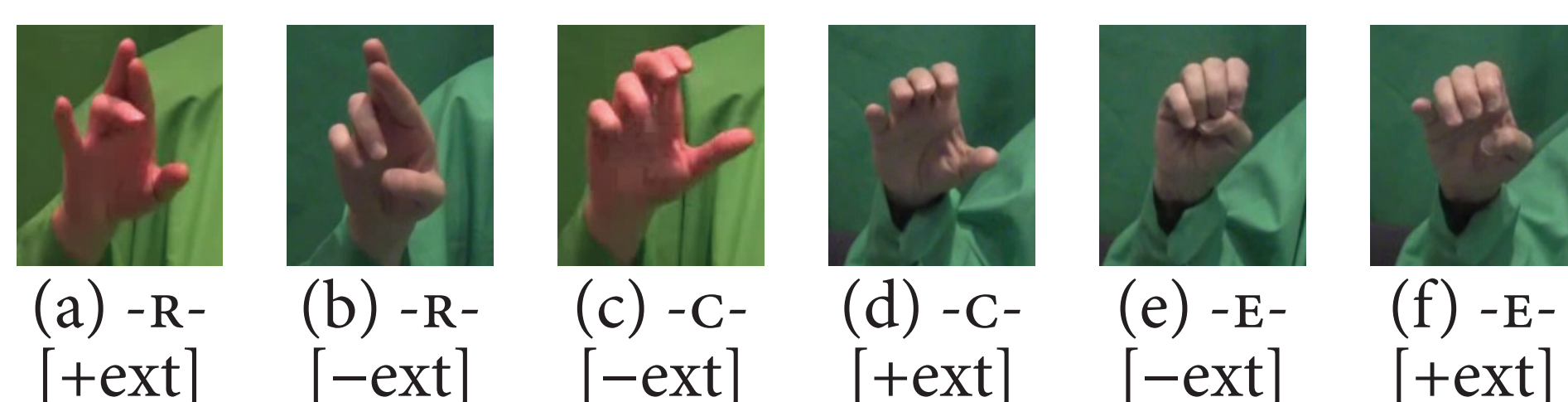


Figure 1: apogees from (a) C-H-R-I-S,

(b) D-I-N-O-S-A-U-R, (c) Z-A-C-K,

(d) E-X-P-E-C-T-A-T-I-O-N,

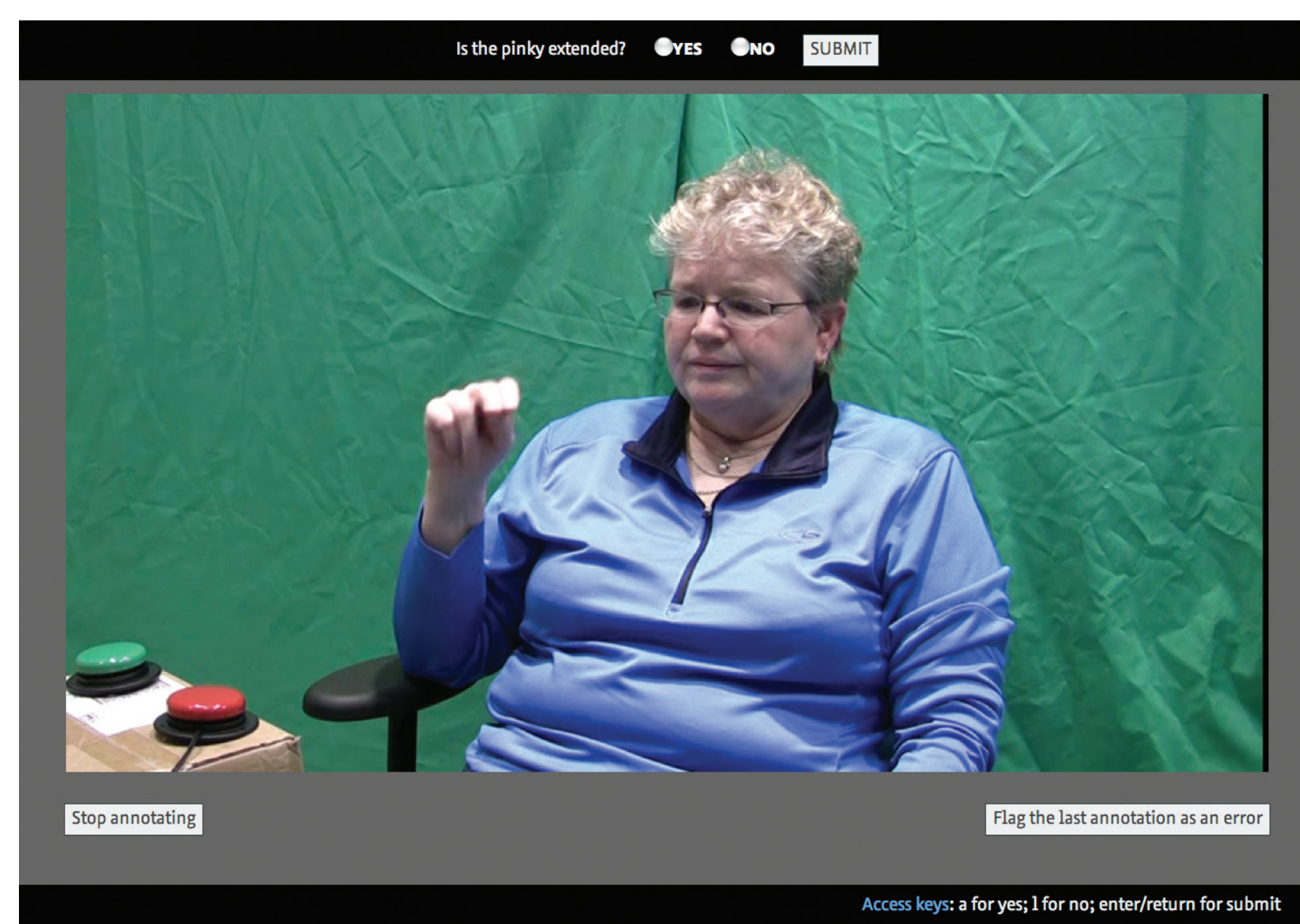
(e) E-V-E-R-G-L-A-D-E-S, and (f) Z-D-R-O-Q-I-E

Extension Annotation

We defined a pinky as extended if:

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

With this metric the canonical hand shapes for -B-, -F-, -I-, -J-, -Y-, and sometimes -C- would have extended pinkies, and the rest would not.



Results

Apogees that have pinky extension in their handshape (ie phonologically specified for), by and large do have pinky extension in their hand configuration (ie phonetic realization). Apogees that don't have pinky extension in their handshape exhibit more variation, which could be a result of coarticulation with surrounding apogees that do have pinky extension.

	handshape (phonology)	
	+PE	-PE
hand config. (phonetics)	1438	295
	49	5870

table 1: Counts for pinky extension: note that there are a large number of apogees with unexpected pinky extension.

Significant in a multilevel logistic regression for predicting pinky extension:

- › handshape of the (current) apogee
- › handshape of the preceding apogee
- › handshape of the following apogee
- › wordtype (English vs. non-English)
- › interaction of following handshape and following transition time

Increase the probability of pinky extension (in decreasing magnitude):

- › the (current) apogee is an -B-, -C-, -F-, -I-, -J-, or -Y-
- › preceding apogee is an -I-, -J-, or -Y-
- › following apogee is an -I-, -J-, or -Y-
- › following apogee is a -B-, -C-, or -F-
- › the wordtype was English (name or noun)
- › both the following transition was shorter, and the following apogee is a B-, -C-, -F-, -I-, -J-, or -Y-

Discussion

Neighboring apogees that are -I-, -J-, and -Y- condition pinky extension much more than -B-, -C-, and -F-, despite the fact that both groups of handshapes canonically have an extended pinky. The only systematic difference is that in -I-, -J-, and -Y- the pinky is extended without other fingers, where as in -B-, -C-, and -F- other fingers are also extended.

There are three extensors involved in finger (excluding thumb) extension (Greftegreff, 1993; Ann, 1993):

1. extensor indicis proprius (index finger alone)
2. extensor digiti minimi (pinky finger alone)
3. extensor digitorum communis (all fingers)

When extended with other fingers, there are two extensors acting on the pinky, but when extended alone, there is only a single one. **This results in slower, less controlled pinky extension when only the pinky is extended.**

Future Directions

Further investigation is needed into:

- › more contextual variation, including the effect of the handshape of the current apogee
- › gradient effects, both temporal and spatial
- › articulatory and gestural modeling of handshape

References

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- Irene Greftegreff. A few notes on anatomy and distinctive features in NTS handshapes. Working papers in linguistics, (17):46–66, 1993.
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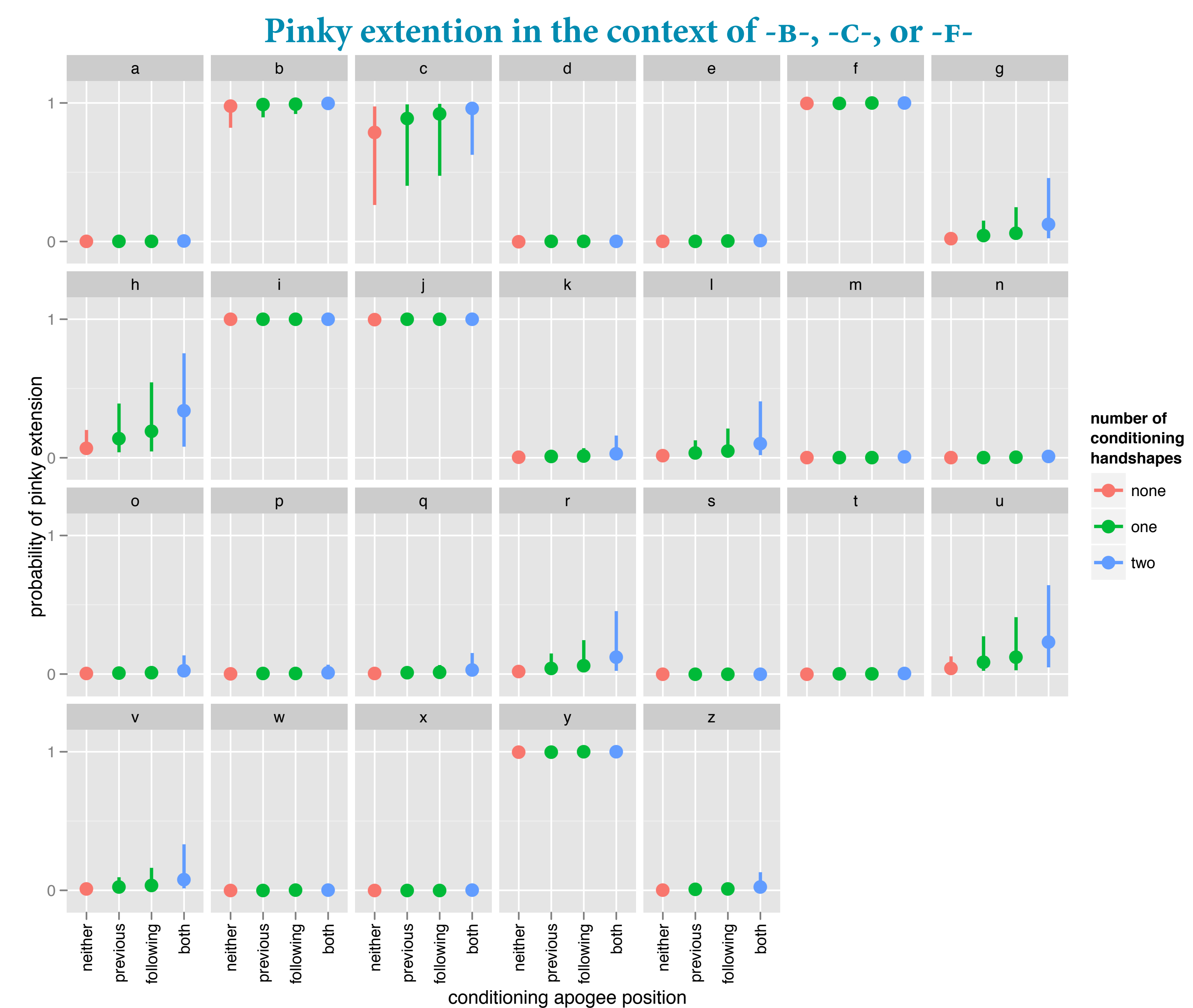
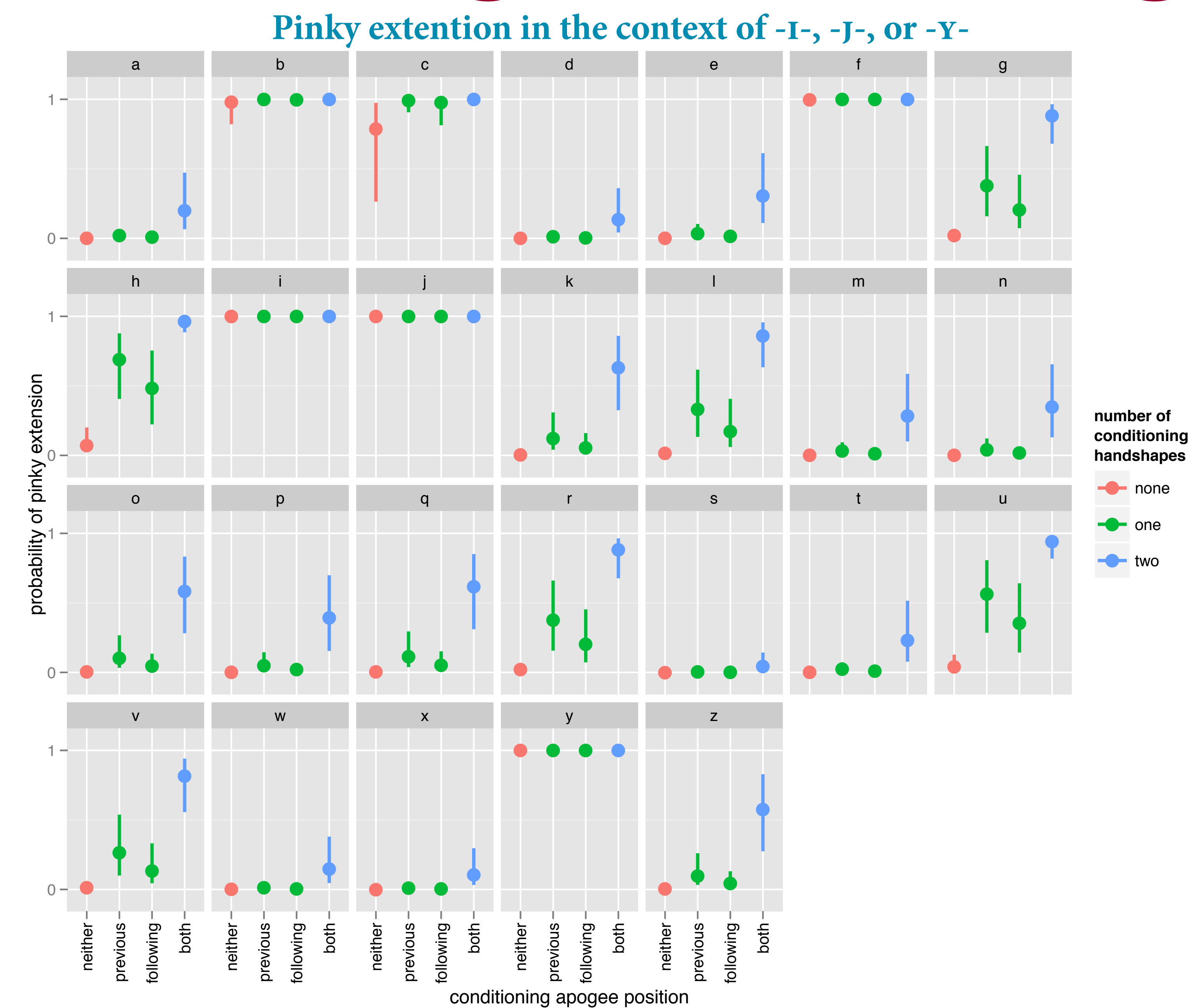


Figure 2: plots showing the effect of neighboring apogees on pinky extension

- › In the handshapes where we expect extension (-B-, -C-, -F-, -I-, -J-, and -Y-) nearly all apogees have pinky extension.
- › In other letters (particularly -E-, -G-, -H-, -K-, -L-, -Q-, -R-, -U-, -V- and -Z-) a neighboring -I-, -J-, or -Y- greatly increases the probability of pinky extension.
- › The dots represent model predictions and the lines – confidence intervals.