

# Lexical Competition Correlates with Articulatory Enhancement in ASL

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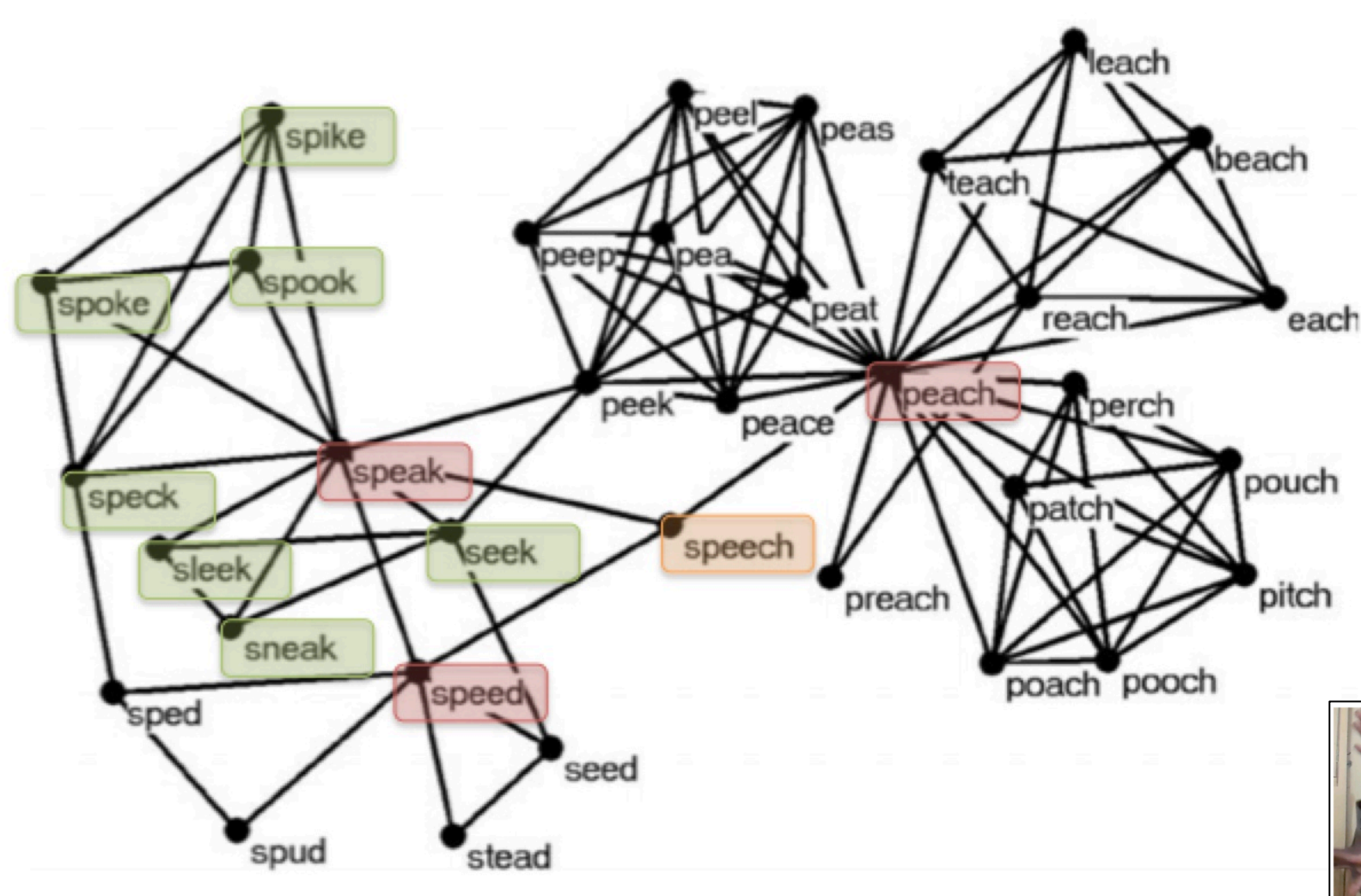
## Research Question & Hypothesis

**Q:** How does lexical competition affect the production of signs?

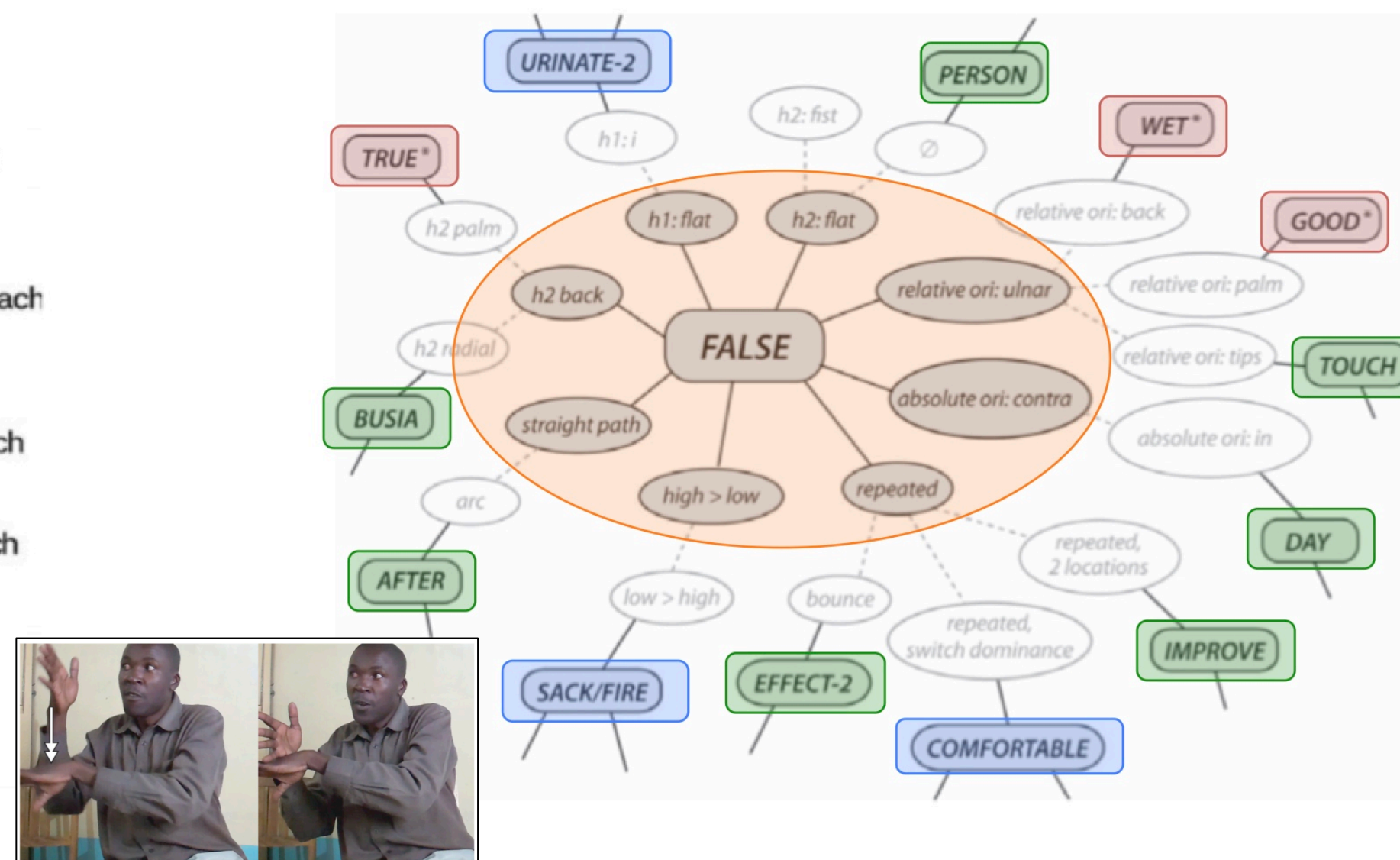
**H:** Greater neighbourhood density will correlate with increased visible amplitude.

## Background: Lexical competition

- Lexical competition: networks of phonologically related words
- Spoken languages: neighbours are words with 1-sound differences
- Signed languages: neighbours are words that share some characteristic(s)



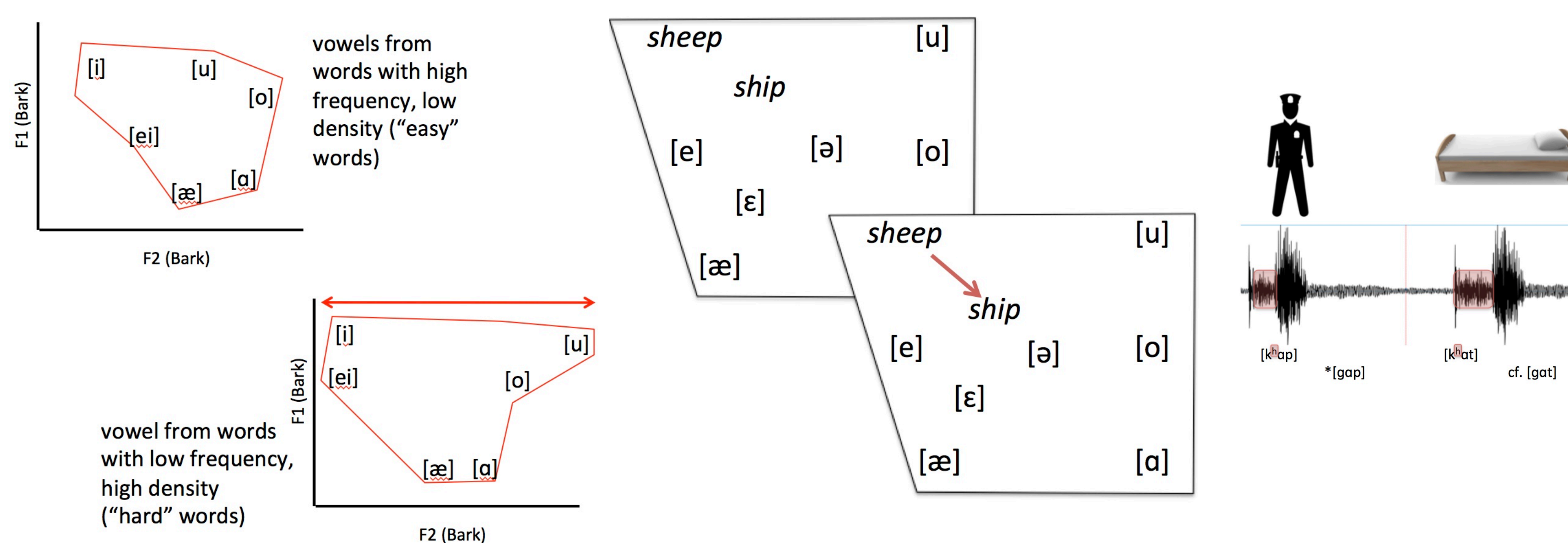
**Fig. 1:** Example of phonological neighbourhood for the word *speech* in English, with **three minimal pairs** shown and **seven near-minimals** highlighted (Chan & Vitevitch 2009).



**Fig. 2:** Example of phonological neighbourhood for the sign *FALSE* in Kenyan Sign Language (Morgan 2017: 108). “FALSE has **three true minimal pairs**, at least **seven near-minimals**, and an **uncounted number of 3-difference pairs**.”

## Background: Articulatory Enhancement

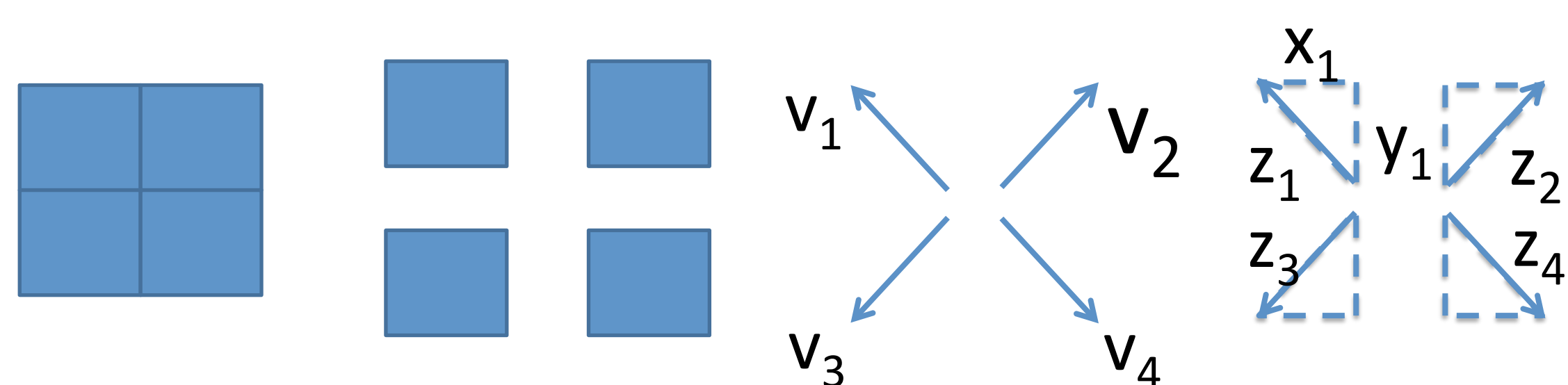
- Increased distinctiveness of a signal is most likely to happen when there is the greatest chance of miscommunication (cf. Lindblom 1990)
- Has various effects on both recognition and **production**, though effects can vary with discourse context, phonological context, measurement type...



**Fig. 3:** (a) General vowel dispersion cf. Munson & Solomon (2004); (b, c) Specific distancing from a neighbour cf. Wedel et al. (2018) and Baese-Berk & Goldrick (2009)

## Measuring “Visible Amplitude” (VA)

- Analogous to acoustic amplitude
- Amount of energy produced by motions that comprise a sign
- Affected by e.g. number of hands, type / shape of movement
- Calculated from a video of a sign by applying *Optical Flow Analysis* (OFA; Horn & Schunck 1981, Barbosa et al. 2008)

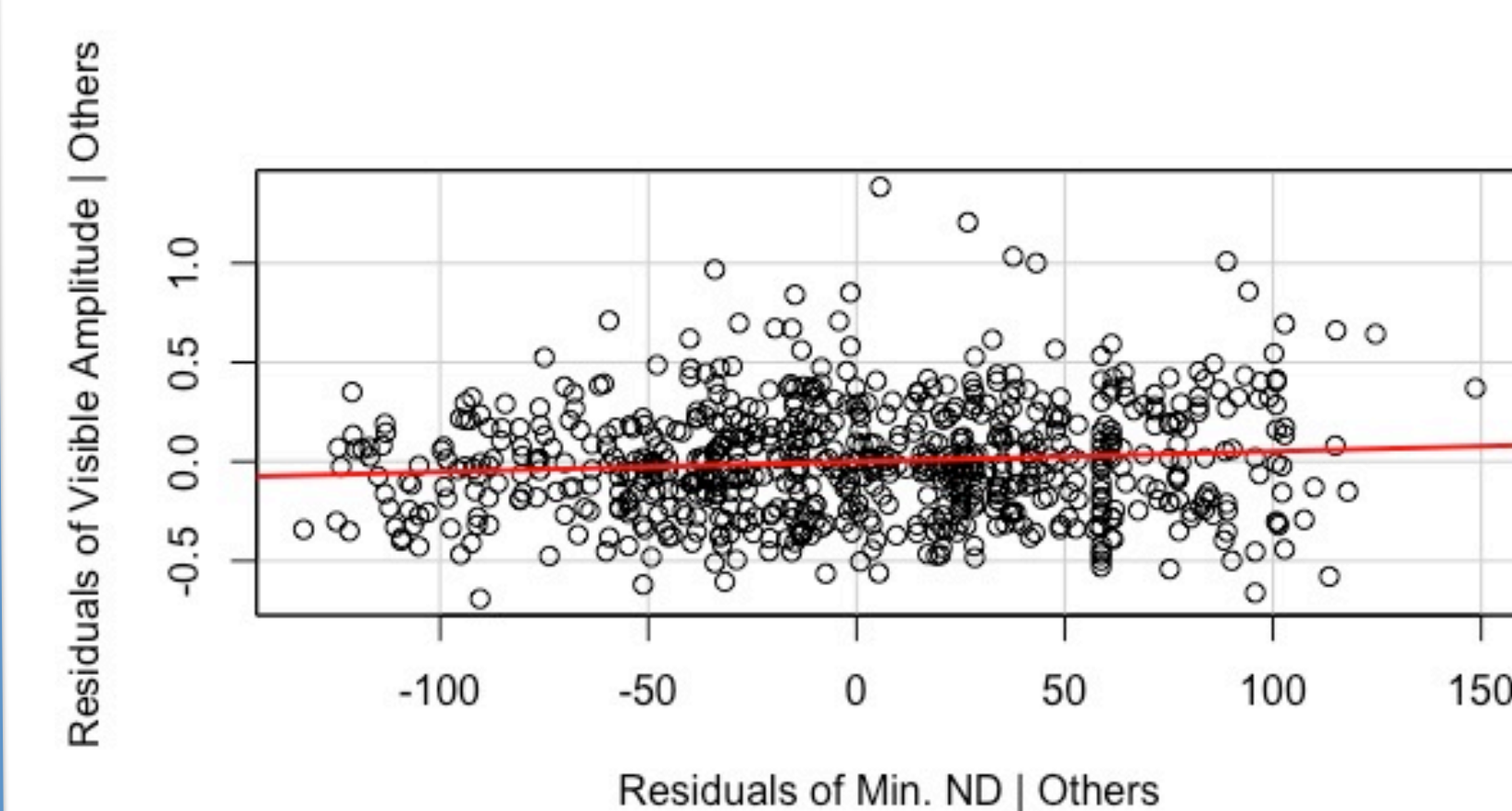


**Fig. 4:** (a) Frame 1; (b) Frame 2; (c) Optical flow field; (d) Calculating magnitudes of individual vectors in the field. To calculate magnitude of frame-step, average the magnitudes (z-values) from (d). To calculate VA, square the magnitudes across frame-steps, sum them, divide by the number of frame-steps, and take the square root.

## Methodology

- ASL-Lex** (Caselli et al. 2017):
  - Database of ~1000 signs of ASL
  - Articulated by a single deaf native signer
  - Each signed in isolation
- ASL-SignBank** (Hochgesang et al. 2019):
  - Database of ~2000 ASL signs
  - Articulated by deaf native signers
  - Each signed in isolation
  - Included only signs that also occur in ASL-Lex
- “Minimal” Neighbourhood Density (ND)**
  - Taken from ASL-Lex
  - The number of signs that share **at least one** of 5 characteristics with a given sign (# of hands, major location, major movement, selected fingers, finger flexion)
  - Most similar to measures used by other sign ND studies
  - Thought to better “capture the phonological structure of the lexicon” (Caselli et al. 2017: 9)
- Removed:**
  - Compounds, atypical handedness or location, clipped videos
- Total signs analyzed:**
  - 691 videos for ASL-Lex and 644 for ASL-SignBank
- Optical flow analysis:**
  - FlowAnalyzer software (Barbosa 2013)
  - Visible amplitude (VA) of each sign computed as in Fig. 4
- Linear model:**
  - Visible amplitude ~ number of hands + major location + minor location + major movement + ND
  - Compare to model without ND

## Results

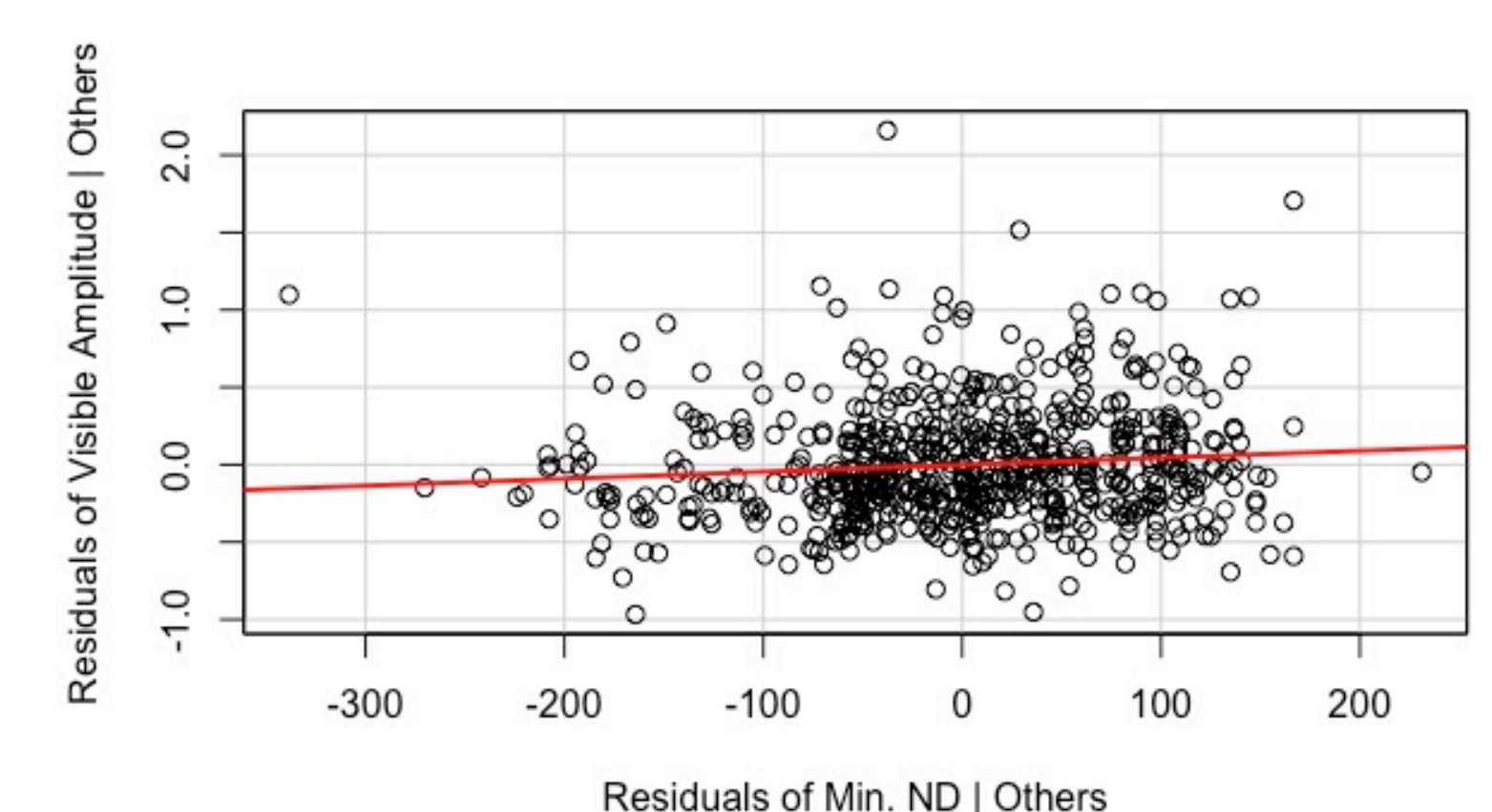


**ASL-Lex (left):**

- ND is a significant predictor ( $p = 0.009$ )
- Effect is in expected direction, though small

## ASL-SignBank (right):

- ND is a significant predictor ( $p = 0.015$ )
- Effect is in expected direction, though small



## Discussion

- Lexical competition may affect articulation in signed languages in a manner similar to that in spoken languages.
- Increased competition is associated with increased magnitude of movements in signs.
- Wedel et al. (2016): spoken language effects better captured by lexical-item-specific measures than generalized ND – how can we capture this in signed languages?
- Note: a similar analysis of the “maximal” ND measure in ASL-Lex (neighbours share 4 of 5 characteristics) showed no significant effect of ND in either database.

## References

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