Perceptual Optimization of American Sign Language: Evidence from a Lexical Corpus

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Background

- Skilled signers fixate on the face of signers [1-3] but signers' hands tend to move in the inferior peripheral visual field [4-7]
- Therefore hand movement must be perceived using peripheral vision where there is less acuity
- Researchers have proposed that the structure of sign languages evolves to accommodate these visual constraints [8-10]
- However, whether sign language structure reflects perceptual limitations has yet to be **empirically** tested
- We combine a lexical database (ASL-LEX) with computational methods that automatically extract wrist location data

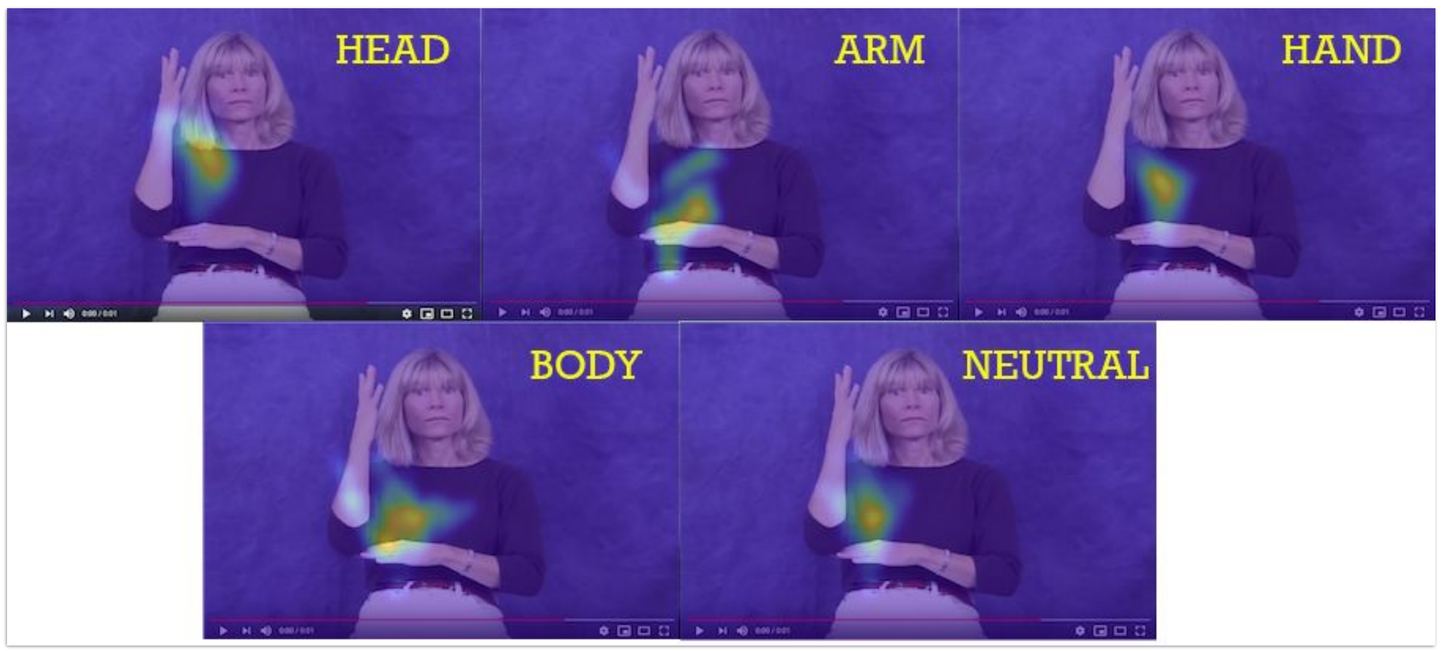
Methods

- ASL-LEX 2.0 database of 2,500 lexical signs [11]
- Utilized OpenPose 10 "deep learning" to perform pose estimation to track the motion of joints over time and analyse wrist location of 2,390 signs
- Videos were normalized across signers by:
  - Controlling for the distance between neck & hips
  - Centering the nose "joint"
- Wrist location data passed through median filter (removes outliers) and Kalman filter (trajectory smoothing)
- ASL-LEX phonological coding determined marked vs unmarked (B,A,S,1,C,O,5) handshape [12]

Discussion

- Findings support previous claims about structure of ASL lexicon
- We show that databases/corpus-based models can be used in conjunction with new technologies to test previously postulated theoretical predictions
- Markedness, however. is not well understood and may not be the best diagnostic for measuring visual acuity pressures
- More research is needed to understand the interaction of competing pressure of perception and production
- In future work we extend these techniques to Nicaraguan Sign Language to test how visual pressures shape language evolution

Question 1: Can we use OpenPose software to estimate wrist position in ASL videos?



Answer 1: Pose estimation accurately evaluated wrist position by comparing locations of the wrist to hand-tagged major location

Question 2: Are signs that require fine-grained phonological distinctions more likely to appear in the central visual field (CVF) than the inferior (peripheral) visual field?

Answer 2: Signs with marked handshapes were more likely to be articulated in the CVF than in the peripheral field