

# Using Computer Vision to analyze nonmanuals across signed languages

Vadim Kimmelman  
University of Bergen  
Vadim.Kimmelman@uib.no

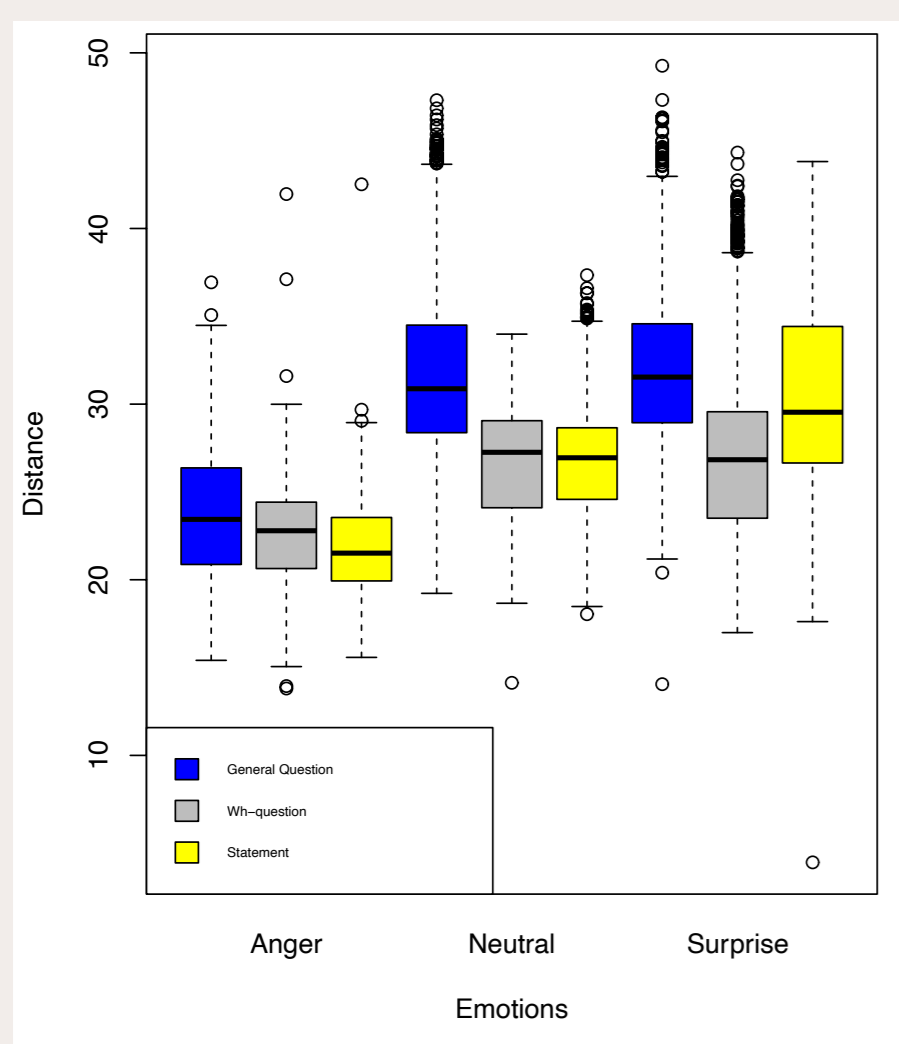


Scan to watch an example

## Main points

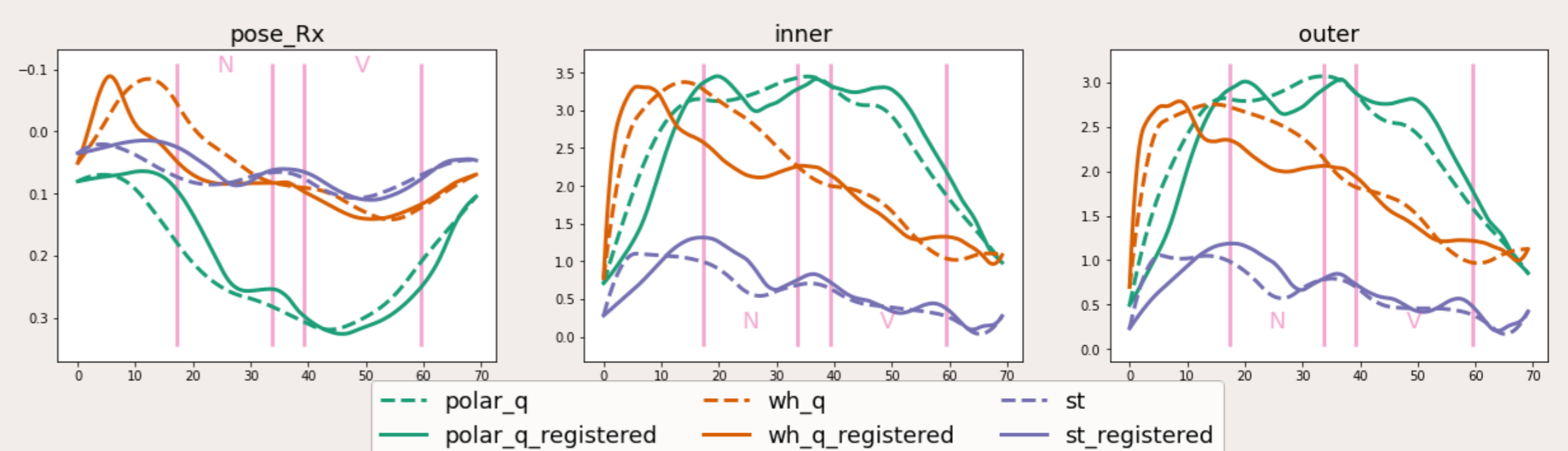
- **Computer Vision** is a way to automatically track the body and facial features of signers in video recordings
- Common applications: Automatic Sign Language Recognition
- Current Computer Vision Solutions (OpenPose + OpenFace, Mediapipe) are good enough to do quantitative linguistic analysis
- We can use it to analyze **nonmanual markers** to describe subtle dynamic patterns and cross-linguistic variation

## Study 1: grammar and emotions in eyebrow position



- Kazakh-Russian Sign Language, 10 signers
- Eyebrow raise used to mark both polar questions and surprise
- Eyebrow lowering used to mark anger
- OpenPose used to measure the eyebrow distance from the nose, average measure per sentence

## Study 2: dynamics of eyebrow movement



- Kazakh-Russian Sign Language, 10 signers
- Statements, polar questions, wh-questions
- Marked by eyebrow movement and head tilts
- OpenFace to measure the eyebrow distance from the nose and head tilts
- Additional Machine Learning to correct errors
- Eyebrow position and head tilt are dynamic: they change throughout the sentence
- Patterns found:
  - Statements: no eyebrow movement, no head movement
  - Polar question: two downward head thrusts, raised eyebrows on the whole sentence
  - Wh-questions: eyebrow raise and backward head tilt on the question sign

## Study 3: headshake expressing negation



- Russian Sign Language, corpus data
- Headshake is used for negation, but in a minority of cases
- OpenFace to measure head turns
- Various shapes of head turns, but no clear relation to different types of negation

## REFERENCES

- Study 1:** V. Kimmelman, A. Imashev, M. Mukushev, and A. Sandygulova, "Eyebrow position in grammatical and emotional expressions in Kazakh-Russian Sign Language: A quantitative study," PLoS ONE, vol. 15, no. 6, Jun. 2020, doi: 10.1371/journal.pone.0233731.
- Study 2:** A. Kuznetsova, A. Imashev, M. Mukushev, A. Sandygulova, and V. Kimmelman, "Functional Data Analysis of Non-manual Marking of Questions in Kazakh-Russian Sign Language," in Proceedings of the LREC2022 10th Workshop on the Representation and Processing of Sign Languages: Multilingual Sign Language Resources, Marseille, France, Jun. 2022, pp. 124–131. Available: <https://www.sign-lang.uni-hamburg.de/lrec/pub/22024.pdf>
- Study 3:** A. Chizhikova and V. Kimmelman, "Phonetics of Negative Headshake in Russian Sign Language: A Small-Scale Corpus Study," in Proceedings of the LREC2022 10th Workshop on the Representation and Processing of Sign Languages: Multilingual Sign Language Resources, Marseille, France, Jun. 2022, pp. 29–36. Available: <https://www.sign-lang.uni-hamburg.de/lrec/pub/22011.pdf>



UNIVERSITY OF BERGEN



## ACKNOWLEDGEMENTS

This project has received funding from the European Research Council (ERC) under the European Union's Horizon Europe research and innovation programme (grant agreement No 101039378)