

Comparing Computer Vision Instruments for Eye Blink Analysis

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Motivation

- Eye blinks are **linguistically meaningful** in sign languages
- Increasing use of computer vision tools for non-manual analysis
- But different tools may produce different measurements

- Do tool-specific differences affect linguistic interpretation of blink kinematics?

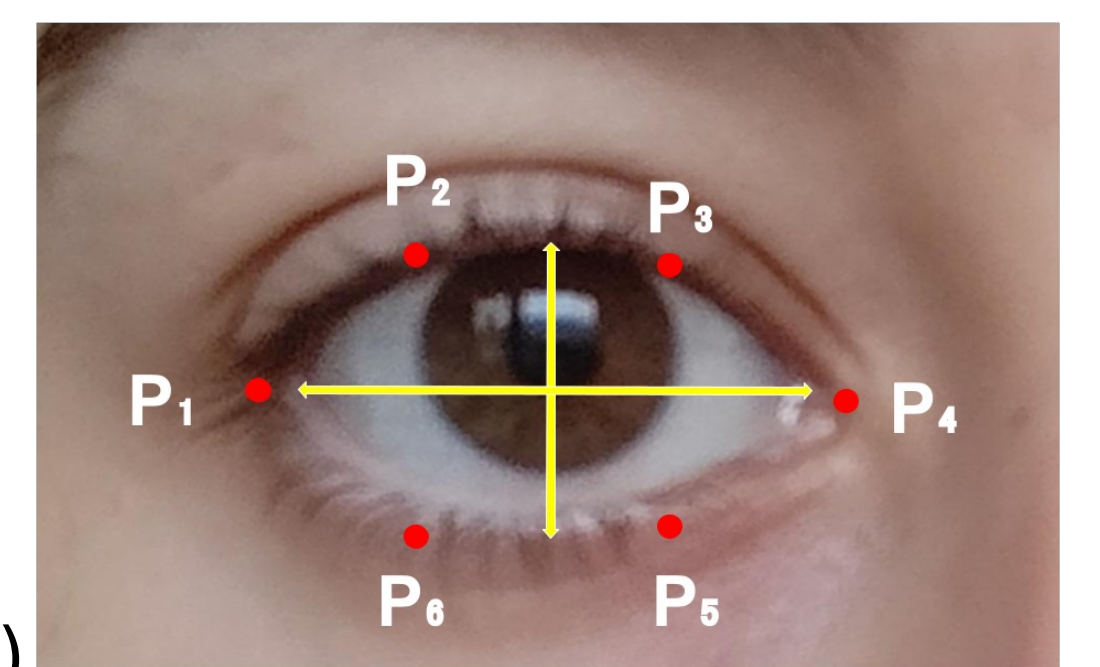
Tools compared

Tool	Type	Strengths
MediaPipe [1]	Neural landmark model	Fine-grained eye tracking, robust to noise and lightning
OpenFace [2]	Statistical landmark model	Interpretable, stable tracking, widely used in research
InsightFace [3]	Deep learning	High landmark accuracy
3DDFA [4]	3D morphable model	Explicit 3D face modelling, handles large head motion

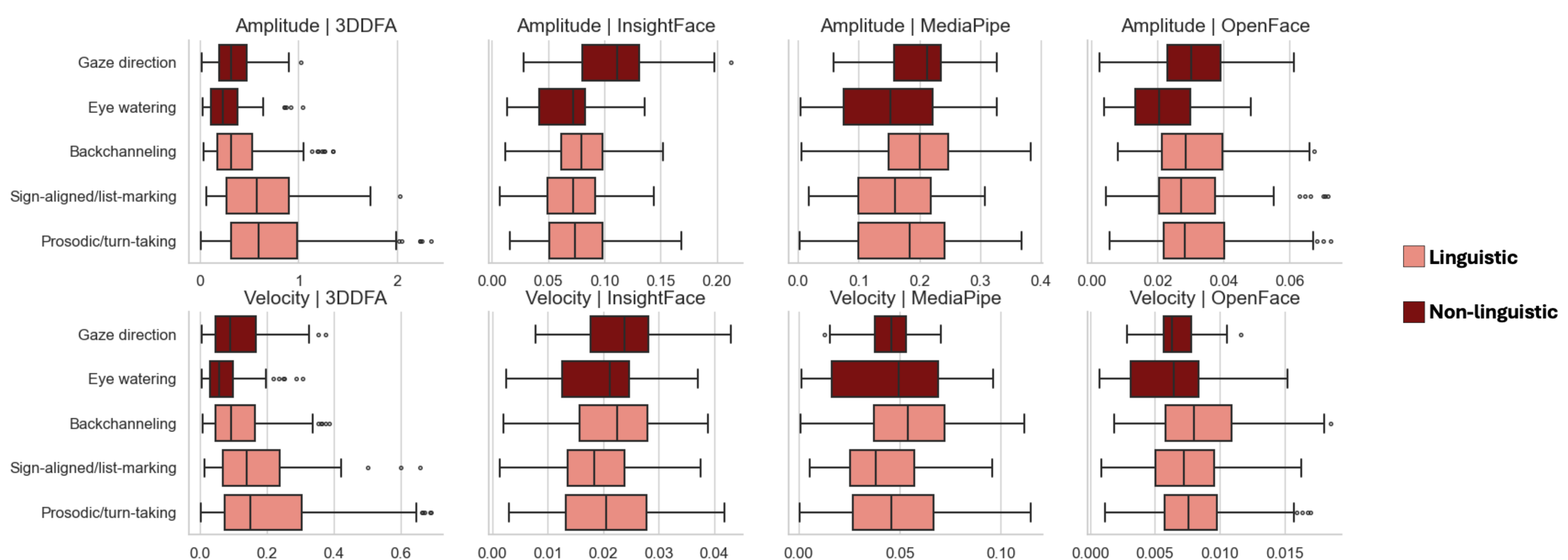
Data & methods

- **Dataset:** Dicta-Sign-LSF-v2 [5]
 - 8 videos
 - 1078 annotated blinks → 650 analyzed
- **Blink categories**
 - *Linguistic vs. non-linguistic*
 - Subtypes: *backchanneling, prosodic/turn-taking, sign-aligned/list-marking, eye-watering, change in gaze direction*

- **Pipeline**
 - Extract facial landmarks + head pose
 - Compute **Eye Aspect Ratio (EAR)** [6] →
 - Smooth signal (splines) [7]
 - Derive:
 - **Amplitude** (maximum lid displacement)
 - **Mean velocity** (speed of eyelid movement)
 - Linear mixed-effects models (R)



Blink velocity & amplitude



Results

Linguistic vs. non-linguistic blinks

- Non-linguistic blinks:
 - Lower amplitude
 - Lower velocity
- Consistent across most tools

Within linguistic blinks

- General pattern (most tools, ≠ 3DDFA): **Backchanneling > prosodic/turn-taking > sign-aligned/list-marking**
- Backchanneling blinks = fastest and largest
- Sign-aligned/list-marking = slowest and smallest

Within non-linguistic blinks

- Eye-watering blinks are slower than gaze-direction-change blinks (across tools)
- Eye-watering blinks have a smaller amplitude (InsightFace & OpenFace)

Takeaways & limitations

- **Blink patterns are linguistically structured**
 - Linguistic blinks show systematic variation
 - Non-linguistic blinks are smaller and slower
- **Not all measures are equally robust**
 - Velocity: stable across tools
 - Amplitude: more tool-dependent → **Tool choice affects results**
- **Head pose is not a neutral control**
 - Effects of Pitch, Roll and Yaw: strong but inconsistent across tools
 - Likely reflects differences in pose estimation methods
- **We only used one language and the sample size was limited**
 - Future work will include more languages and more data

REFERENCES



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