Testing MediaPipe Holistic
for the analysis of eyebrow movement in questions

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In previous research (Kuznetsova et al. 2021), we used OpenFace (OF) (Baltrusaitis et al. 2018) to analyze eyebrow movement for question marking in Kazakh-Russian Sign Language (KRSL). We found that polar questions were marked with eyebrow raise on the whole clause and forward head thrusts, while wh-questions were marked with eyebrow raise and backward head movement only on the wh-sign. Importantly, we have shown that OF cannot be used to directly measure eyebrow movement because the presence of a head tilt leads to distortion of the 3D reconstructed model of the face. Recently a new CV solution, MediaPipe Holistic (MPH) was published (Lugaresi et al. 2019). In this study, we tested whether MPH copes better with eyebrow position estimation than OF.

We extracted landmark locations from the same dataset of questions and statements in KRSL using MPH, and applied the same measures of eyebrow position. MPH seems to show generally the same pattern as OF corrected, but with smaller differences between sentence types.

In order to further test MPH in the context of head tilts, we recorded short videos of a single subject performing head tilts with and without eyebrow raise at three different distances from the camera. We estimated eyebrow position using MPH and OF (uncorrected), and estimated head tilts using OF.

Summarizing the results informally, MPH performs better than OF for pitch up, but worse for pitch down. A surprising additional pattern is revealed: MP's estimation of eyebrow position in the presence of backward head tilt behaves differently with and without eyebrow raise. Without eyebrow raise, eyebrow position is not greatly affected by head tilt, but with the eyebrow raise, their position estimation is greatly affected by head tilt.

Our explanation for the apparently good performance of MPH on our KRSL dataset is that the distortions that MPH introduces are generally in the direction of the actual effects. The take home message is that MPH, similarly to OF, clearly cannot be used for accurate measurement of eyebrow movement in the presence of head tilts, and a correction model is required.

References: • Kuznetsova, A. et al. (2022) Functional Data Analysis of Non-manual Marking of Questions in Kazakh-Russian Sign Language, *Proceedings of the LREC2022* • Baltrusaitis, T. et al. (2018) Openface 2.0: Facial behavior analysis toolkit, In *FG 2018,* IEEE • Lugaresi, C. et al. (2019) MediaPipe: A Framework for Building Perception Pipelines, doi: 10.48550/ARXIV.1906.08172.