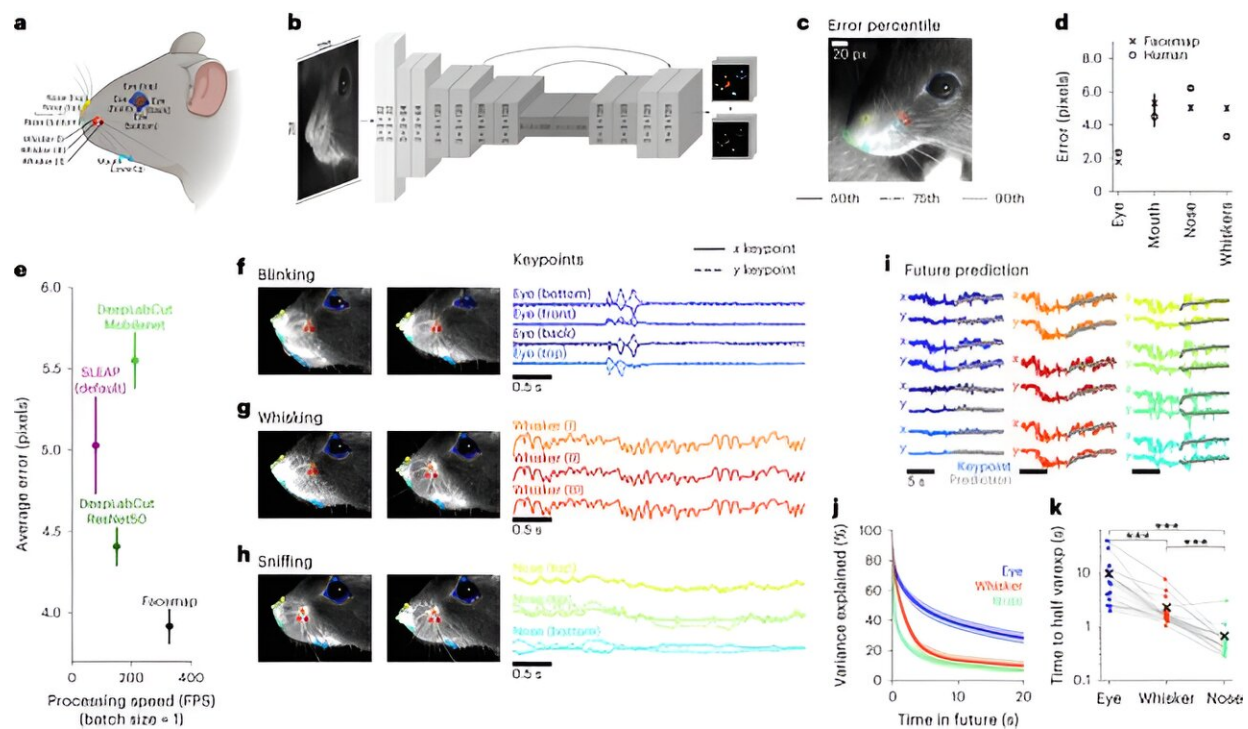


# Reading a mouse's mind from its face: New tool decodes neural activity using facial movements

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Fast and accurate mouse orofacial keypoint tracking. **a**, A total of 13 distinct keypoints selected for tracking the eye, mouth, whiskers and nose on the mouse face, illustration created with BioRender.com. **b**, Architecture of the Facemap network, a U-Net style convolutional neural network. **c**, The error percentiles across test frames from a new mouse, where error is defined as the Euclidean distance between the ground-truth label and the prediction. **d**, Summary of Facemap performance on test data for different subgroups of keypoints. Human error shown for a subset of the test frames labeled in two different sessions by a

human annotator. Error bars represent s.e.m.,  $n = 400, 95, 361$  and  $300$  keypoint labels for eye, mouth, nose and whiskers, respectively, across  $100$  test frames. e, The average error, in pixels, and processing speed, in video frames processed per second, of the Facemap tracker compared with other pose estimation tools. Error bars represent s.e.m.,  $n = 1,156$  keypoint labels. f–h, Traces of  $x$  and  $y$  coordinates of keypoints during different orofacial behaviors. i, Prediction of keypoint traces into the future (test data). j, Variance explained of future prediction at different time lags, summarized for each face region. Error bars represent s.e.m.,  $n = 16$  recordings. k, Decay time to  $50\%$  of variance explained at  $20$  ms timelag. The 'x' represents the average. Two-sided Wilcoxon signed-rank test, \*\*\*P

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