Beyond Fixations: Spatiotemporal Dynamics of Emotional Gaze in Autism

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BACKGROUND

Outstanding issues on emotional face processing in autism:

- Failure to control for comorbid Alexithymia (Bird & Cook, 2013);
- Modulation to priors and goals (Pellicano & Burr, 2012).
- Design artifacts (quantification of gaze, AOIs);
- Static metrics (e.g. Fixation Duration) don't leverage spatio-temporal properties of gaze data.

DESIGN AND METHODS

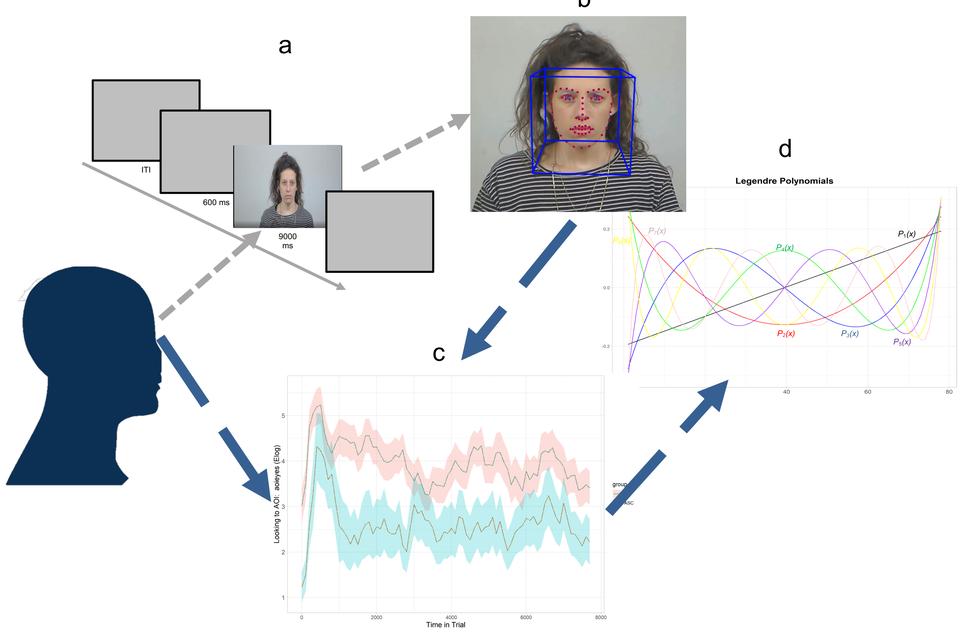

Fig1. Design and workflow.
Time series gaze coordinates were dynamically assigned to dynamic AOI's through the LVRT method, computing Euclidian distances from facial landmarks (fig 1b) and a 200° radius (px) threshold (Baltrušaitis et al, 2016, Hessels et al, 2018). Proportion distribution timeseries for gaze*AOIs were then created (fig. 1c), and modeled using Legendre Polynomials in lmer (fig.1d).

Participants: N = 79, IQ matched Autistic (n = 20, MedAge = 42, range: 24 – 64) and Controls (n = 59, MedAge = 25, 18 – 53).

Emotion Viewing Task: 42 emotional faces presented in 4 conditions: Free Gaze, Recognition, Cued, Intensity Rating.
Eye tracking: Tobii TX 300, 300hz, 61cm, running in PyGaze.

Data Processing and Analysis
Preprocessing was done in *eyetrackingR* package. Data was analyzed using Linear Mixed Models, implemented in the lme4 package R (Bates et al., 2015).

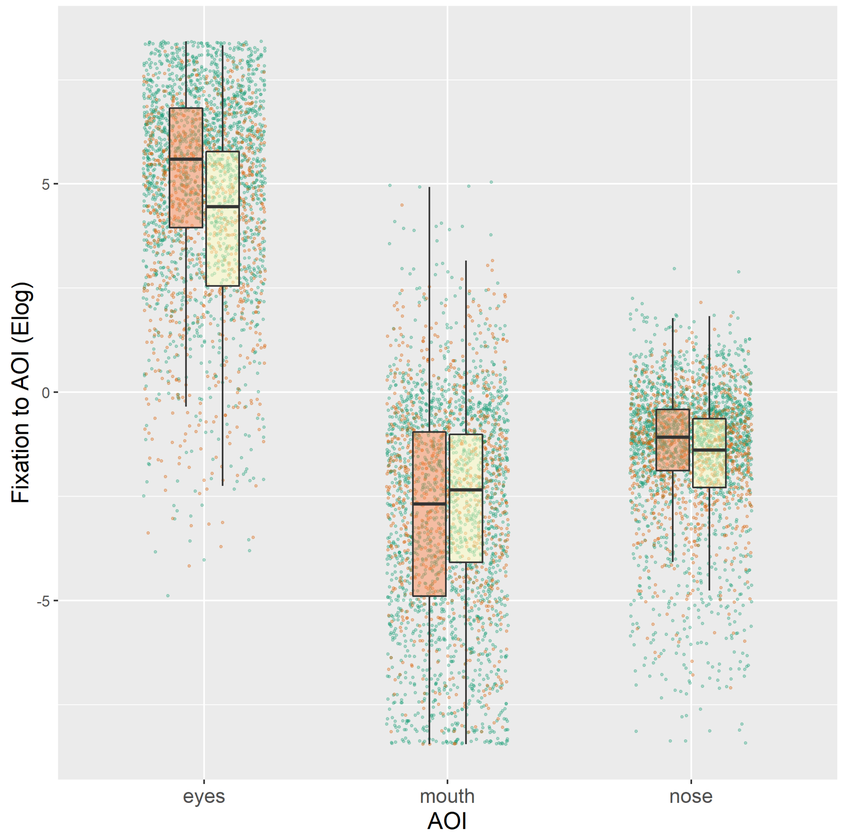

Fig. 2. Raw eye-tracking data by AOIs and group (split by NT on the left, and ASC on the right). Points represent individual trials per subject.

RESULTS

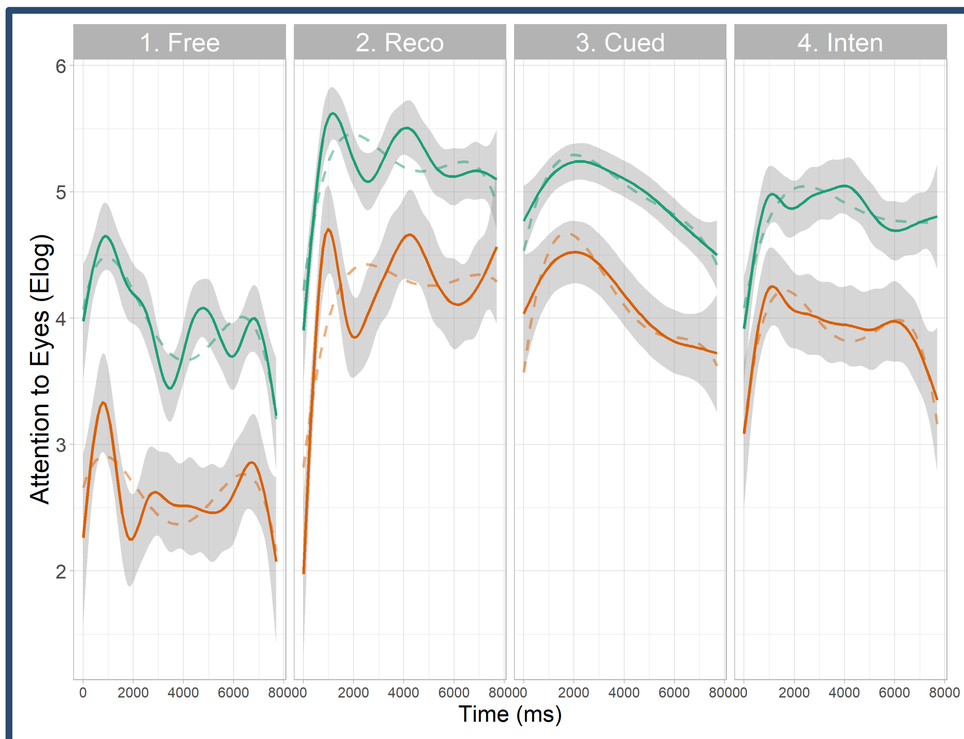

Fig. 3. Growth-curve for Eye AOI.
Solid lines represent observed patterns+ 95%CI errors (smoothed to reduce over plotting). Dashed lines represent prediction patterns.

Model:
Eyes ~ group * alexithymia * condition * (ot1 + ot2 + ot3 + ot4) + (ot1 | Participant)

ΔAIC = 144, ΔLog = 133, $\chi^2_{(76)}$ = 265.58, p < 001.

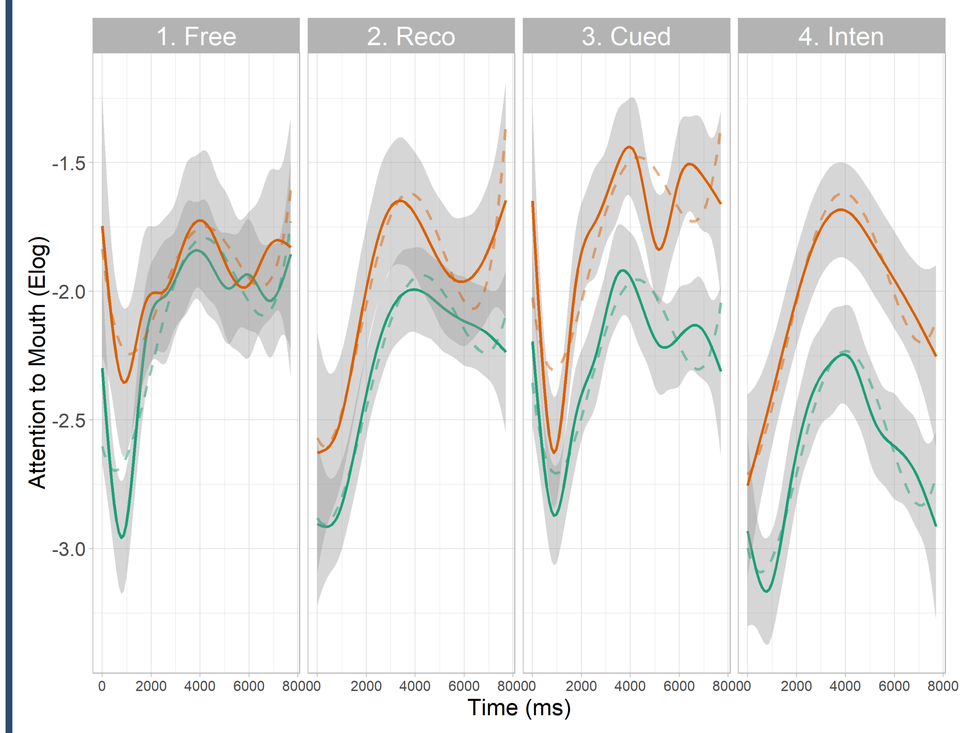

Fig. 4. Growth-curve for Mouth AOI.

Model:
Mouth ~ group * alexithymia * condition * (ot1 + ot2 + ot3 + ot4) + (ot1 | participant)

ΔAIC = 48, ΔLog = 64 133, $\chi^2_{(40)}$ = 208, p < 001

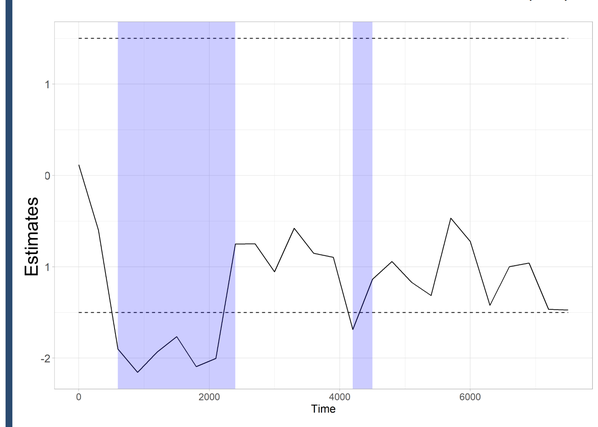

Fig. 5. Parametric cluster based Bootstrapping of estimates. Shaded clusters show significant divergence, p < .05 (1000 iterations).

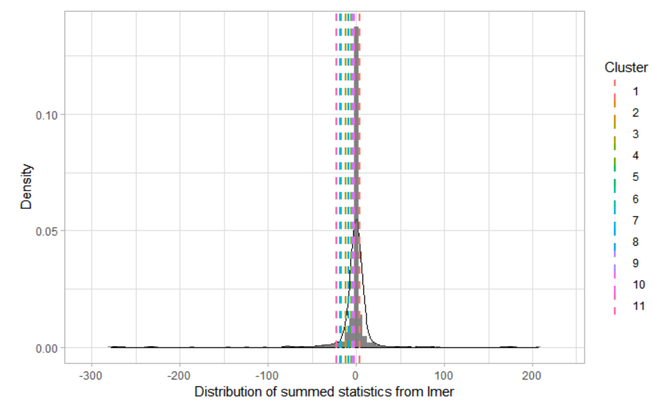

Fig. 6. Distributions of summed statistics from LMER. Shows the density associated with the probability of divergences for each cluster under the null.

CONCLUSION

- Polynomial based LMMs reliably distinguish the spatio-temporal evolution of gaze between ASC and controls.
- Gaze patterns diverge as a function of group, alexithymia and task goal. ASC show a bigger modulation effect by condition and reduced eye-modulation in free gaze.
- Diagnosis models do not outperform Alexithymia models.
- ***Atypical emotional viewing in autism may reflect a difficulties with or reduced propensity to modulate gaze to eye cues depending on task goals and priors.***

SELECTED REFERENCES

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Scripts and markdown code available on GitHub

https://github.com/hcuve

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