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, manipulations);
- Static metrics (e.g. Fixation Duration) don't leverage spatio-temporal properties of gaze data.

STUDY: Design and Methods

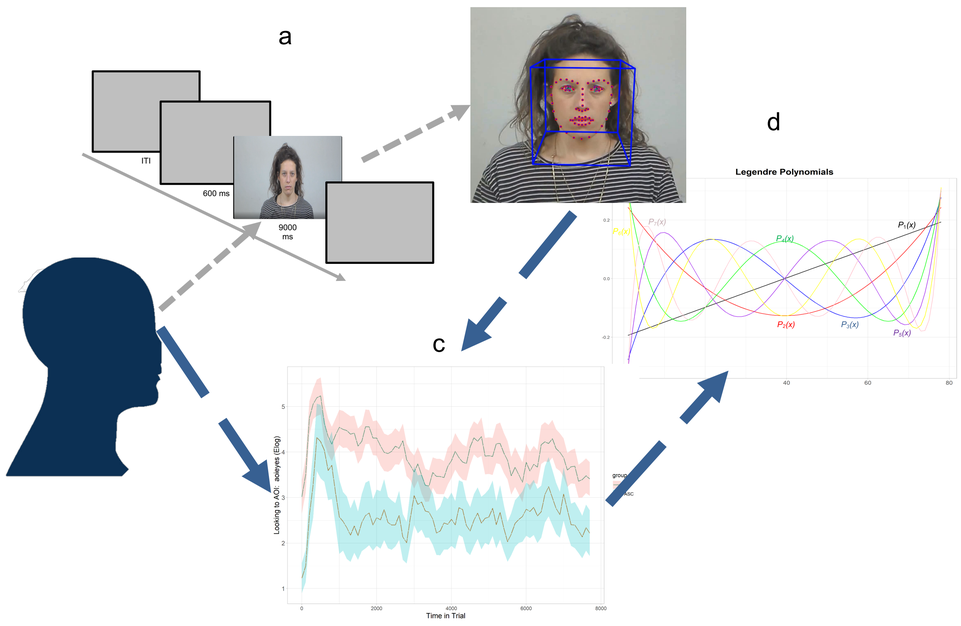

Fig1. Design and workflow.
Gaze coordinates were dynamically assigned to dynamic AOI's by the LVRT method, computing Euclidian distances from facial landmarks (fig 1b) at 200° radius (px) threshold (Baltrušaitis et al, 2016, Hessels et al, 2018). Proportion distribution timeseries for each AOIs were then created (fig. 1c), and modeled using orthogonal 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, sampling at 300hz, 61cm, interfaced with Python.*

Data Processing and Analysis
Track loss analysis was conducted in *eyetrackingR package.*
Data was analyzed by modeling predictors and Legendre Polynomials in Linear Mixed Models, implemented in the lme4 package R (Bates et al., 2015).

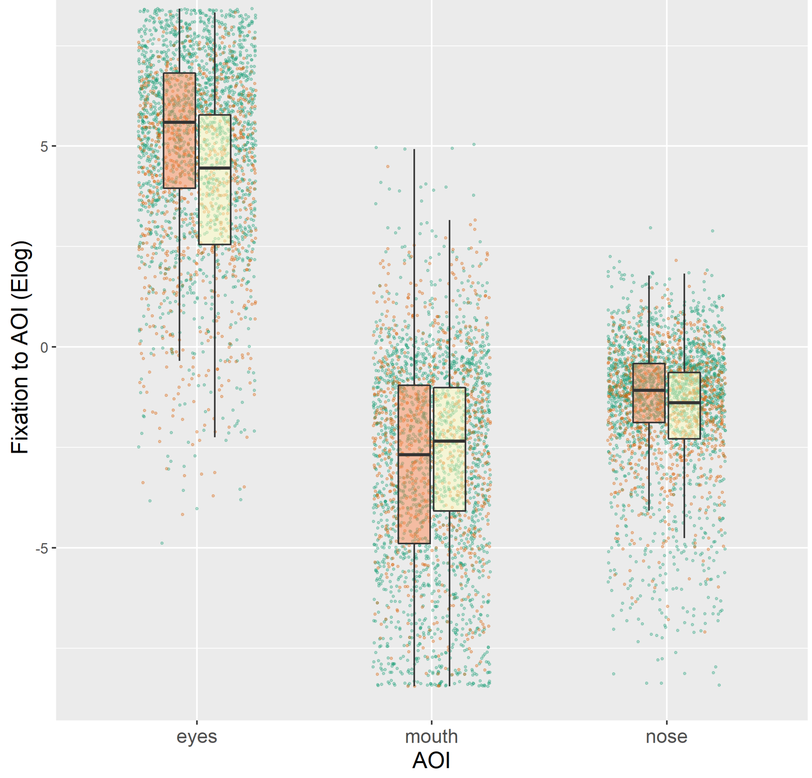

Fig. 2. Raw eye-tracking data by AOIs and group (split NT - left, and ASC right). Points represent individual trials per subject

RESULTS

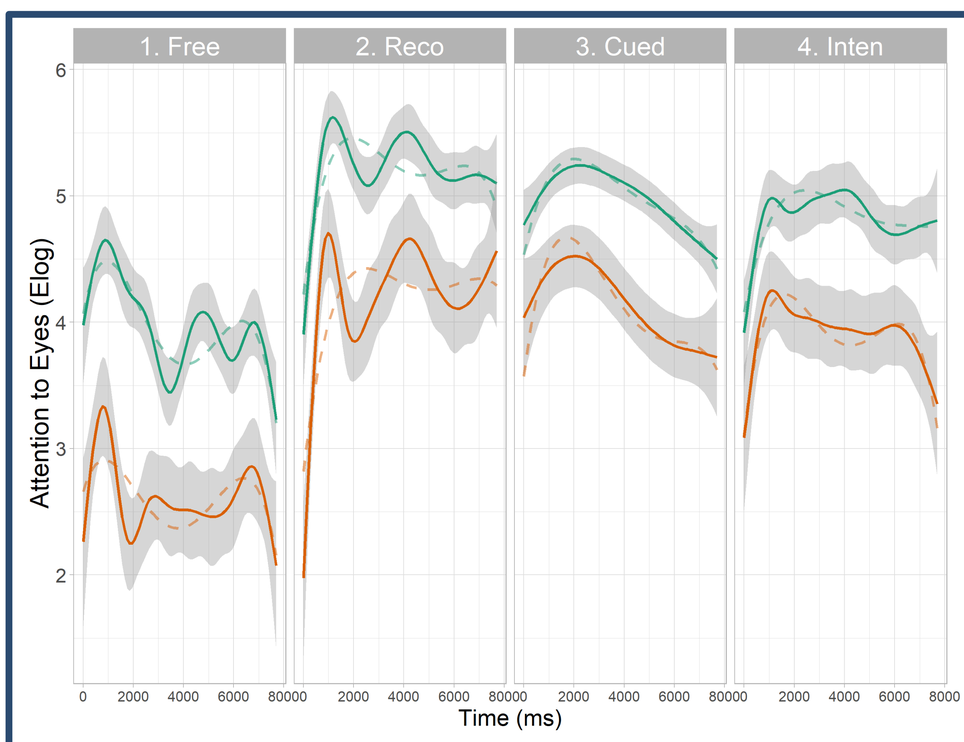

Fig. 2. Time course showing the growth-curves.
Solid lines represent observed averages (smoothed to reduce over-plotting). Dashed - lines represent mean predictions, 95% CI.

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

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

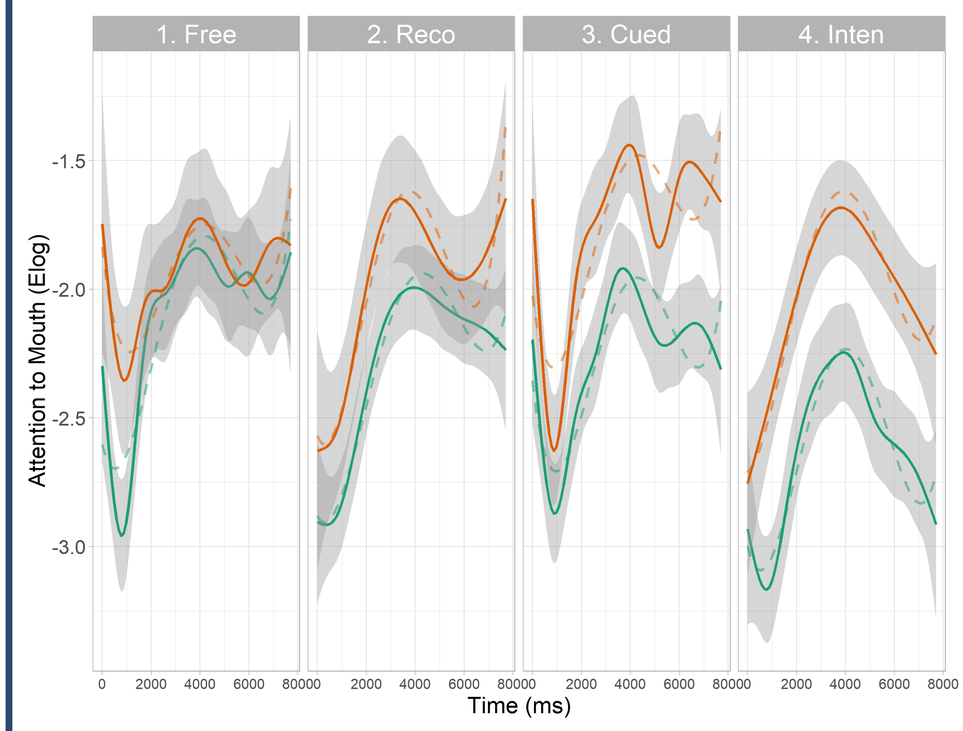

Fig. 3. Growth-curves for Mouth AOI.

Elog Mouth ~ group * alexithymia score * condition + (ot1 + ot2 + ot3 + ot4) + (ot1 | participant)

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

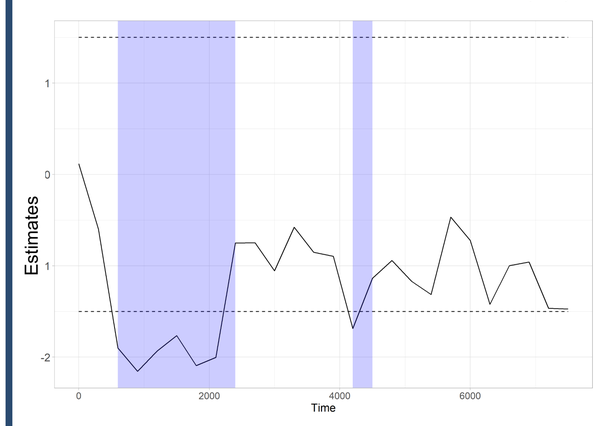

Fig. 4. Parametric Bootstrapping Clustering of estimates Shaded bins show significant divergence clusters p< .05 (1000 iterations).

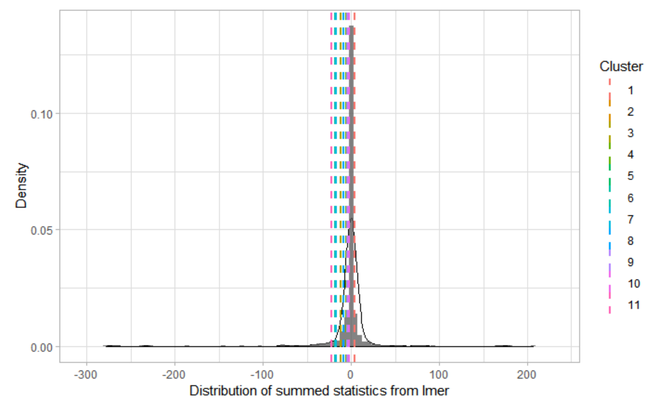

Fig. 5. Distributions of summed statistics from LMER. Shows the density associated with the probability of divergences for each cluster under the null (1000 iterations).

CONCLUSION

- Polynomial based LMMs reliably distinguish the spatio-temporal evolution of gaze between ASC and controls.
- Gaze patterns diverge between groups as a function of task goal. ASD show a significant modulation by condition, displaying reduced eye-modulation in free gaze.
- Diagnosis models do not outperform Alexithymia models.
- ***Atypical emotional viewing in autism may reflect a difficulty in modulating gaze to emotions (and eyes in particular) or reduced propensity to do so in absence of a task goal or cue.***

Selected References

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Scripts and markdown code available on GitHub

https://github.com/hcuve

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