Rhesus Macaque Infants Born to Low-Ranking Dams Show Heightened Vigilance When Viewing Videos of Dam-Infant Interactions

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- Rhesus macaques (*Macaca mulatta*) are indispensable as a model system due to their altriciality & complex social lives.
- In social groups, status in a strict hierarchy is passed from dam to offspring & shapes the early rearing environment.

- Previous work found links between maternal rank & infants' attention to faces (Paukner et al., 2017), vigilance to social threats (Mandalaywala et al., 2014), & attention to eyes alongside accelerated maturation of the visual cortex (Ford et al., 2023).

We therefore hypothesize that individual differences in social-visual attention in macaque infants can be explained in part by maternal rank.

Predictions

- Infants born to lower-ranking dams will show earlier peaks in social-visual attention, particularly to faces & eyes.
- Lower-ranking infants will attend for longer periods of time to macaques appearing in the background of videoclips.
- Overall, we expect to confirm & expand on Ford et al.'s (2023) results.

References:

Ford et al., 2023. Dev Cognitive Nsci 60: 101213.
Hinde & Spencer-Booth, 1967. Animal Behaviour 15: 169-196.
Machado & Bachevalier, 2003. J Child Psychology & Psychiatry 44: 64-87.
Mandalaywala et al., (2014). Psychological Sci 25: 1893-1902.
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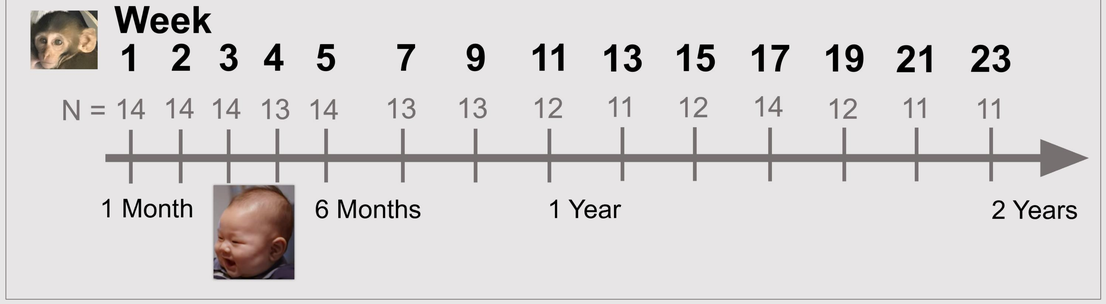
Eye-Tracking

Subjects

- **N = 18 male rhesus macaque infants (9 low-rank, 9 high-rank)**
- Born 2018 – 2021 at the E.N.P.R.C. Field Station (Lawrenceville, GA)
- Raised by their dams in outdoor compounds housing multigenerational social groups of 50-100 macaques



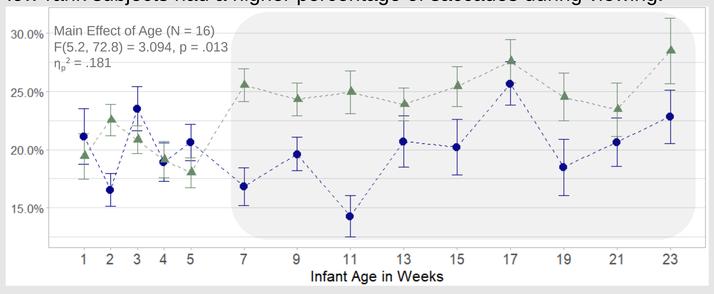
E.N.P.R.C staff developed noninvasive procedures for eye-tracking with macaque infants. Modelled after human studies at the Marcus Autism Center (Emory University, Atlanta, GA), these methods allow the infant to remain in ventral contact with his dam & to continue nursing throughout the 30-min session. Data were collected over 14 sessions from birth to 24 weeks of age (~24mo, or 2yrs, in human development). Stimuli included 27 unique videoclips, each ~10 seconds in length, depicting interactions between dams, their infants, & other macaques in the scene.

Social-Visual Attention

Regions of Interest (ROI's)

Scene Background | Dam Head | Dam Eyes | Infant Head | Infant Eyes | Other Macaques

(A) Saccades / Total Frames: From ~2 months of age onwards, low-rank subjects had a higher percentage of saccades during viewing.

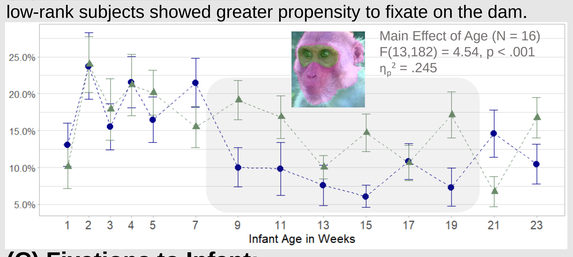


Lost Data / Total Frames:
High-Rank Avg: 43.4% ± 1.3% (SE)
Low-Rank Avg: 35.2% ± 1.2% (SE)

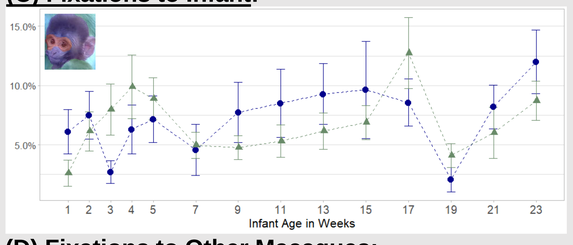
Fixations / Total Frames:
High-Rank Avg: 33.6% ± 1.1% (SE)
Low-Rank Avg: 39.2% ± 1.0% (SE)

Viewing patterns to videos of mother-infant interactions. Frame-by-frame, datapoints were parsed into 4 distinct types**: fixations, saccades, blinks, & lost/missing data**. Saccades *(A)* & fixations are plotted here longitudinally. Vertical bars represent standard error. Low- & high-rank subjects fixated at similar levels to ROI's representing infants' head & eyes *(C)*, other macaques *(D)*, & the scene background *(E)*.

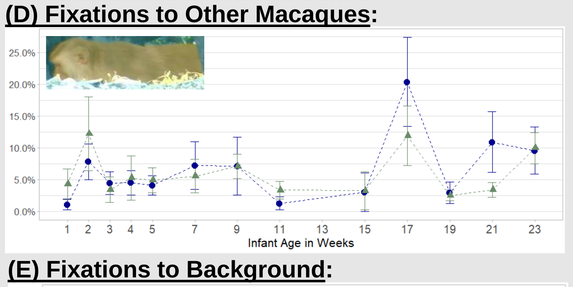
(B) Fixations to Dam: From ~2 months of age onwards, low-rank subjects showed greater propensity to fixate on the dam.



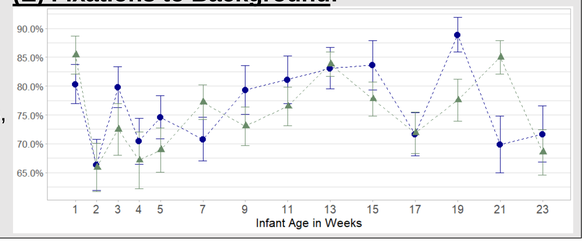
(C) Fixations to Infant:



(D) Fixations to Other Macaques:



(E) Fixations to Background:



Conclusions

- These findings provide preliminary support for our hypothesis.
- Compared to higher-ranking peers, low-rank infants showed more fixations, particularly to dams' head & eyes *(B)*, & more saccades *(A)*. These differences emerged after ~2 months, the age at which macaque infants become increasingly active in their play & exploration.
- Lower-ranking macaques may adapt to their environment from a very young age by displaying heightened vigilance for potential social threats.

Future Directions

Salience mapping is an evidence driven, "bottom-up" technique for quantifying, **frame-by-frame**, to what a particular group of subjects is attending. Information about saliency can then be visualized as a series of heat maps in which areas of high **convergence** or **divergence** between viewers are indicated by warm and cool colors, respectively. Below are example salience maps of viewing patterns from subjects in their final eye-tracking session, at ~6 months of age (N = 11).