

ePeekaboo: A new passive experimental paradigm to assess anticipation & response to reward using Event-Related Potentials (ERPs) in infants & toddlers (pre-reg. report)

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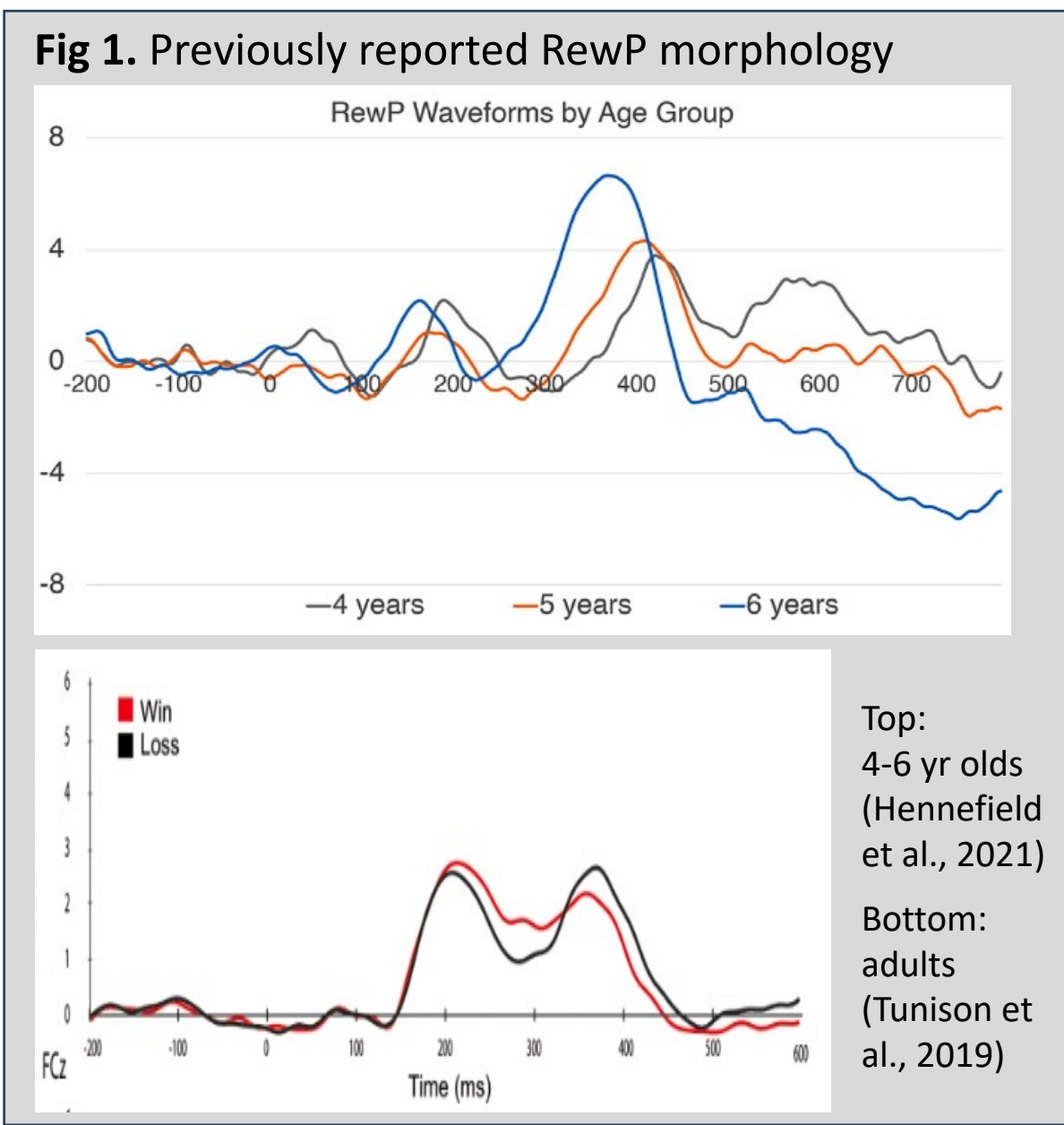


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Introduction

- Alterations in reward processing are consistently reported in autism, ADHD, and neurodevelopmental conditions. [1]
- It remains unknown how reward circuitry develops in the first years of life – **what aspects of reward (anticipation, response, etc.) develop on what timeline** – partly due to lack of passive experiments appropriate for infants and toddlers.
- Reward Positivity (**RewP**) Event Related Potential: can measure the response aspect of reward processing [2]
- RewP = positive amplitude around 300ms (in adults) after a win, compared to baseline
- Tasks commonly used to elicit the RewP (e.g., Doors Guessing, Incentive Delay) require a timed button press, exceeding the cognitive and language levels of some autistic individuals and most infants and toddlers.
- Youngest sample studied with RewP: 4-6 year olds (Fig 1, top)
- Longitudinal, developmental study of such a transdiagnostic construct as response to reward could have far-reaching implications, particularly as a biomarker for use in autism intervention studies.



Objective

- To assess feasibility of **ePeekaboo**, a novel passive paradigm to measure response to reward (social and nonsocial) via the RewP
- To gather preliminary data on the developmental trajectory of the RewP

Methods

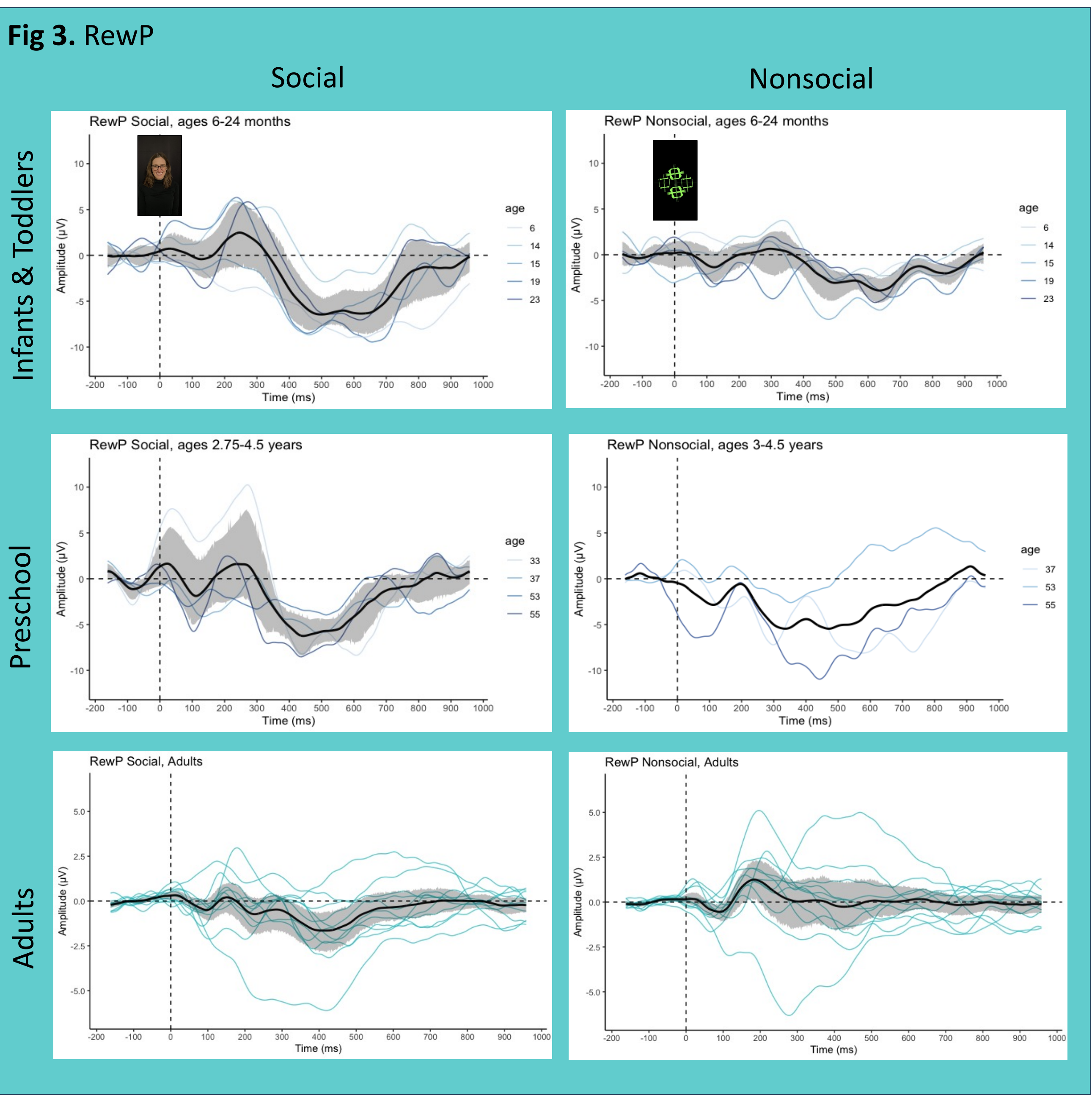
Participants

Children (n=12; 6-55mos); Adults (n=11; 22-27yrs) as proof-of-concept control group

EEG Data Acquisition

- EGI MagStim Geodesic Hydrocell 128 channel electrode nets. Impedences < 100Ω
- No difference in manual segment removal vs cleaning with HAPPE-ER 3.0 [4]

ePeekaboo Pilot Results



ERP Processing

- HAPPE: down-sample 500Hz • Band-pass filter 0.1-30Hz • Bad channel detection • Wavelet thresholding (soft) • Segment • Interpolate • Baseline correct • Reject segments (+/- 200uV) • Average re-reference
- Exclusion criteria: <20 trials/condition (n=2 children); pre/post waveletting $r < 0.05$ in >2 frequency bands (n=1 child); preprocessing failed (n=2 child)
- Region of Interest (frontal-central: Fz, Cz, E6, E13, E112)

Discussion

ePeekaboo appears to elicit:

- positive peak between 200-300ms for children (for adults, 200 and 300ms (social only))
- a slower negativity from 350-700ms, primarily in the social condition for children

Did the passive ePeekaboo task elicit the expected waveforms in adults? Some, not all.

- Expected positive peaks at 200ms (nonsocial and social) and 300ms (social only) were observed
- Based on past literature [2], the RewP would not necessarily be expected in adults after passive reward receipt
- Next step: compare each condition to control condition

Greater magnitude observed in social condition

- In children and adults, greater changes in amplitude were observed qualitatively in social trials
- Converges with observations of infant and toddlers’ behavioral responses to stimuli (“Mama!!!”)

What this study adds

- First evidence of a potential RewP in children under 4 years
- Demonstration of feasibility of passive paradigm (like ePeekaboo) to collect reward processing data (response) in infants

Limitations & Future Directions

- Small sample with some experimental inconsistencies due to changes in paradigm design throughout pilot testing (increase trials, add fake outs doubling as attention-getters, increase duration of anticipation period, change sounds)
- Future directions: larger cross-sectional data collection, exploring relationships with developmental level (Mullen) and temperament (IBQ-R), and calculate RewP compared to baseline condition
- Analyze anticipation via Stimulus Preceding Negativity (SPN) ERP

References

- Clements, Asuncion, and Nelson. J Am Acad Child Adolesc Psychiatry, s0890-8567. (2022).
- Proudfit. Psychophys. 52(4), 449-459. (2015).
- Hennefield et. al. Dev Science. 25(3), e13196 (2022).
- Monachino, Lopez, Pierce, Gabard-Durnam, Dev. Cog. Neuro. 57, 101140. (2022).

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Designed to mimic peekaboo

- Sound A or B plays to cue the infant that their caregiver’s video will soon appear on the left (sound A) or right (sound B).
- Each block includes 2 ‘fake outs’ where a novel stimulus appears on the ‘wrong’ side. Fake-outs serve to potentiate the RewP and as attention getters.

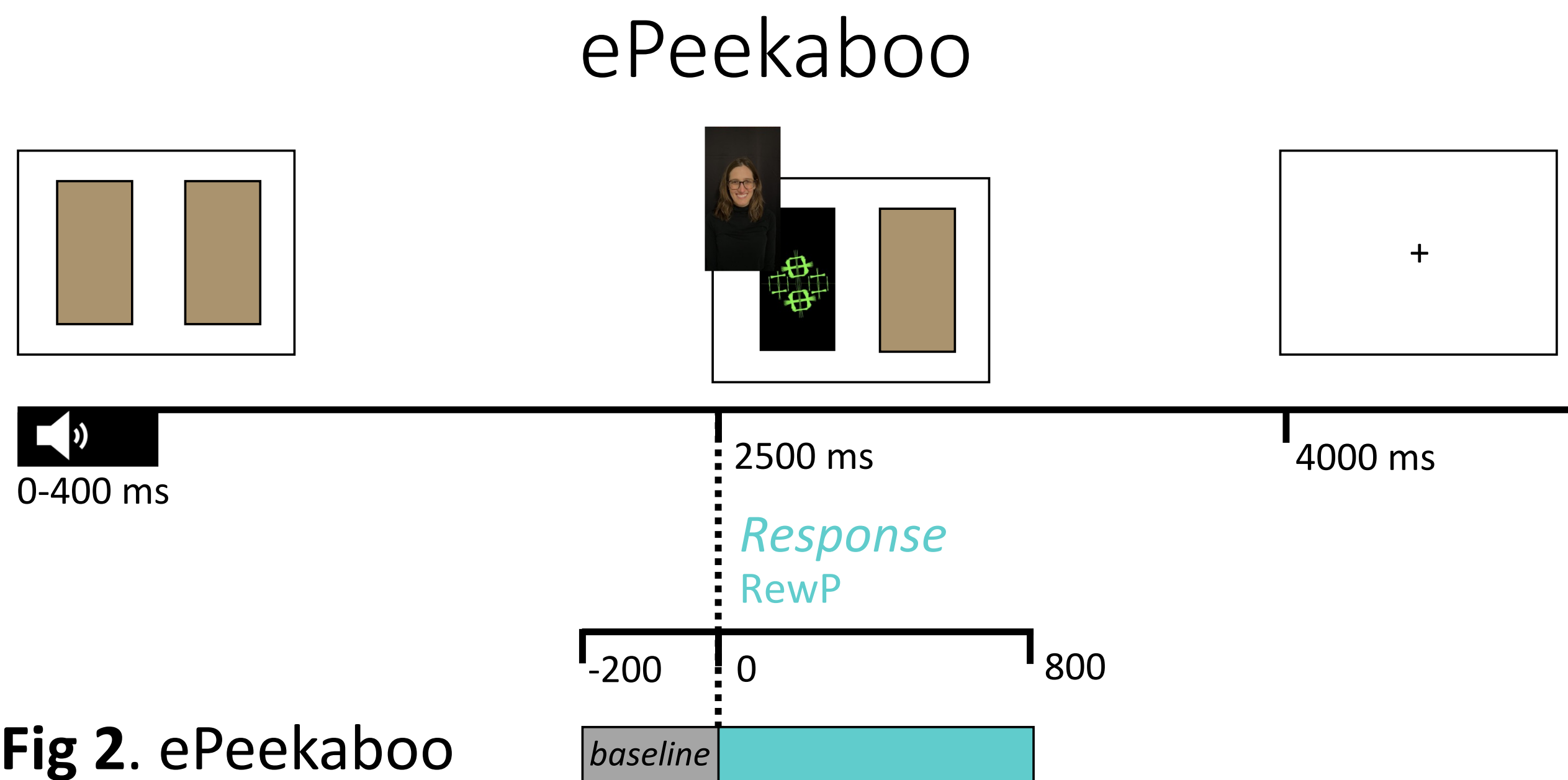


Fig 2. ePeekaboo

Stimuli

- nonsocial (fractal) or social (child’s caregiver or adult’s favorite celebrity)
- Both videos and static photos used during piloting; combined for this analysis

Blocks (counterbalanced)

- Baseline (10 trials), Nonsocial photo (30), Social photo (30), Nonsocial video (30), Social Video (30).