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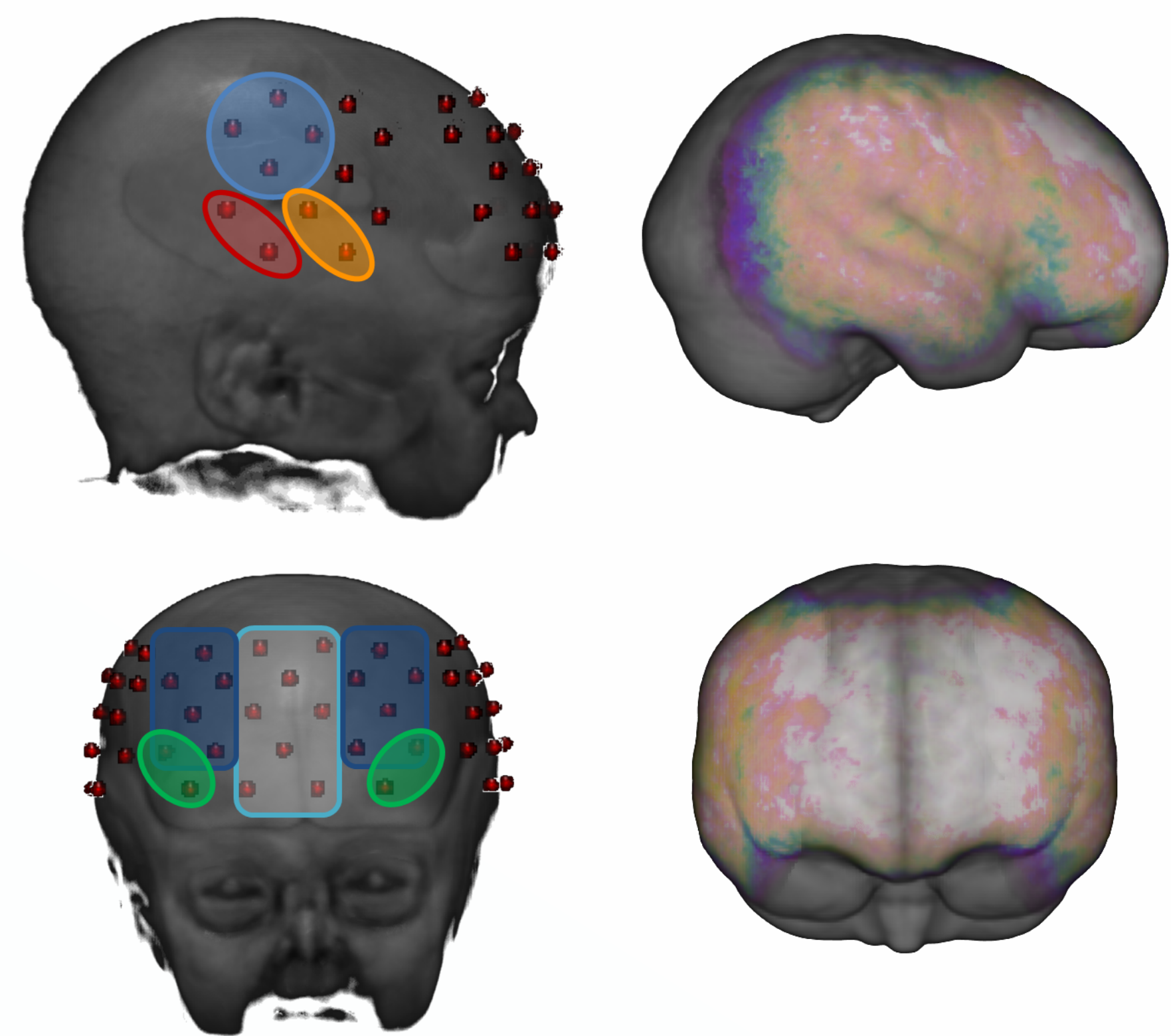
Research questions

- Facial emotion recognition emerges in infancy and is considered a critical building block to social-emotional development [1].
- Little is known about facial emotion recognition between 2-4 years of age, particularly regarding subtle facial emotions.
- We used an explicit behavioral task and a passive neuroimaging task to investigate behavioral and neural responses to facial emotions of varying intensities in 3-year-olds.

fNIRS Regions Of Interest

- Age-appropriate MRIs selected from database [2,3] matched to study participants in age and head circumference.
- Optodes placed onto MRIs from probe geometry and placement photographs [4].
- Cortex regions labeled using the LONI atlas [5].
- Group regions of interest (ROIs) defined based on average channel cortical localization over a subset of participants for which localizations have been processed to date (N=7).
- TPJ defined as the conjunction of the angular (BA 39) and supramarginal (BA 40) gyri

Average channel locations and sensitivity profile



Temporo-Parietal Junction (TPJ)
Superior Temporal Gyrus (STG)
Middle Temporal Gyrus (STG)

Superior Frontal Gyrus (SFG)
Middle Frontal Gyrus (MFG)
Inferior Frontal Gyrus (IFG)

Conclusions

- Increased sensitivity to happy expressions in this age group is reflected in behavioral and neuroimaging results
- fNIRS sensitivity to low intensity (40%) dynamic fear faces contrasts with the low behavioral accuracy for explicitly recognizing fearful faces

Acknowledgments

- The work was supported by the National Institute of Mental Health (R01 MH078829). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Mental Health of the National Institutes of Health.
- Study data were collected and managed using Research Electronic Data Capture (REDCap) tools hosted at Boston Children's Hospital. REDCap is a secure, web-based application designed to support data capture for research studies, providing: 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources [10]
- We thank the coordinators, participants, families, students, and research assistants who made this research possible.

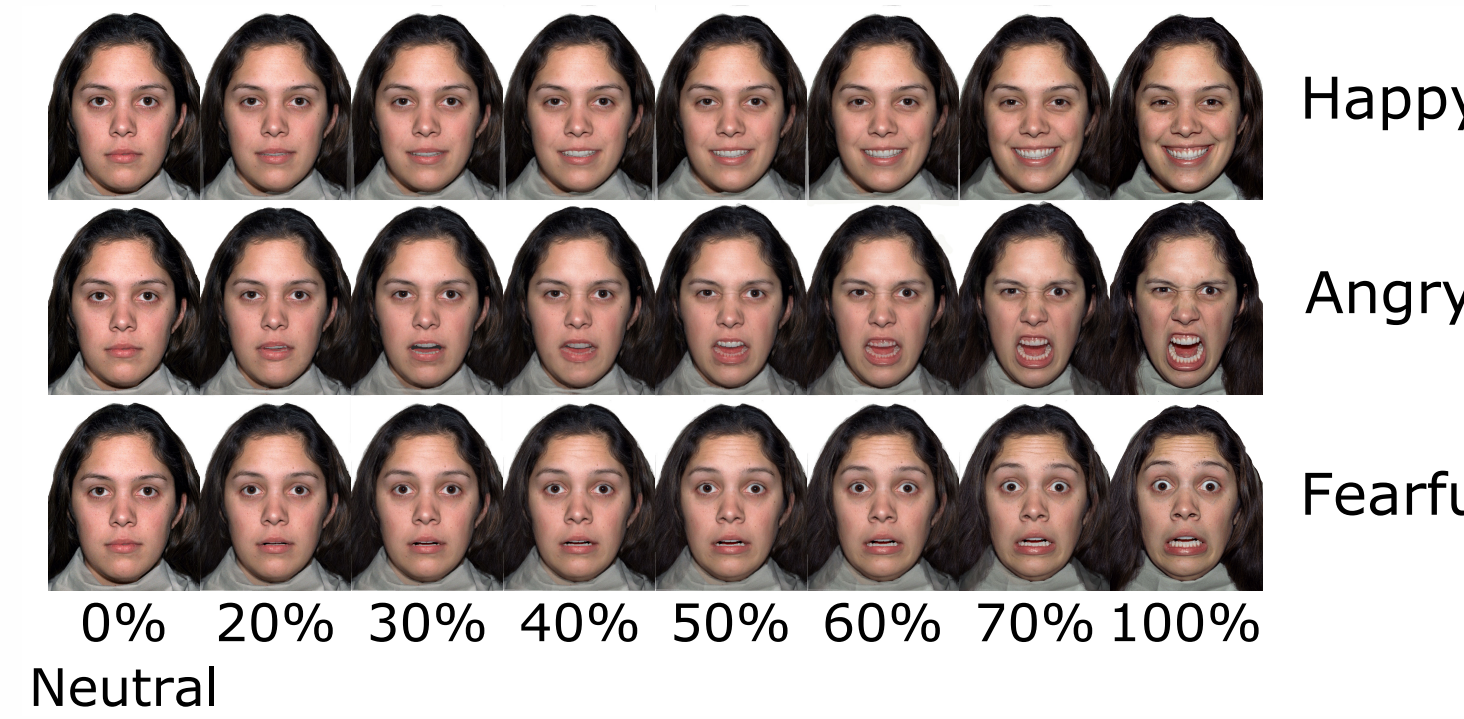
Behavioral materials and methods

Participants

- N=208 3-year-olds, 56 of whom also contributed valid fNIRS data

Paradigm

- Children sorted neutral and happy, angry, and fearful faces of varying intensity into four houses representing these emotions [6]
- The task required an overt, explicit response but not verbal labelling



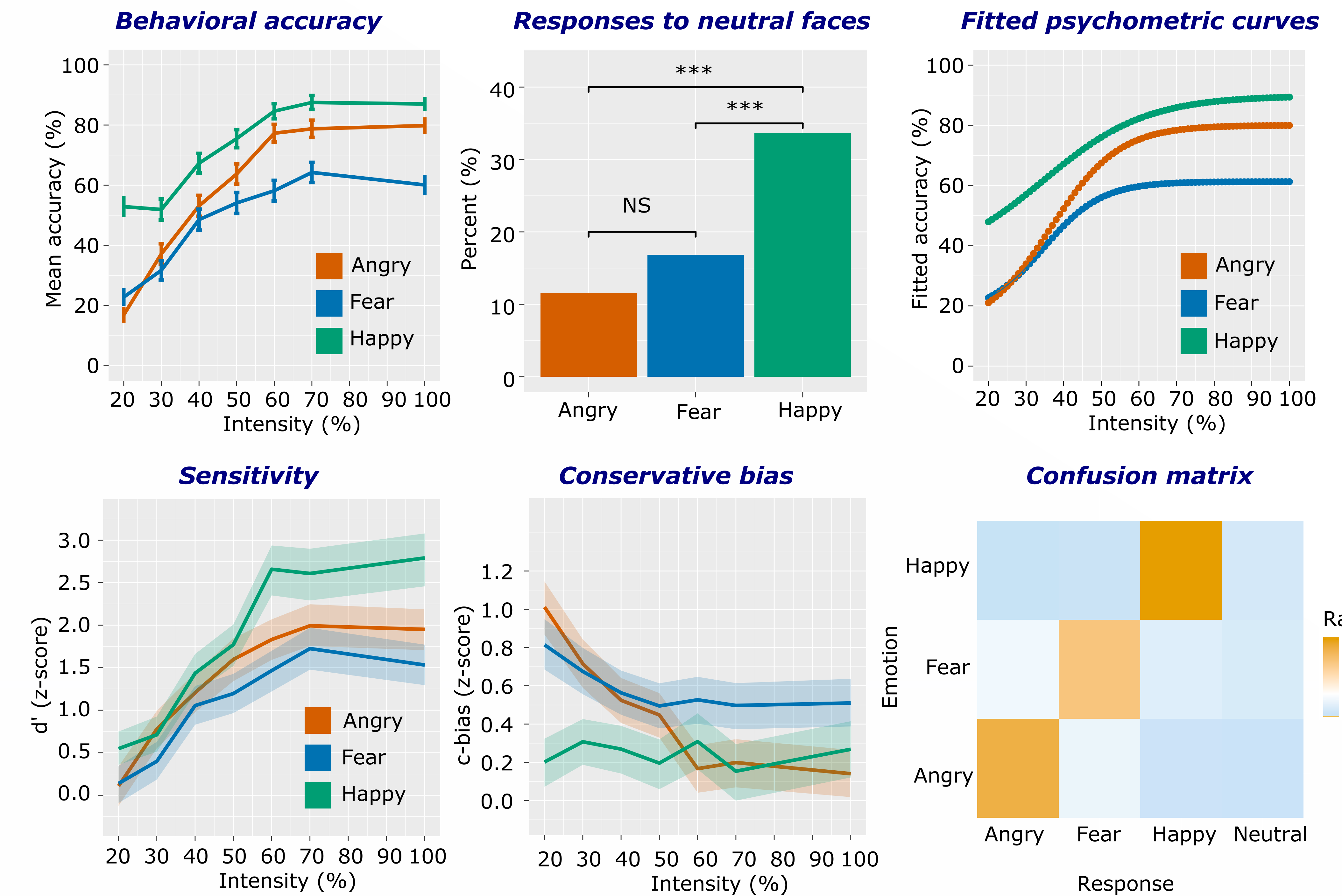
Psychometric curve modeling

- Psychometric curves model by custom nonlinear least-square models
- Non-parametric 95% CIs for the asymptote(s) and thresholds (i.e., inflexion points) obtained from N=10,000 bootstrap samples

$$f(x) = Y_0 + \frac{Y_{100} - Y_0}{1 + \exp[-a * (x - \theta)]}$$

- Intensity thresholds for recognition at about 35% intensity, no significant differences between expressions
- Upper accuracy asymptote significantly lower for fear than for happy and angry; marginally lower for angry than happy
- High-intensity fear and angry significantly more confused with one another than with happy or neutral
- Neutral faces categorized as emotional (i.e., non-neutral) 62.02% of the time, interpreted as happy more often than as angry or fear (ps < .001).

Behavioral results



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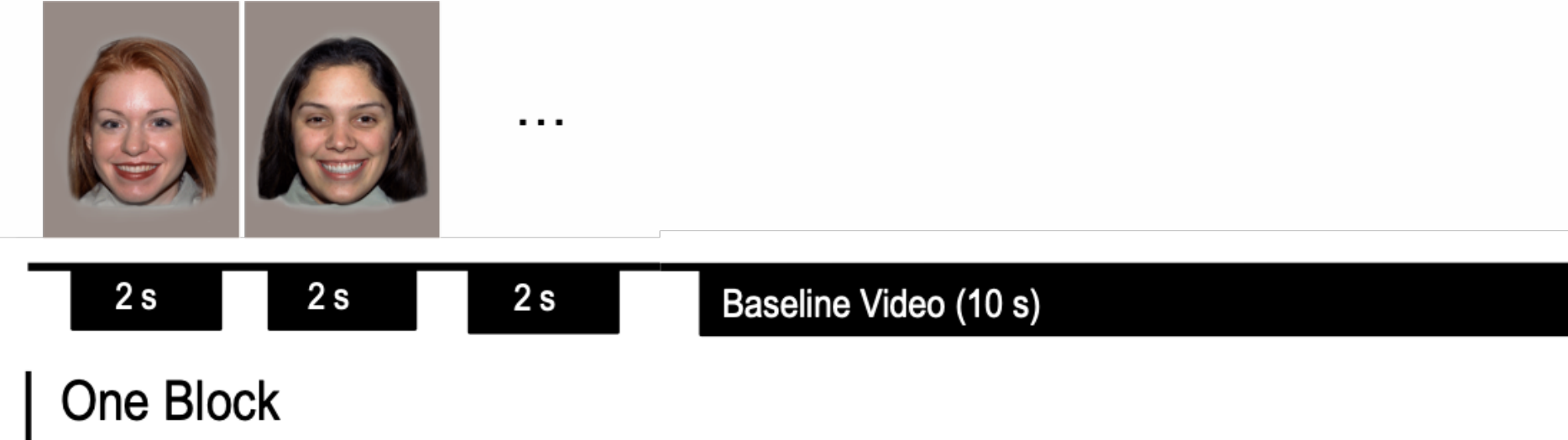
fNIRS materials and methods

Participants

- N=60 3-year-olds, 56 of whom also contributed behavioral data
- Additional N=94 completed the task but were rejected (6 bad hat placement, 76 50% or more bad channels, 12 technical failure)

Paradigm

- 46-channels fNIRS (Hitachi ETG-400) recorded at 60 Hz
- Passive viewing of 60 blocks of dynamic emotional faces generated from the NimStim [7]

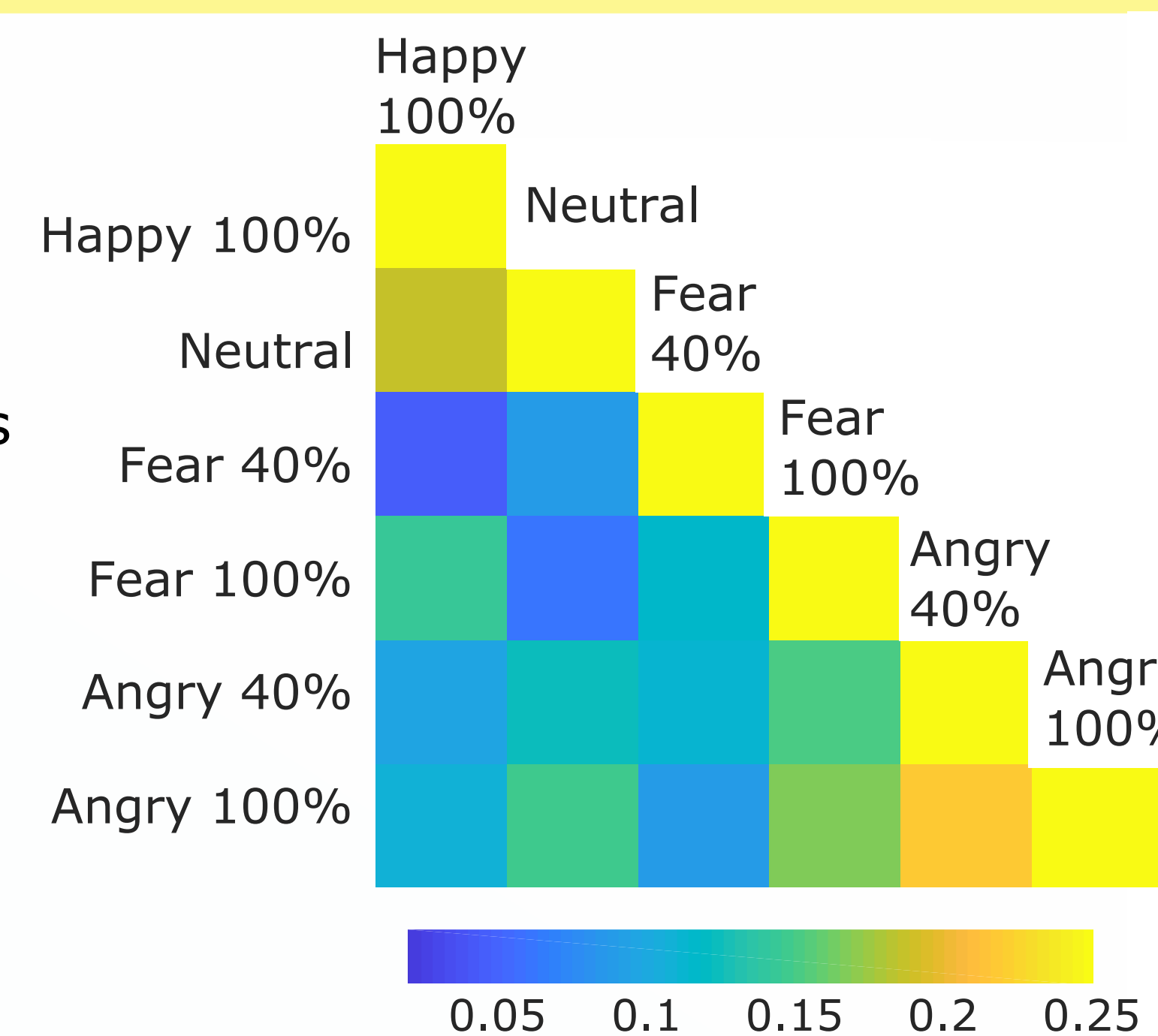


Preprocessing

- Preprocessing in Homer2 using previously described methods [8,9]
- Average changes in oxyHb extracted from 1-5s post-onset based on group grand mean peak hemodynamic response function

Average similarity matrix (all ROIs)

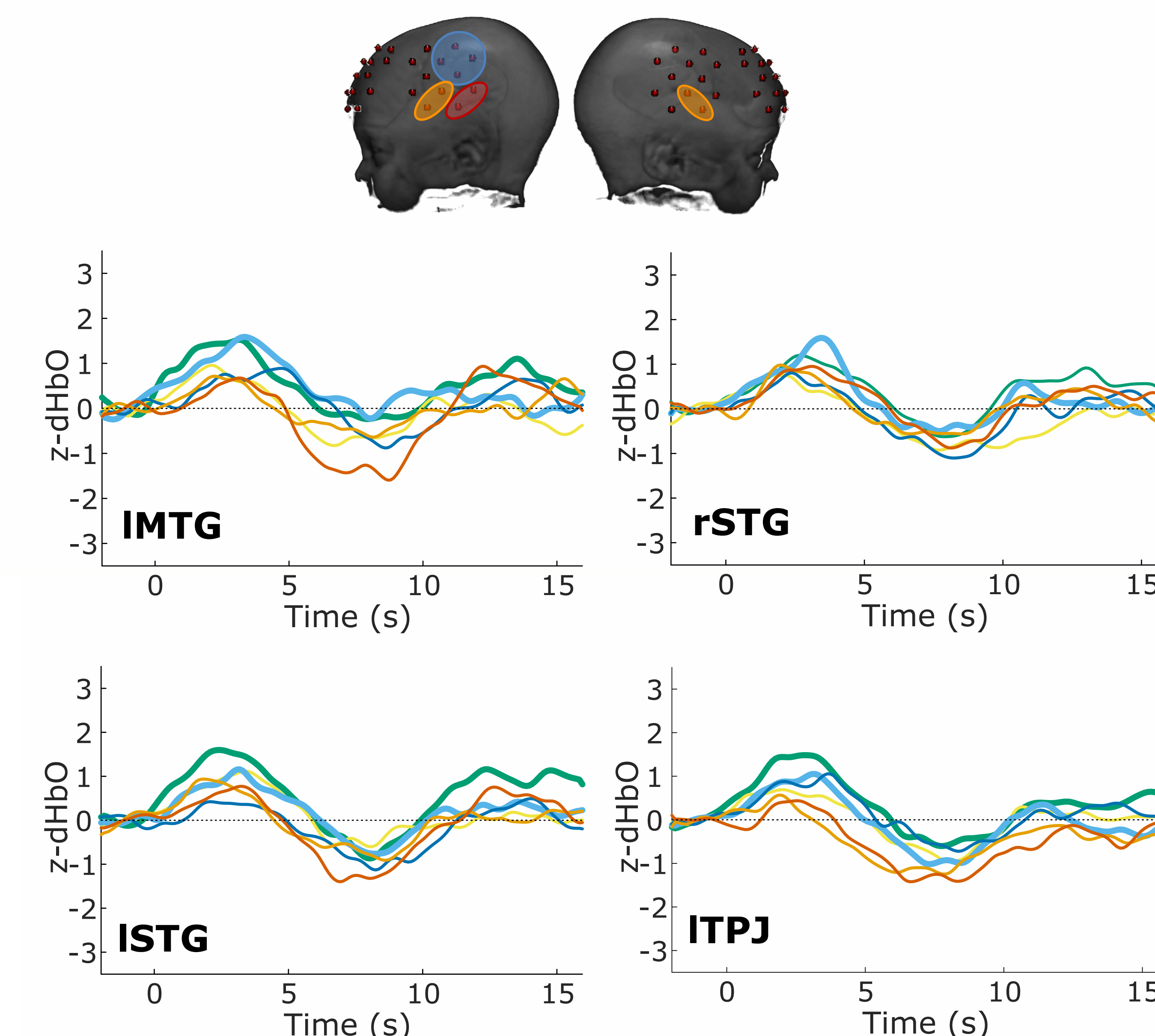
- Average split-half r = 0.978 [0.963 0.990] over 10,000 random splits



fNIRS results

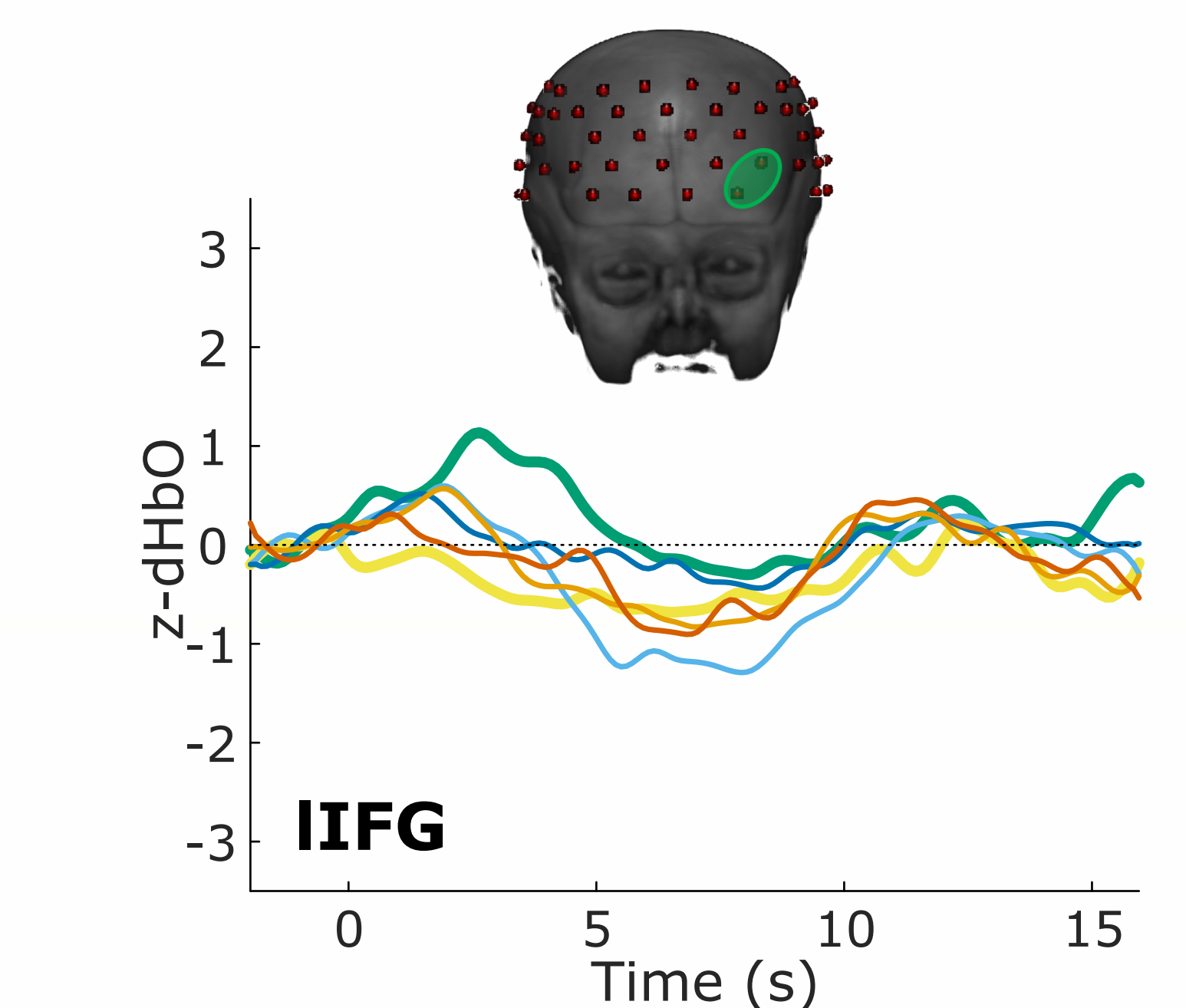
Activations versus Baseline

- Significant activations in response to Happy (100%) and/or Fear (40%) versus baseline over the left MTG, bilateral STG, and left TPJ



Differential responses versus Neutral

- Significant difference in response to Happy (100%) versus Neutral over the left IFG



Brain-behavior relationships

- No significant effect of mean behavioral accuracy on activation in any ROI after FDR correction, controlling for number of trials