

An Event-Related Potential Study on Emotional Face Processing, Temperament, and Internalizing Traits in Three-Year-Old Children

Finola Kane-Grade¹, Wanze Xie¹, Halie Olson², Michelle Bosquet Enlow^{1,3}, & Charles Nelson^{1,3,4}

¹Labs of Cognitive Neuroscience, Division of Developmental Medicine, Boston Children's Hospital, Boston MA, USA, ²Massachusetts Institute of Technology, Cambridge MA, USA, ³Harvard Medical School, Boston MA, USA, ⁴Harvard Graduate School of Education, Cambridge MA, USA



Introduction

- Face- and attention-sensitive components of the event-related potential (ERP), including the P400, Nc, and N290, are reliably elicited from young children.^{1,2}
- ERPs are useful tools to understand how individual differences in neural response relate to emotional difficulties, including anxiety.
- Early temperament has also been associated with later anxiety.³
- This work examines neural indices of facial emotion processing, and whether ERP responses to emotional faces and early temperamental characteristics are associated with anxiety symptoms in preschool-aged children.

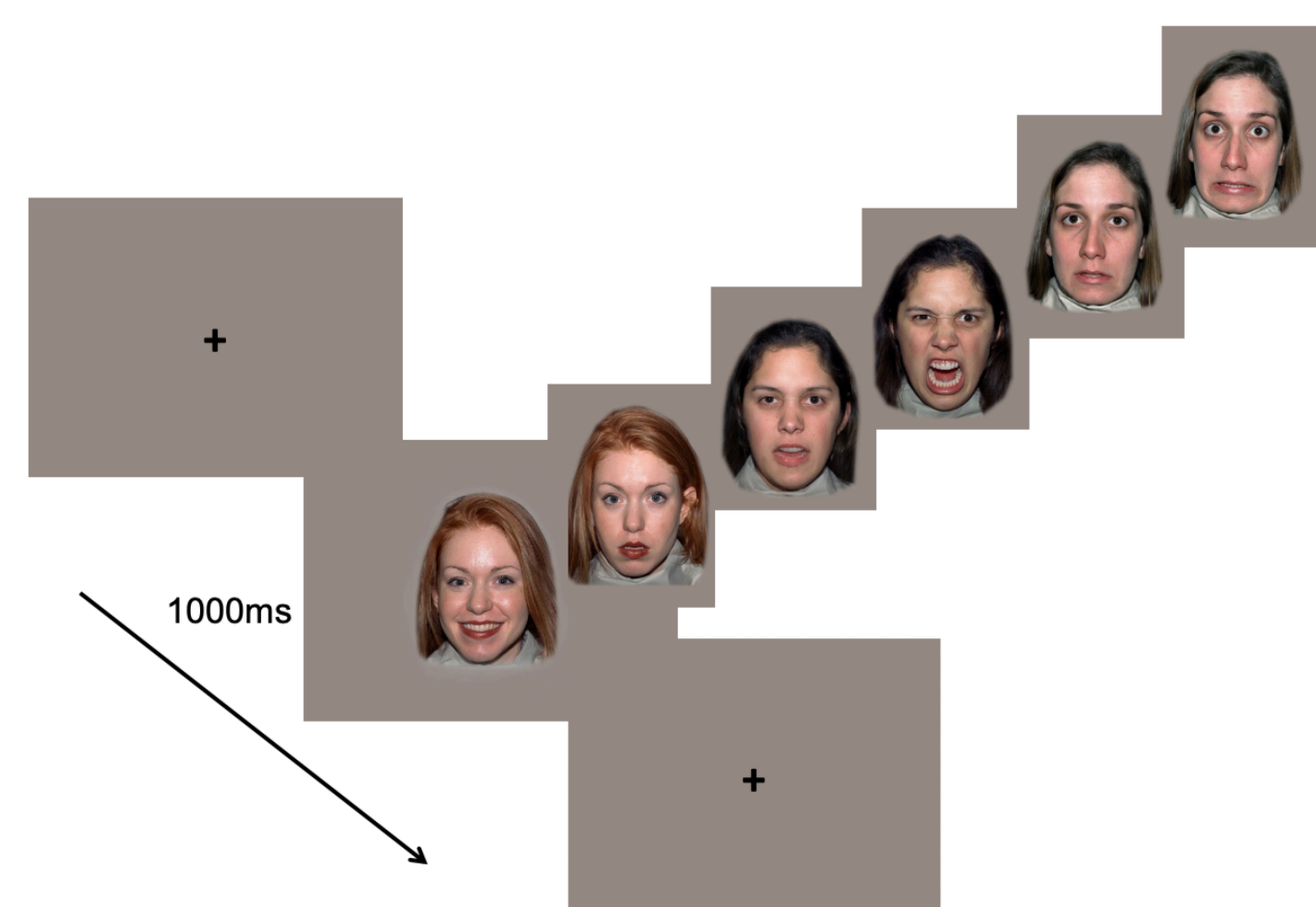
Methods

IMAGING

- 128 electrode Hydrocel Geodesic Sensor Net
- EGI NetAmps 300 used to amplify the EEG signals; data acquired using NetStation 4.5.4 software and sampled at 500Hz.
- N=132 3-year-old children recruited in Boston MA, USA



STIMULI DESIGN



STIMULI

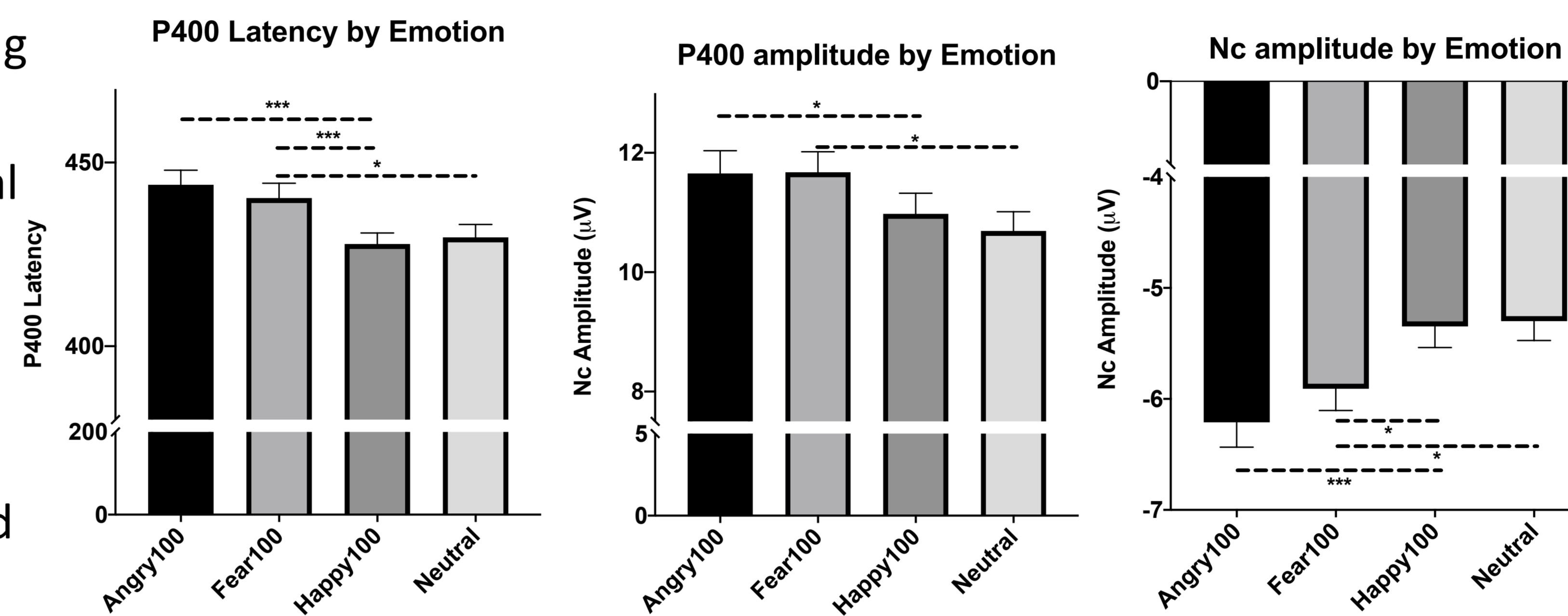
- Photos of neutral, happy, angry, and fearful female faces from NimStim set; up to 300 faces presented
- Parent-reported infant temperament (Infant Behavior Questionnaire; IBQ) and 3-year-olds' internalizing symptoms (Infant-Toddler Social & Emotional Assessment; ITSEA)

DATA PROCESSING

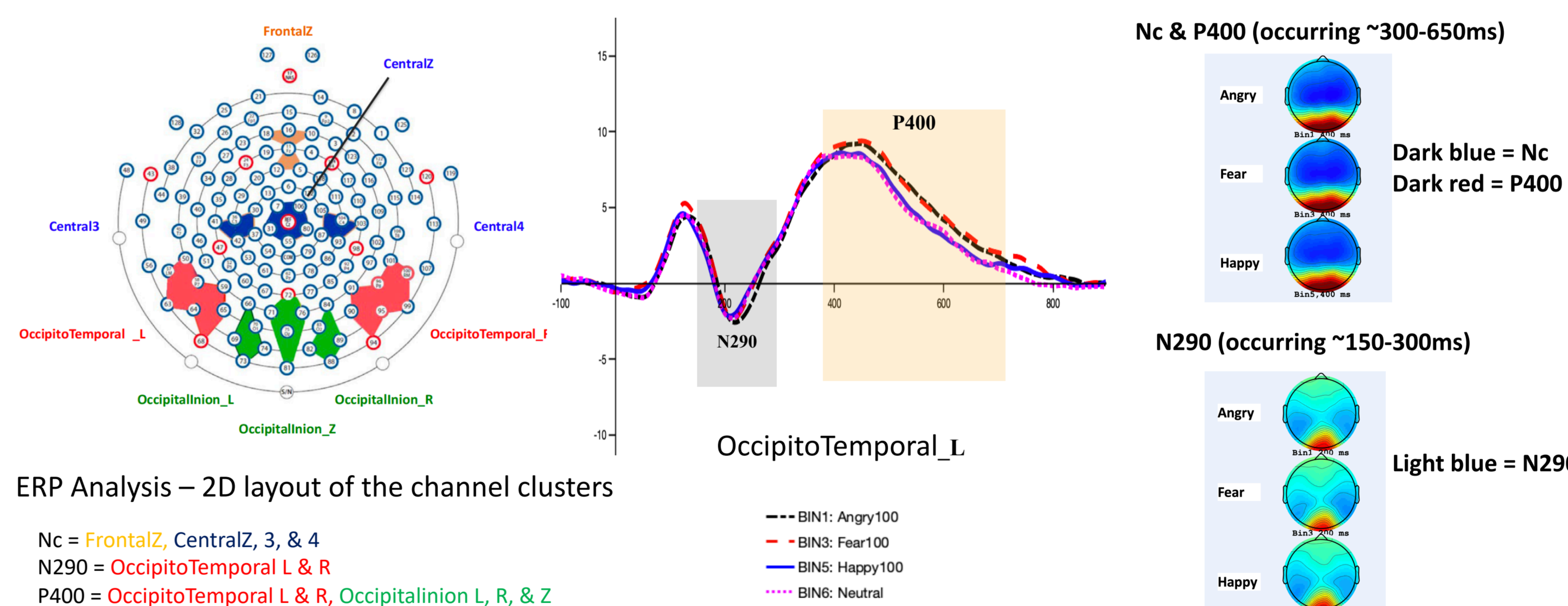
- Data inclusion criteria:
 - 10 or greater trials with acceptable data per emotion condition
- Processed using ERPLab
- Time windows: N290: 150-300ms, P400: 300-650ms, Nc: 300-650ms

Results

ERP Responses to Passive Viewing of Emotional Facial Expressions



We did not find any significant differences for N290 amplitude or latency x emotion type, $p > .05$

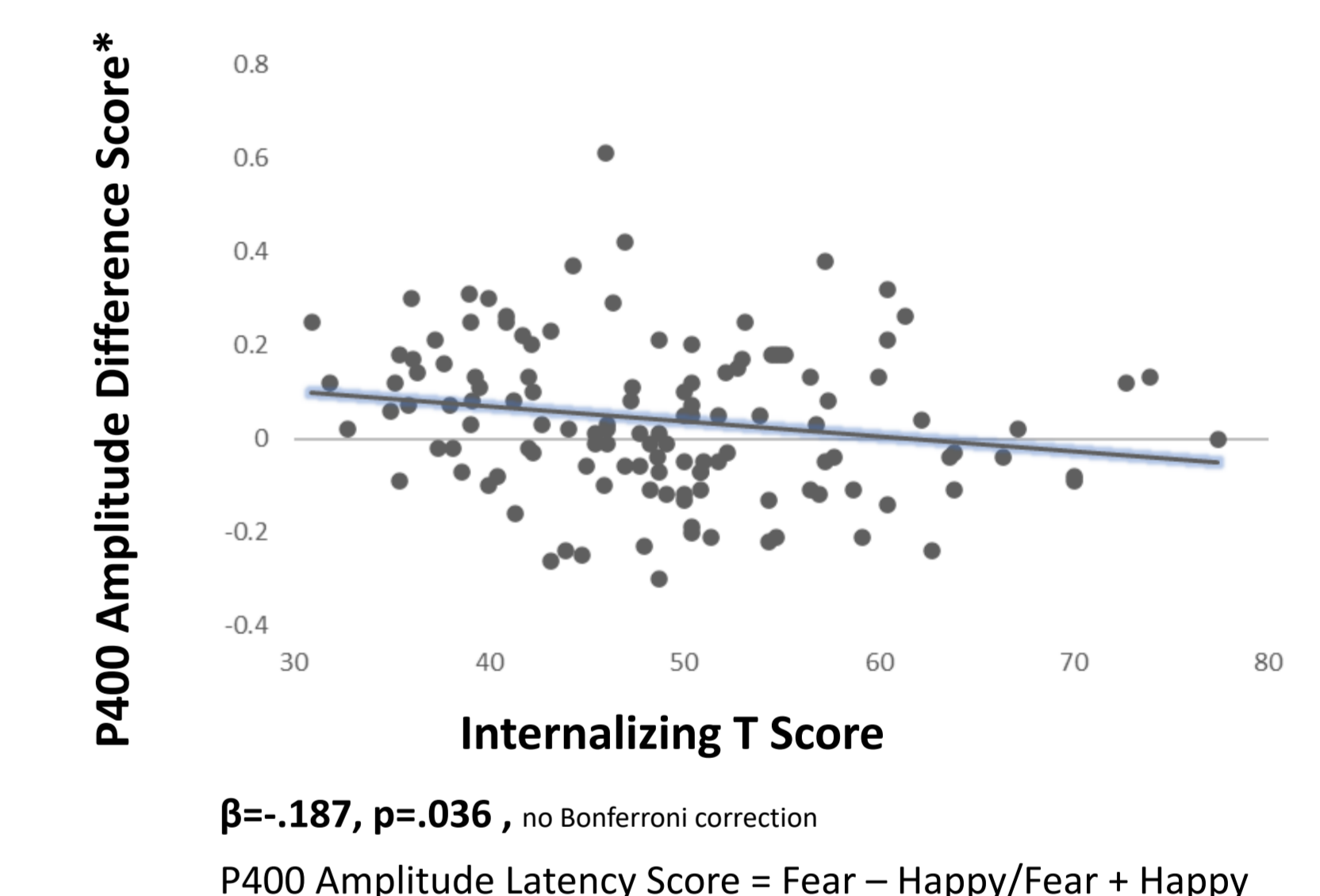


Infant Temperament & 3-year Internalizing Traits

	3 year ITSEA Internalizing T Score
IBQ Distress	** .234
IBQ Fear	* .194
IBQ Falling Reactivity	* -.235
IBQ Cuddliness	* -.191
IBQ Sadness	* .190
IBQ Negative Emotionality	*** .310

Note: *= $p < .05$, **= $p < .01$, ***= $p < .001$, two-tailed, N=118

ERP Response to Emotional Faces & Internalizing Traits



Conclusions

- The P400 and Nc components were found to be larger in amplitude (& longer latency for P400) in response to angry and fearful faces over central and frontal scalp, indicating greater attention to the negatively-valenced faces.
- Children's' brain responses to fearful faces (versus happy faces) may be associated with their internalizing traits.
- Temperament characteristics reported in infancy were associated with internalizing traits reported at age 3 years.
- Identifying early neural and behavioral markers of anxiety risk will inform the design of identification methods and interventions to prevent the development of anxiety in at-risk children.

Acknowledgements

The work was supported by the National Institute of Mental Health (R01 MH078829). Assistance with data processing was provided by Lauren Steele, Anna Fasman, Swapna Kumar, and Saul Urbina-Johanson. Our sincere thanks to the families for their participation.

REFERENCES

- Leppanen, J.M., Moulson, M.C., Vogel-Farley, V.K., & Nelson, C.A. (2007). An ERP study of emotional face processing in the adult and infant brain. *Child Development*, 78, 232-245.
- Van den Boomen, C., Munsters, N.M., & Kemner, C. (2017). Emotion processing in the infant brain: The importance of local information, *Neuropsychologia*.
- Tang, A., Crawford, H., Morales, S., Degnan, K.A., Pine, D.S., & Fox, N.A. (2020). Infant behavioral inhibition predicts personality and social outcomes three decades later. *Proceedings of the National Academy of Sciences*.