

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

Finola Kane-Grade<sup>1</sup>, Wanze Xie<sup>1</sup>, Halie Olson<sup>2</sup>, Michelle Bosquet Enlow<sup>1,3</sup>, & Charles A Nelson<sup>1,3,4</sup>

<sup>1</sup>Labs of Cognitive Neuroscience, Division of Developmental Medicine, Boston Children's Hospital, Boston MA, USA, <sup>2</sup>Massachusetts Institute of Technology, Cambridge MA, USA  
<sup>3</sup>Harvard Medical School, Boston MA, USA, <sup>4</sup>Harvard 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.<sup>1,2</sup>
- ERPs are useful tools to understand how individual differences in neural response relate to emotional difficulties, including anxiety.
- The temperamental profile of behavioral inhibition has been associated with later anxiety.<sup>3</sup>
- 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.

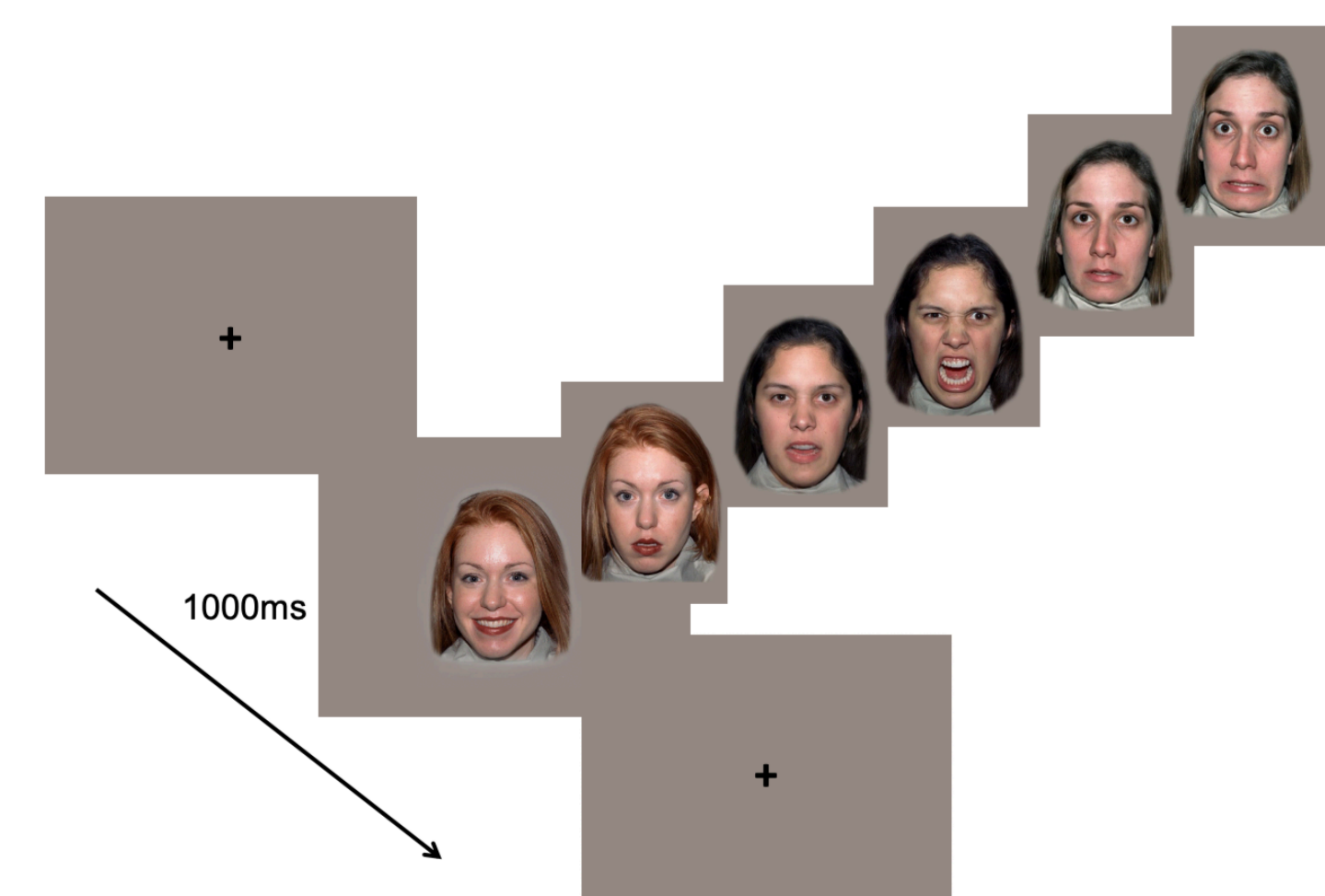
## Methods

### 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

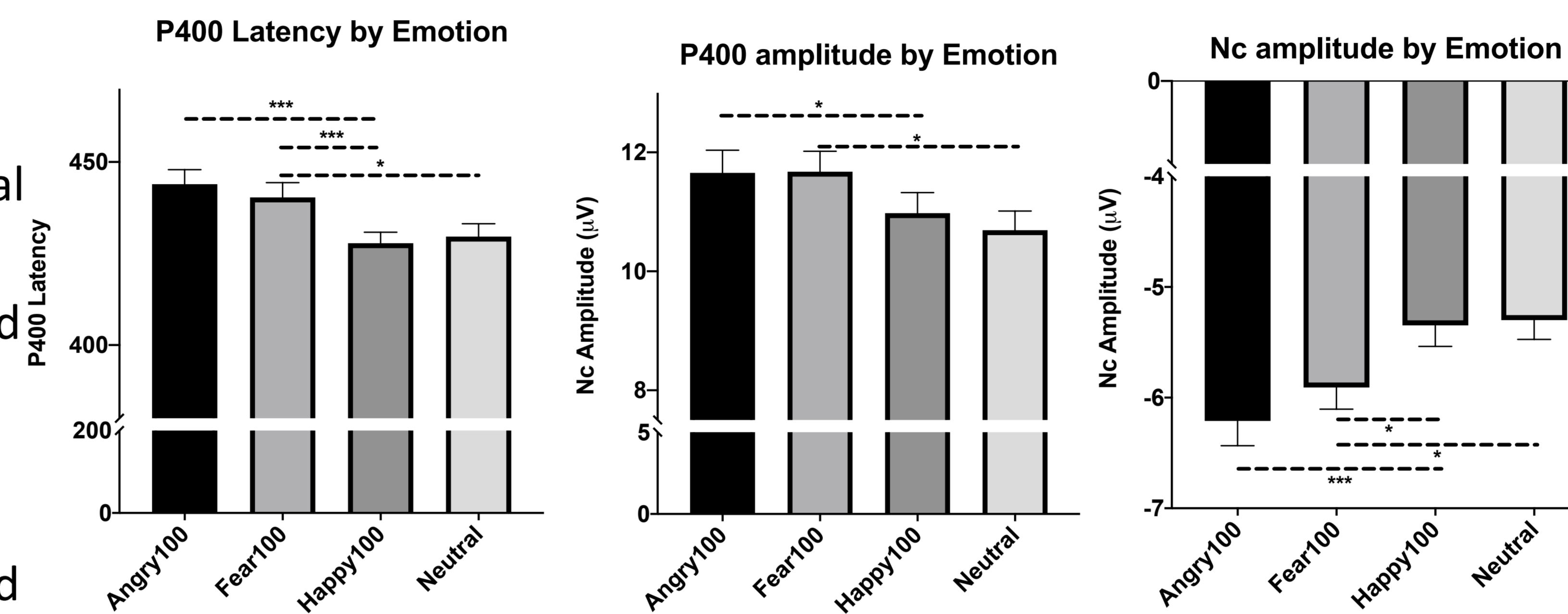
- Photos of neutral, happy, angry, and fearful female faces from NimStim set; up to 300 faces presented
- Parent-reported infant temperament (Infant Behavior Questionnaire; IBQ) and 3-year-olds' internalizing symptoms (Infant-Toddler Social & Emotional Assessment; ITSEA)

### DATA PROCESSING

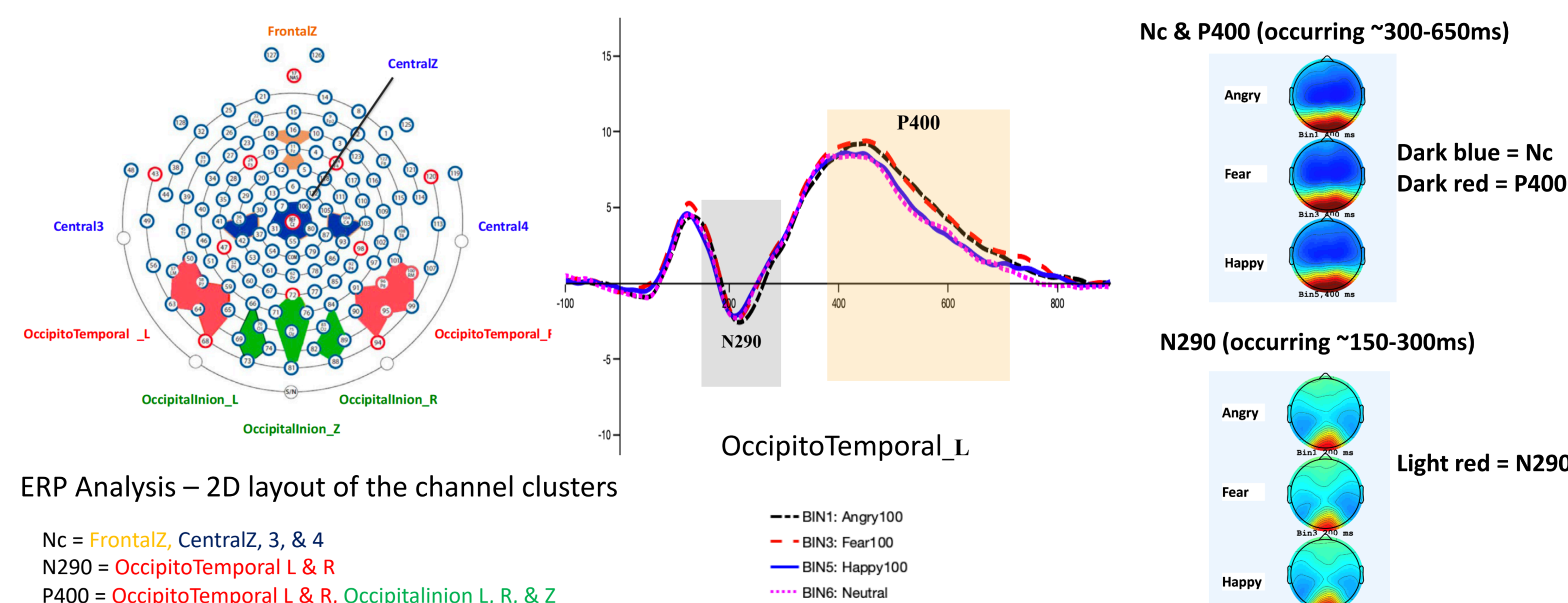
- Data inclusion criteria:
  - 10 or greater trials with acceptable data per emotion condition
- Processed using ERPLab
- Time windows: N290: 150-300ms, P400: 300-650ms, Nc: 300-650ms

## 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,  $p > .05$

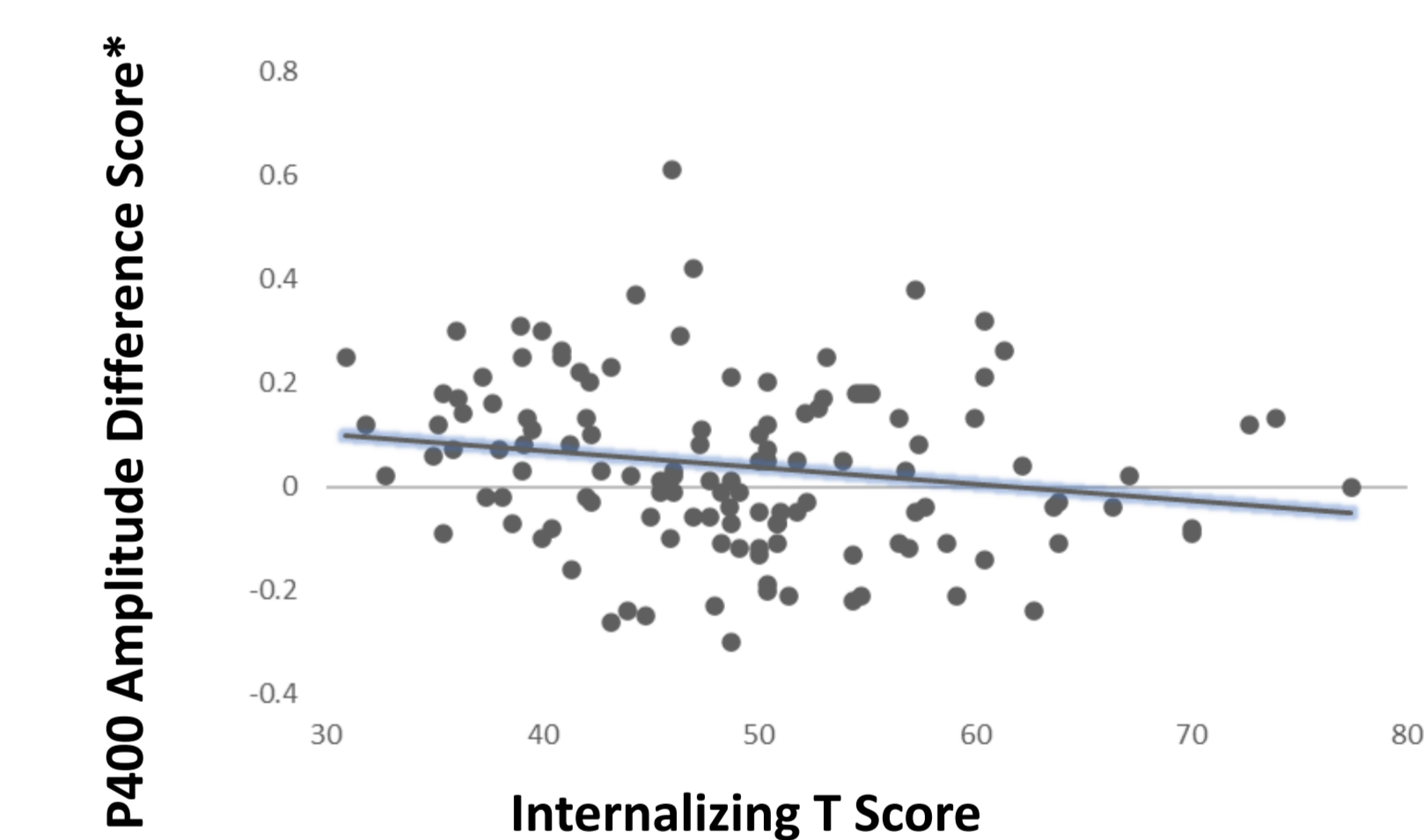


### Infant Temperament & 3-year Internalizing Traits

	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

- Our findings indicate that 3-year-olds displayed heightened attention to the negatively-valenced faces, as 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.
- Additionally, we found that 3-year-olds' brain responses to fearful faces (versus happy faces) may be associated with their internalizing traits.
- Further, temperament characteristics reported in infancy (distress, fear, negative emotionality, falling reactivity, cuddliness, and sadness) 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*.