Moderation between Electrophysiological Measures of Reactivity and Cognitive Control for Predicting Punitive Parenting Practices

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Background

Punitive parenting practices involve verbal or physical punishment to control children's expression of negative emotions (Fabes et al., 1990). Parenting practices are related to self-regulation abilities (Bridgett et al., 2015) that entail an interaction between cognitive/inhibitory control and reactivity (Evans & Rothbart, 2009). Central theta power is a neural indicator of cognitive/inhibitory control (Cavanagh & Frank, 2014). Frontal alpha asymmetry is linked to reactivity to positive and negative emotions; while right asymmetry is linked to approach behaviors and emotions, left asymmetry is linked to withdrawal (Smith et al., 2017). While the extant literature predominantly focuses on behavioral and self-reported predictors of parents' maladaptive practices (e.g., Bridgett et al., 2017; Chen et al., 2021; Valiente et al., 2007; etc.), the current study aimed to explore the interaction between these neural indicators.

Method

Sample

- Fifty-three mothers ($M = 36.31$ years, $SD = 4.17$) of preschool- and kindergarten-age children

Instruments

- Punitive parenting self-report (measured by the CCNES questionnaire; Fabes et al., 1990)
  - Cronbach's alpha .79
  - $M = 1.80$ (range 1 – 4.33)
- EEG recordings
  - Net Station Geodesic system, 128 electrodes
  - Pre-processing included filtering, manual artifact removal, PCA/ICA removal of eye movements and blinks, trial-by-trial automatic interpolation of noisy segments

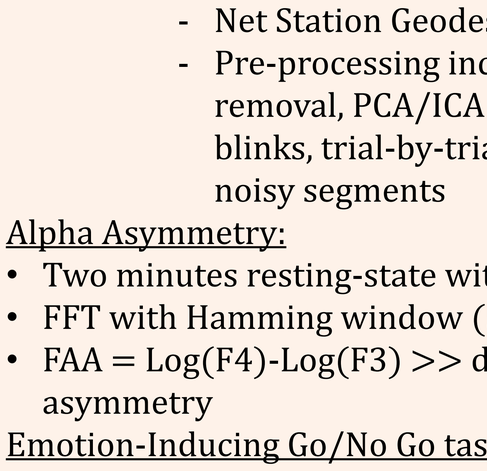
Alpha Asymmetry:

- Two minutes resting-state with opened eyes recording
- FFT with Hamming window (5 seconds; 50% overlap)
- FAA = Log(F4)-Log(F3) >> divided into right or left asymmetry

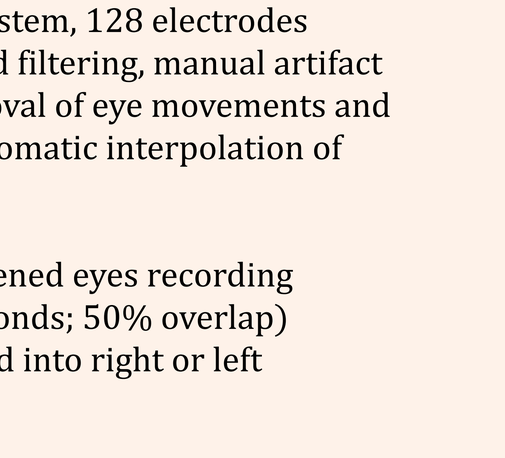
Emotion-Inducing Go/No Go task

- Three blocks with fake competition feedback (loss feedback during negative emotion-inducing block)
- Mean theta band power (4-8 Hz in Cz between 200-600 ms) after No Go stimuli in block B

Topographic Distribution of Alpha Power



Topographic Distribution of Theta Power at 250 ms after No Go Stimulus

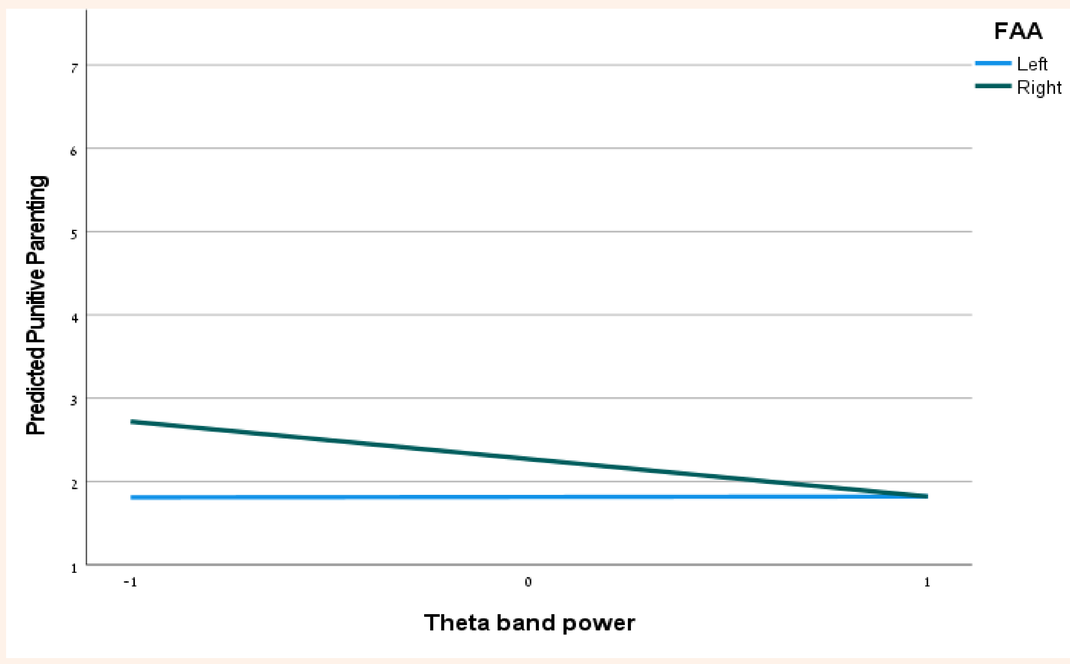


Results

Multiple regression analysis was carried out using Hayes' moderation model. Between all reported parenting scales within the CCNES questionnaire, only punitive parenting was significantly predicted by the interaction term ($R^2 = .283, F(6, 46) = 3.03, p = .014$; $\beta_{int} = -.44, t(46) = -2.11, p = .039$)

Predictors	Punitive Parenting Practices		
	β	95% CI	
		LL	UL
SES	-.03	-.25	.20
Age	-.01	-.06	.04
Raven	-.17	-.38	.04
Theta power	.00	-.31	.30
FAA	.45*	.02	.90
Interaction	-.44*	-.86	-.02

Note. $N = 53$. All predictors are standardized. SES = socioeconomic factor loaded by income, education years, number of houserooms and cars; FAA = frontal alpha asymmetry grouped by left (*below zero difference* = 0) or right (*above zero difference* = 1); interaction term between theta power and FAA. *$p < .05$.

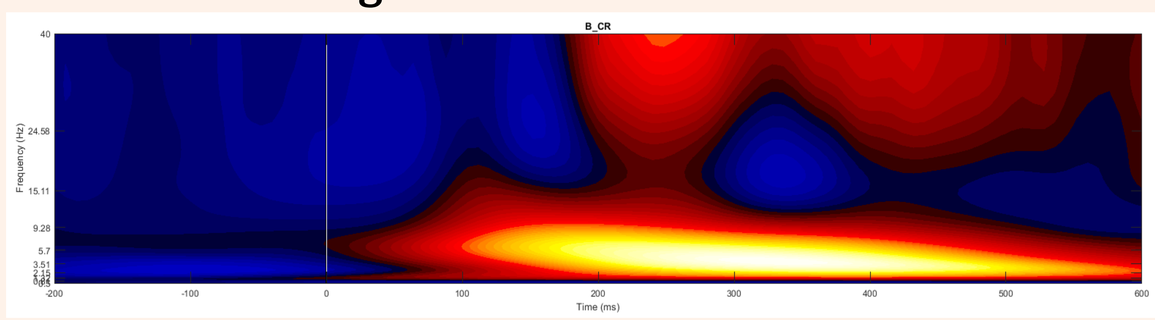


Controlled for socio-economic statues, age, and raven score.

Discussion

Findings revealed that lower power in theta activity accompanied by right asymmetry was associated with higher levels of punitive parenting, while all other combinations were associated with lower levels. Meaning, for mothers with high reactive tendencies for approaching behaviors and externalized emotions (like anger and frustration), their level of cognitive control moderates their behavior of punitive responses when the child expresses negative emotions. These findings align with Rothbart's temperament model (Evans & Rothbart, 2009) and exhibit electrophysiological support for the interaction between reactivity and cognitive control.

Time-Frequency Analysis of Theta Power when Inhibition is Required in the Negative Emotion-Inducing Block



This study was partially supported by the Israel Scientific Foundation (ISF; Grant number 533/20)

References

Bridgett, D. J., Burt, N. M., Edwards, E. S., & Deater-Deckard, K. (2015). Intergenerational transmission of self-regulation: A multidisciplinary review and integrative conceptual framework. *Psychological Bulletin*, *141*(3), 602-654.
Bridgett, D. J., Kanya, M. J., Rutherford, H. J. V., & Mayes, L. C. (2017). Maternal executive functioning as a mechanism in the intergenerational transmission of parenting: Preliminary evidence. *Journal of Family Psychology*, *31*(1), 19-29. https://doi.org/10.1037/fam0000264
Cavanagh, J. F., & Frank, M. J. (2014). Frontal theta as a mechanism for cognitive control. *Trends in Cognitive Sciences, 18*, 414–421. https://doi.org/10.1016/j.tics.2014.04.012
Chen, S. H., Deng, X. F., Zhang, E., Wang, L. K., & Liu, C. H. (2021). Self-regulatory development in children from Chinese immigrant families: Evidence for commonality and specificity. *Child Development*, *92*(6), e1126-e1137.
Evans, D. E., & Rothbart, M. K. (2009). A two-factor model of temperament. *Personality and individual differences*, *47*(6), 565-570.
Fabes, R. A., Eisenberg, N., & Bernzweig, J. (1990). *Coping with Children's Negative Emotions Scale (CCNES): Description and scoring.* Arizona State University.
Smith, E. E., Reznik, S. J., Stewart, J. L., & Allen, J. J. (2017). Assessing and conceptualizing frontal EEG asymmetry: An updated primer on recording, processing, analyzing, and interpreting frontal alpha asymmetry. *International Journal of Psychophysiology*, *111*, 98-114.
Valiente, C., Lemery-Chalfant, K., & Reiser, M. (2007). Pathways to Problem Behaviors: Chaotic Homes, Parent and Child Effortful Control, and Parenting. *Social Development*, *16*(2), 249–267. https://doi.org/10.1111/j.1467-9507.2007.00383.x