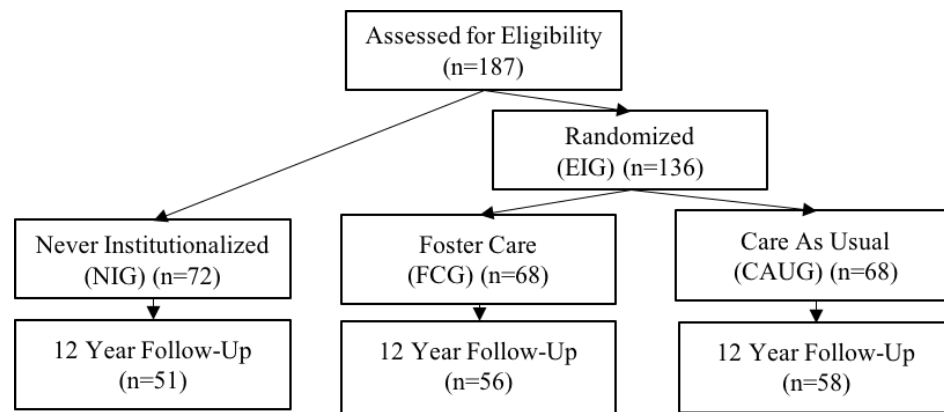


EEG Theta/Beta Ratios as an Index of how Early Institutionalization Impacts Externalizing Problems and Callous-Unemotional Traits in Early Adolescence

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Bucharest Early Intervention Project (BEIP)

- First two years of life include sensitive and critical periods important for developmental
- Severe psychosocial deprivation as an extreme form of early adversity
- BEIP = longitudinal randomized controlled trial of infants assigned (at avg 22 mo) to foster care as intervention for institutionalized care; ongoing follow-ups every ~4 years



Methodology — 12 Year Follow-Up

Health and Behavior Questionnaire (HBQ)

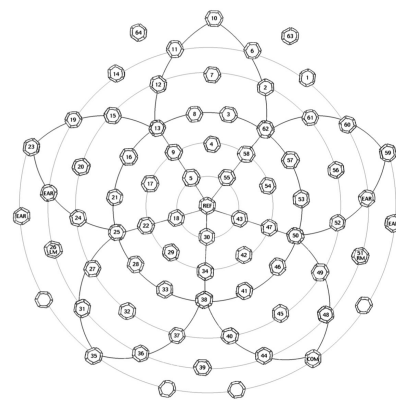
- **Conduct Disorder (CD):** externalizing disorder (EXT), “aggression to people and animals, destruction of property, deceitfulness or theft, serious violations of the rules”¹
- **Oppositional Defiant Disorder (ODD):** EXT, angry & irritable mood, argumentative behavior, vindictiveness²

Inventory of Callous-Unemotional Traits (ICU)

- **Callous-Unemotional (CU) Traits:** uncaring, antisocial, and aggressive behaviors, fearless temperament, fundamental disregard for wellbeing of others.³

Electroencephalography (EEG)

- Precisely measure timing of electrical activity (postsynaptic dendritic currents) of pyramidal neurons; relative power
- Frontal (F), frontal temporal (FT), and whole brain (W)
- **Theta/Beta Ratio (TBR):** ratio of subcortical activity (theta, 4-6 Hz) to cortical regulation (beta, 13-20 Hz)⁴, elevated in ADHD populations

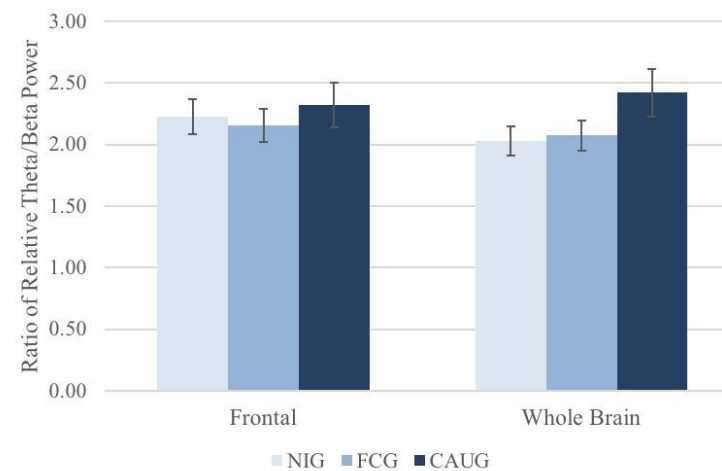


Research Question

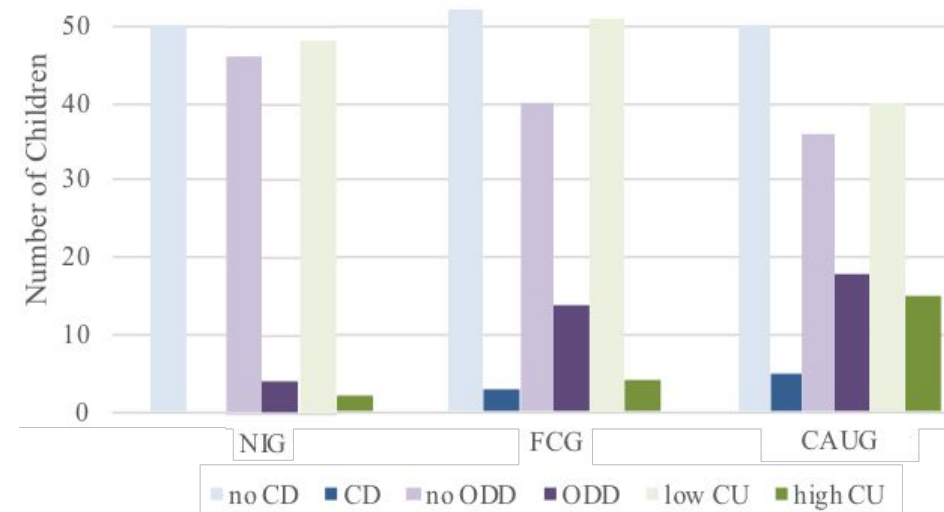
Is TBR a mechanism through which early psychosocial deprivation manifests as these behavioral outcomes?

Preliminary Analysis

TBR is not related to early psychosocial deprivation.

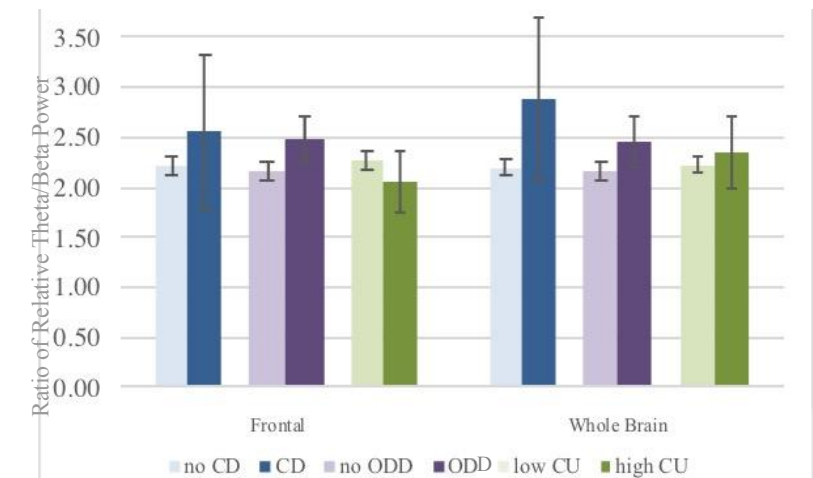


Early psychosocial deprivation is related to CD, ODD, and CU traits.



	EIG vs NIG	CAUG vs FCG
CD	t = -4.640 p < 0.001***	t = 1.195 p = 0.460
ODD	t = -3.629 p < 0.001***	t = 1.825 p = 0.322
CU Traits	t = -4.016 p = 0.016**	t = 1.693 p = 0.051†

TBR is not related to CD, ODD, or CU traits.



Validity Check — Is TBR linked to ADHD?

TBR is moderately related to ADHD in our sample.

- Frontal TBR by ADHD cutoff (p=0.057)
- Whole brain TBR by ADHD cutoff (p=0.02)
- TBR by total ADHD HBQ score not significantly related.

Post Hoc Analysis — Theta & Beta Independently

Increased theta power is related to CD and ODD.

- CD cutoff (t-test): FT, p=0.065; W, p=0.077
- ODD cutoff (t-test): F, p=0.05; FT, p=0.04; W, p=0.032
- CD total score (bi. corr.): F, p=0.019; FT, p=0.002; W, p=0.001
- ODD total score (bi. corr.): F, p=0.023; FT, p=0.012; W, p=0.003

Increased theta power is not related to CU traits.

Beta power is not related to CD, ODD, or CU traits.

Conclusions

- There is a significant relationship between early psychosocial deprivation and EXT/CU traits.
- TBR is not an indicator of CD, ODD, CU traits, or ADHD in our sample.
- Theta power is a potentially important mechanism for evaluating EXT.
- CD/ODD and CU traits have different underlying neural mechanisms.

Sources:
1. American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders (5th ed.)*. Washington, DC.
2. Frick, P. J., & Nigg, J. T. (2012). Current issues in the diagnosis of attention deficit hyperactivity disorder, oppositional defiant disorder, and conduct disorder. *Annual Review of Clinical Psychology, 8*, 77–107. doi:10.1146/annurev-clinpsy-032511-143150.
3. Kimonis, E. R., Graham, N., & Cauffman, E. (2018). Aggressive male juvenile offenders with callous-unemotional traits show aberrant attentional orienting to distress cues. *Journal of Abnormal Child Psychology, 46*(3), 519–527. doi:10.1007/s10802-017-0295-4
4. Schulte, I., Kienemann, J. L., & Schutter, D. J. L. G. (2017). Resting-state theta/beta EEG ratio is associated with reward- and punishment-related reversal learning. *Cognitive, Affective, & Behavioral Neuroscience, 17*(4), 764–763. doi:10.3758/s13415-017-0510-3