

## Supplemental Methods

**Dimensions of Early Externalizing and Callous-Unemotional Behaviors.** To examine callous-unemotional behavior and control for the overlap with other early externalizing behaviors, we used a three-factor model with 17 items of the Child Behavior Checklist that form separable 5-item callous-unemotional behaviors (e.g., lack of guilt after misbehavior), 6-item oppositional behaviors (e.g., defiant), and 6-item attention-deficit behaviors (e.g., can't stand to wait) scales (see Supplemental Figure 1). This theory-based model captures dimensions of high emotional dysregulation (oppositional behaviors), lack of inhibition and impulsivity (attention-deficit behaviors), and callousness/low of empathy (callous-unemotional behaviors) important for the development of early antisocial behavior (1, 2). This specific factor structure and measure of callous-unemotional behaviors has been validated in five independent samples (1, 3-5), including the current sample (6), where callous-unemotional behaviors at 27 months also uniquely predicted teacher reports of externalizing behavior at age 7 over and above early reports of oppositional and attention-deficit behaviors (6). In addition, a recent meta-analysis of 10 studies demonstrated that callous-unemotional behaviors measured in early childhood (i.e., before age 5) robustly predict later externalizing outcomes, over and above other correlated early externalizing behavior measures (7). The items for the callous-unemotional behaviors dimension are detailed in Table S2 where these items are outlined for their relevance to measures of callous-unemotional traits in later childhood and adolescence and the DSM-5 “limited prosocial emotions” specifier for Conduct Disorder.

**Biological Mother Antisocial Behavior.** We assessed biological mother antisocial behavior when adoptive children were 3-6 months old using 47 items from the self-reported computerized Diagnostic Interview Schedule (8, 9). Biological mothers rated items reflecting their engagement in delinquent and antisocial acts, including vandalism, physical violence, drug use, and theft. As callous-unemotional traits in children and psychopathic traits in adults have been linked to more severe antisocial behavior (10, 11), we created a “severe antisocial behavior” scale to assess an adult phenotype more closely related to callous-unemotional traits. This scale contained the 10 most severe antisocial/illegal acts (e.g., breaking and entering, using a weapon), which though uncommon still contained substantial variability in endorsement (i.e., 45% of mothers endorsed 1 or more items, 9% endorsed >2 items). Models were tested using a sum of the most severe 10 items, though we also ran analyses using scores for the full 47 items with a similar pattern of findings.

### **Analytic Strategy**

**Addressing missing data.** We estimated models with mean and variance adjusted weighted least squares estimation, which is recommended for use with ordinal items. Across most measures, there was little missing data ( $n=492-561$ ), with the exception of positive reinforcement, for which data were coded only for 334 adoptive mothers that are part of EGDS Cohort I ( $n=361$ ). This variable was not coded for adoptive mothers in EGDS Cohort II ( $n=200$ ) and can be considered to be “planned missing.” Weighted least squares estimation in Mplus accounts for missing data in four steps that include two steps using maximum likelihood estimation which has been shown to be more efficient than listwise deletion and produce unbiased results with up to 50% missing at random (or planned missing) (12). To confirm the

reliability of our results, we re-computed all analyses using only Cohort I (listwise deletion) and using the whole sample with maximum likelihood estimation with identical results (Table S1).

However, given the additional power and likely lower bias of full-information, we focus our discussion of results on the full sample.

**TABLE S1.** Biological mother severe antisocial behavior, adoptive mother positive reinforcement, and their interaction predict callous-unemotional, attention-deficit, and oppositional behavior factor scores when the child is 27 months old based on Cohort 1 data only ( $N=334$ )

	Callous-Unemotional behaviors 27 months			Attention-deficits behaviors 27 months			Oppositional behaviors 27 months		
	B	SE	$\beta$	B	SE	$\beta$	B	SE	$\beta$
Biological mother severe antisocial behavior	.11	.06	.15*	.07	.05	.10	.06	.05	.07
Adoptive mother observed positive reinforcement	-2.60	.95	-.20**	-.84	.74	-.07	-1.95	.79	-.15*
Interaction term	-1.43	.53	-.18**	-.10	.38	-.01	-.43	.54	-.06

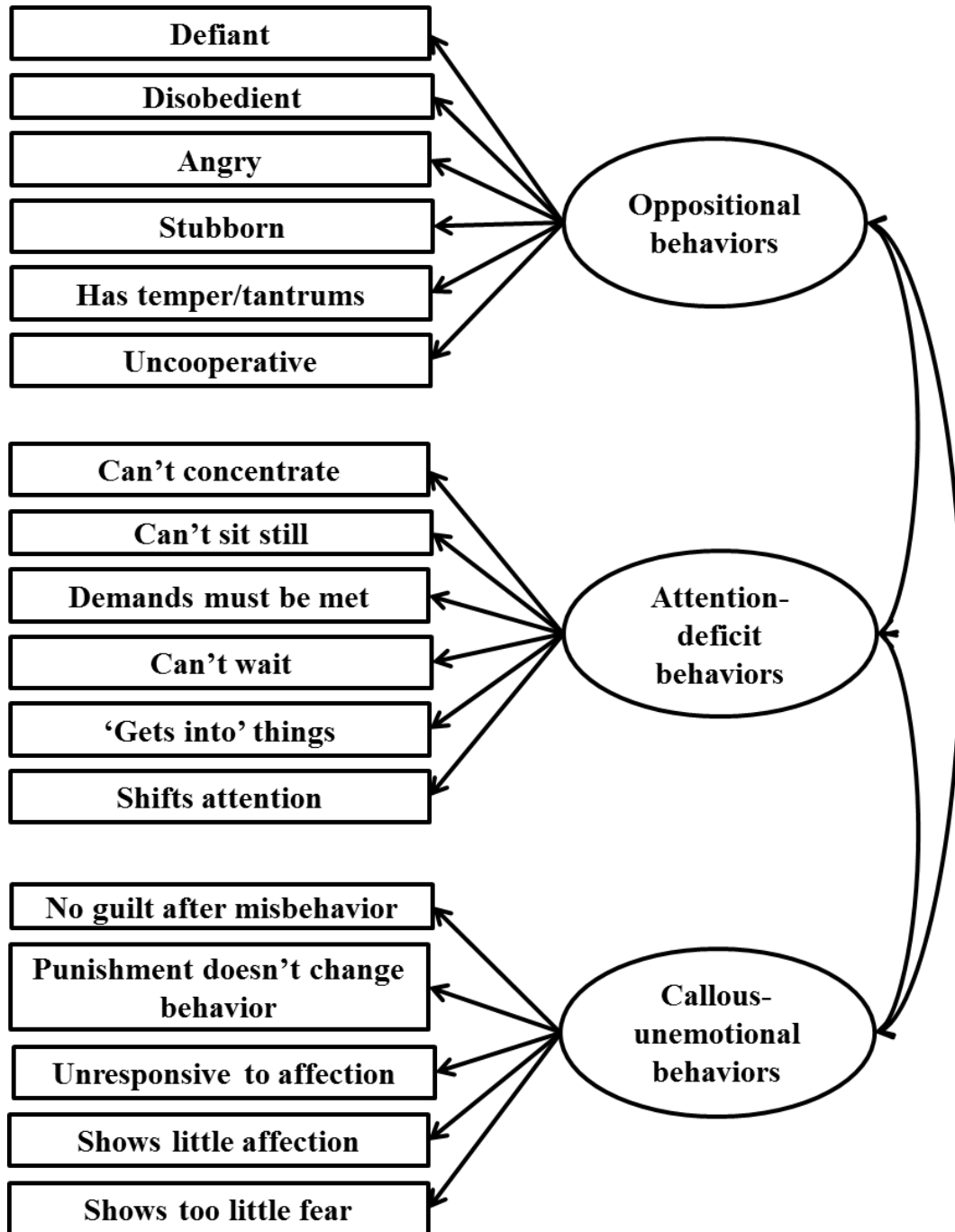
Note. † $p < .10$ , \* $p < .05$ , \*\* $p < .01$ . Model fit statistics:  $\chi^2 = 347.85$ ,  $df = 209$ ,  $p < .001$ , CFI = .95, TLI = .94, RMSEA = .043 (CI, .04-.05). All models control for child gender, perinatal complications, and adoption openness.

**TABLE S2.** Description of the correspondence between an early measure of Callous-Unemotional Behaviors and measures of Callous-Unemotional Traits.

<b>Child Behavior Checklist items in Callous-Unemotional Behaviors Dimension</b>	<b>Related symptom of DSM-5 Limited Prosocial Emotions specifier</b>	<b>Items from the Inventory of Callous-Unemotional Traits</b>
No guilt after misbehavior	- Lack of remorse or guilt	- Does not care who she/he hurts - Feels bad or guilty - Shows no remorse
Punishment doesn't change behavior	- Unconcerned about performance	- Is concerned about school work (R) - Does not care if she/he in trouble
Unresponsive to affection	- Lack of empathy (“..is unconcerned about the feelings of others..”) - Shallow of deficient affect	- Seems cold and uncaring - Feelings of others are unimportant - Seems cold and uncaring
Shows little affection	- Lack of empathy (“..is unconcerned about the feelings of others..”) - Shallow of deficient affect	- Expresses his or her feelings openly - Does not show emotions - Concerned about the feelings of others - Seems cold and uncaring - Is expressive and emotional - Feelings of others are unimportant - Does things to make others feel good.
Shows too little fear	- Shallow of deficient affect	- Does not show emotions

Note – The item pool for the early measure of Callous-Unemotional behaviors is constrained by existing items in the Child Behavior Checklist. We also expect some heterotypic continuity: Early behavior that are less complex, may become more nuanced and complex across development as the child develops emotionally and cognitively.

**FIGURE S1.** Factor structure of early Child Behavior Checklist items loading on separate Callous-Unemotional, Oppositional, and ADHD behaviors.



Note: All factor loadings, range .41-.86,  $p < .001$ . Correlations between factors, range = .70-73,  $p < .001$ . Model fit statistics:  $\chi^2 = 391.97$ ,  $df = 116$ ,  $p < .001$ ; CFI = .94, TLI = .93, RMSEA = .069. For more details see reference (6).

## REFERENCES

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