Supplemental Materials

Reward Processing Among Children with Disruptive Behavior Disorders and Callous-Unemotional Traits in the ABCD Study

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Neuroimaging Methods

Acquisition. The ABCD Study is a collaborative effort, including a Coordinating Center, 21 data acquisition sites across the United States, and a Data Analysis and Informatics Center (DAIC). The ABCD DAIC performs centralized processing and analysis of MRI data from each modality, leveraging validated methods used in other large-scale studies, including Alzheimer's Disease Neuroimaging Initiative (ADNI) and Pediatric Imaging, Neurocognition, and Genetics (PING). A standard ABCD scan session includes sMRI series (T_1w and T_2w), one dMRI series, three sets of two task-fMRI series (MID, SST, and EN-back), and four rs-fMRI series.

Quality Control (QC) Procedures. All ABCD MRI exams have been systematically checked for MRI protocol compliance and completeness, and images have been manually rated for quality by trained MR analysts before and after processing. Based on this manual review of data quality, reviewers assigned binary QC scores (0 = Reject [most severe artifacts or irregularities, rejected series excluded from subsequent processing and analysis]; 1 = Accept) to the different types of images reviewed (e.g., T1w, T2w). In addition, manual review of FreeSurfer cortical surface reconstruction was also undertaken as part of the ABCD Study. Similar to the above approach, for the FreeSurfer QC, reviewers provided a binary score of 0 (Reject) or 1 (Accept) based on the severity of five types of articfacts (i.e., motion, intensity homogeneity, white matter underestimation, pial overestimation, magnetic susceptibility artifact). Results of raw QC were used to exclude poor quality scans, and of the remaining acceptable quality scans, the final scan of the session was used. Following guidelines set forth in the 2.0 data release (http://dx.doi.org/10.15154/1503209), cases in this study were removed if they received a score of 0 in relation to their T1w QC, T2w QC, or FreeSurfer QC.

We also provide here, a direct excerpt from Hagler Jr, Hatton (1) regarding standard QC procedures for the ABCD study- *Using a combination of automated and manual methods, we review datasets for problems such as incorrect acquisition parameters, imaging artifacts, or*

corrupted data files. Automated protocol compliance checks are performed by the on-site FIONA workstations, providing feedback to the scan operators before upload to the DAIC about the completeness of the dataset and the adherence to the intended imaging parameters. After receipt of the data at the DAIC, protocol compliance information is recreated and uploaded to the ABCD REDCap Database. Out-of-compliance series are reviewed by DAIC staff, and sites are contacted if corrective action is required.

Protocol compliance criteria include whether key imaging parameters, such as voxel size or repetition time, match the expected values for a given scanner. For dMRI and fMRI series, the presence or absence of corresponding B_0 distortion field map series is checked. Each imaging series is also checked for completeness to confirm that the number of files matches what was expected for each series on each scanner. Missing files are typically indicative of either an aborted scan or incomplete data transfer, of which the latter can usually be resolved through re-initiating the data transfer. Errors in the unpacking and processing of the imaging data at various stages are tracked, allowing for an assessment of the number of failures at each stage and prioritization of efforts to resolve problems and prevent future errors.

Automated quality control procedures include the calculation of metrics such as signal- to-noise ratio (SNR) and head motion statistics. Overall head motion is quantified as the average of estimated FD. Dark slices, an artifact indicative of abrupt head motion, are identified as outliers in the RMS difference between the original data and data synthesized from tensor fitting. For fMRI series, measures include mean FD, or frame-to-frame head motion, the number of seconds with FD less than 0.2, 0.3, or 0.4 mm (Power et al., 2012), and temporal SNR (tSNR) (Triantafyllou et al., 2005) computed after motion correction.

Trained technicians visually review image series as part of our manual QC procedures, including T_1w, T_2w, dMRI, dMRI field maps, fMRI, and fMRI field maps. Reviewers inspect images for signs of artifacts and poor image quality, noting various imaging artifacts and flagging unacceptable data, typically those with the most severe artifacts or irregularities. Reviewers are

shown several pre-rendered montages for each series, showing multiple slices and views of the first frame, and multiple frames of individual slices if applicable. For multi-frame images, linearly spaced subset of frames are shown as a 9x9 matrix of 81 frames. For dMRI and fMRI, derived images are also shown. For fMRI series, derived images include the average across time and the temporal SD (computed following motion correction). All series are consensus rated by two or more reviewers. In the case of a rejection, the reviewer is required to provide notes indicating the types of artifacts observed using a standard set of abbreviations for commonly encountered artifacts. Series rejected based on data quality criteria are excluded from subsequent processing and analysis.

To ensure the quality of derived measures, trained technicians additionally review post-processed sMRI data to evaluate the accuracy of cortical surface reconstruction. For each cortical surface reconstruction, reviewers gauge the severity of five categories of image artifact or reconstruction inaccuracy: motion, intensity inhomogeneity, white matter underestimation, pial overestimation, and magnetic susceptibility artifact. Numeric values are assigned on a scale of 0-3, indicating absent, mild, moderate, and severe levels of each type of artifact, respectively. The reviewers assign an overall QC score indicating whether the cortical surface reconstruction is recommended for use (1) or recommended for exclusion (0). Exclusion is recommended if any of the five categories are rated as severe (a value of 3). Group comparisons on a range of QC score criteria is provided in **Table S15***.*

Brain Segmentation. Cortical surface reconstruction and subcortical segmentation was performed using FreeSurfer v5.3.0 and included skull stripping, N3 intensity inhomogeneity correction, white matter segmentation, initial mesh creation, correction of toplogical defects, generation of optimal white and pial surfaces, and nonlinear registration to a spherical surface-based atlas based on the alignment of sulcal-gyral patterns (2). Because intensity scaling and inhomogeneity correction was included in sMRI preprocessing, the standard FreeSurfer pipeline was slightly modified to bypass the initial intensity scaling and N3 correction. Subcortical

structures were labeled using an automated, atlas-based, volumetric segmentation procedure (3). Labels for cortical gray matter and underlying white matter voxels were assigned based on surface-based nonlinear registration to atlas based on cortical folding patterns and Bayesian classification rules (4).

Image preprocessing. The ABCD Study is a collaborative effort, including a Coordinating Center, 21 data acquisition sites across the United States, and a Data Analysis and Informatics Center (DAIC). The ABCD DAIC performs centralized preprocessing prior to data release for public use. The ABCD DAIC leverages validated methods from other large-scale studies. For task fMRI preprocessing, the following steps were carried out: 1) head motion correction with AFNI's 3dvolreg, aligning each volume to a reference scan and resampling the image with cubic interpolation (5); 2) Field map distortion correction with estimated field maps derived from AP-PA phase encoded GRE images (6); 3) the initial frames of the functional image time series were excluded to ensure T1 longitudinal magnetization equilibrium; 4) functional image time series were normalized by dividing each voxel time series by its mean over time; 5) functional data were then projected to cortical surfaces using FreeSurfer, and region-of-interest (ROI) time courses are created by averaging the time course of functional data for every voxel within anatomically-based cortical and sub-cortical parcellations (7-9) using FreeSurfer; 6) nuisance regressor time courses were also extracted from the white matter (WM) and cerebrospinal fluid (CSF) compartments of the FreeSurfer anatomical parcellation.

First-level analysis. A first level general linear model (GLM) was computed for each participant using AFNI's 3dDeconvolve program. 3dDeconvolve was run with event-related time courses for each of the 5 event-types in the MID (big win, small win, big loss, small loss, no win/loss), and also included 6 head motion realignment parameters, WM and CSF nuisance regressors, as well as censoring of time points with greater than .9 mm interscan framewise displacement. To overcome factitious motion associated with respiratory disturbance of the main magnetic field B0, Fair et al. (10) head motion realignment parameters are notch filtered

prior to computing the first level GLM to attenuate frequencies in the range .31-.43 Hz, corresponding to a respiratory rate of 18.6-25.7 breaths per minute. The first level GLM modeled the BOLD response as a Gamma variate basis with temporal derivative (SPMG2 in 3dDeconvolve). The first level model was computed separately for each of 2 task runs, and the output from 3dDeconvolve included a regression weight (beta coefficients) for each event type. Beta coefficients from each run were then combined in a weighted average based on degrees of freedom (df) used by the model (censoring time points in a participant with a lot of head motion may cost many df). Runs with fewer than 50 df remaining after censoring high motion time points were excluded from the weighted average. The run-averaged beta coefficients were then analyzed in group level analyses described below (1, 11).

Maximum a posteriori (MAP) scoring of CU Traits construct

In their development study of the CU traits measure, which is used in the current investigation, Hawes, Waller (12) employed moderated nonlinear factor analysis (MNLFA; 13) to explore measurement invariance of the CU traits construct across relevant study covariates (i.e., sex, race, age). MNLFA allows for simultaneous testing of whether item parameters (i.e. CU trait item thresholds and factor loadings) remain invariant across multiple covariate influences. Alternatively stated, MNLFA allows for assessing whether study covariates contribute to differential item functioning [DIF] of items included on the CU traits measure. as well as investigating differences of mean and variance estimates of the CU traits factor. Item-level DIF was examined on an item-by-item basis, accounting for covariate effects on the CU traits factor mean and variance. A final MNLFA model was established by retaining all significant covariate effects on the CU traits factor (mean and variance) and items (thresholds and loadings). Parameter estimates from this final MNLFA model were used to produce maximum a posteriori (MAP) scale scores on the CU traits construct. These MAP scores represent person-specific CU trait scores when accounting for potential differences in both the latent factor and individual items as a function of all covariates of interest, simultaneously. That

is, CU traits MAP scores account for differences in the CU traits factor mean and variance, as well as item DIF, resulting from participant's sex, race, and age, along with any multiplicative effects. Unlike traditional summed score approaches, MAP scores provide unique information about individual differences by taking into account which items were endorsed and by whom, thus providing person-specific factor scores for the CU trait construct (13). For a more thorough review of MNLFA procedures and/or MAP score estimates, see Bauer (2017) and Curran et al. (2014) (13, 14)

Latent Variable Modeling Approach

We used a latent variable modeling approach to determine whether the pattern of activation (i.e., relative contribution of each ROI to a broader "reward network") differed between groups during reward anticipation and reward. This approach allowed for an examination of overall model fit and network-level patterns of activation for a hypothesized reward network. The following steps were conducted separately for reward anticipation and reward outcomes. First, a second-order factor model was specified wherein each lateral ROI was specified to load onto a corresponding lateralized (i.e., right or left) reward factor. These two first-order factors were then used as indicators of a second-order factor, representing an overarching latent reward construct. Residuals from matching ROI pairs were allowed to correlate (e.g., left with right OFC). These models were assessed using several global fit indices including the comparative fit index (CFI) and the root mean square error of approximation (RMSEA). Cutoff values of .90 or greater were used to indicate acceptable fit and .95 or greater to indicate good fit for both CFI and TLI (15, 16). RMSEA values between .05 and .10 were considered to represent an acceptable fit, while values less than .05 were considered to indicate good fit (17, 18). All analyses were conducted using MPlus 7 software and modeling results were extracted with the R package MplusAutomation (19).

Measurement Invariance Testing

Invariance testing was conducted to evaluate the reward network model across each of the study comparison groups. First, a baseline configural model was specified, allowing factor loadings and intercepts of each ROI to vary across groups. Subsequently, a metric invariance model was examined by constraining factor loadings and intercepts to equality across groups, followed by a scalar invariance model having factor covariances and item residual variances constrained to equality across groups. Competing models were compared using a difference testing approach (DIFFTEST procedure in MPlus 7.2; 20), which provides a corrected chi-square difference test for nested models. However, as this method has been shown to be sensitive to sample size and violations of normality (21), we also compared differences in absolute fit indices among these nested models. Prior research suggests that changes in CFI equal to or less than .01, and changes in RMSEA of equal to or less than .015 provides evidence in support of invariance (22, 23), although some research suggests using a more stringent criteria (i.e., change in CFI equal to or less than .002; 24).

Table S1. ROI Naming Conventions in the Official ABCD Study Data Release 2.0

Study ROIs	**Variable Name in the Official ABCD Data Release 2.0 Dataset**	
	Anticipation Phase	**Outcome Phase**
Amygdala	tfmri_ma_alrvn_b_scs_ay	tfmri_ma_rpvnfb_b_scs_ay
Anterior Cingulate Cortex (dorsal)	tfmri_ma_alrvn_b_cds_clatcge	tfmri_ma_rpvnfb_b_cds_clcge
Anterior Cingulate Cortex (perigenual)	tfmri_ma_alrvn_b_cds_roatcge	tfmri_ma_rpvnfb_b_cds_roage
Caudate	tfmri_ma_alrvn_b_scs_cd	tfmri_ma_rpvnfb_b_scs_cd
Cuneus	tfmri_ma_alrvn_b_cds_cu	tfmri_ma_rpvnfb_b_cds_cu
Insula	tfmri_ma_alrvn_b_cds_insula	tfmri_ma_rpvnfb_b_cds_insula
Midbrain	tfmri_ma_alrvn_b_scs_vndc	tfmri_ma_rpvnfb_b_scs_vndc
Nucleus Accumbens	tfmri_ma_alrvn_b_scs_aa	tfmri_ma_rpvnfb_b_scs_aa
Occipital Cortex	tfmri_ma_alrvn_b_cds_loc	tfmri_ma_rpvnfb_b_cds_loc
Orbitofrontal Cortex	tfmri_ma_alrvn_b_cds_lobofr	tfmri_ma_rpvnfb_b_cds_lobofr
Posterior Cingulate Cortex	tfmri_ma_alrvn_b_cds_pocge	tfmri_ma_rpvnfb_b_cds_pocge
Precentral Gyrus	tfmri_ma_alrvn_b_cds_prec	tfmri_ma_rpvnfb_b_cds_prec
Putamen	tfmri_ma_alrvn_b_scs_pt	tfmri_ma_rpvnfb_b_scs_pt
Superior Frontal Gyrus	tfmri_ma_alrvn_b_cds_sufr	tfmri_ma_rpvnfb_b_cds_sufr
Thalamus	tfmri_ma_alrvn_b_scs_tp	tfmri_ma_rpvnfb_b_scs_tp
Ventromedial Prefrontal Cortex	tfmri_ma_alrvn_b_cds_mobofr	tfmri_ma_rpvnfb_b_cds_mobofr

*__Notes__. For each of the official ABCD Data Release 2.0 variable names listed above, either an ‘lh’ or ‘rh’ suffix should be added to the end of the variable name to indicate either ‘right’ or ‘left’ hemisphere.

Table S2. Associations between CU Traits and Negative Emotionality

	Study Subsample (*n* = 1,163)	Full Sample (*n* = 7,113)
	CU Traits	CU Traits
CBCL DSM-Oriented Anxiety Problems Scale	.32*** (.-.18**)	.17*** (.-.04**)
CBCL DSM-Oriented Depressive Problems Scale	.48*** (-.09*)	.28*** (.02)
CBCL Internalizing Problems Scale	.57*** (-.06)	.27*** (.02)

Notes. ***p<.001, **p<.01, *p<.05;
Output in parentheses is controlling for DBD symptomology
Study Subsample = youth included study subgroups (i.e., TD, DBD+CU, DBD-only)
Full Sample = all youth in ABCD Study with useable MID Task data

Table S3. Main Study Analyses (alternative grouping criteria)

	Planned Group Comparisons OR (95% CI)					
	Reward Anticipation			**Reward Receipt**		
	TD vs ^DBD+CU	**DBD-only vs. ^DBD+CU**	**TD vs. ^DBD-only**	**TD vs. ^DBD+CU**	**DBD-only vs. ^DBD+CU**	**TD vs. ^DBD-only**
Left Hemisphere						
Amygdala	1.00	1.01	.99	1.02	1.11	.92
ACC (dorsal)	.98	.85	1.14	**.75***	.88	.85
ACC (perigenual)	**1.25***	1.02	**1.22***	.78	.87	.90
Caudate	.94	.81	1.16	**.69***	.83	.92
Cuneus	.90	.85	1.05	.91	.92	.99
Insula	1.02	.91	1.11	.91	.88	1.03
Midbrain	1.03	.88	1.16	.88	.89	.98
Nucleus Accumbens	.86	.80	1.07	.86	.99	.86
Occipital Cortex	.80	**.72***	1.03	.92	1.03	.89
Orbitofrontal Cortex	1.05	1.04	1.01	.91	1.11	.81
Posterior Cingulate Cortex	.95	.85	1.09	.92	.90	1.02
Precentral Gyrus	.79	**.76***	1.03	1.04	.88	1.18
Putamen	.87	.79	1.11	.83	.84	.98
Superior Frontal Gyrus	.91	.80	1.22	.82	.89	.92
Thalamus	**.72***	**.71***	1.01	**.74***	.84	.87
vmPFC	1.24	1.12	1.10	**.64***	**.75***	.85
Right Hemisphere						
Amygdala	1.03	1.05	.98	.90	.93	.97
ACC (dorsal)	1.05	.91	1.15	**.70***	.86	**.81***
ACC (perigenual)	1.13	1.03	1.09	**.74***	.88	.84
Caudate	1.01	.88	1.14	**.74***	.83	.89
Cuneus	.99	.86	1.14	.88	.86	1.02
Insula	.92	**.81***	1.13	.99	.96	1.03
Midbrain	1.00	.86	1.16	.80	.85	.93
Nucleus Accumbens	1.04	.85	**1.21***	**.70***	.89	.79
Occipital Cortex	.86	.81	1.05	.94	.90	1.04
Orbitofrontal Cortex	1.08	.98	1.22	**.61***	.93	**.66***
Posterior Cingulate Cortex	.95	.87	1.31	.89	.85	1.04
Precentral Gyrus	.85	**.77***	1.10	1.00	.85	1.17
Putamen	.97	.87	1.11	.86	.87	.98
Superior Frontal Gyrus	.82	**.78***	1.05	.92	.92	.99
Thalamus	.85	.89	.95	.90	.90	1.00
vmPFC	1.24	1.19	1.04	**.64***	**.76***	.84

Notes. For the above analyses, inclusion into the TD group was made less restrictive (i.e., t-score criterion changed from t= 50 to t ≤ 56) and inclusion into the DBD group was made more restrictive (i.e., t-score ≥ 70)

Table S4. Main Study Analyses (KSADS grouping criteria)

	Planned Group Comparisons OR (95% CI)					
	Reward Anticipation			**Reward Receipt**		
	TD vs ^DBD+CU	**DBD-only vs. ^DBD+CU**	**TD vs. ^DBD-only**	**TD vs. ^DBD+CU**	**DBD-only vs. ^DBD+CU**	**TD vs. ^DBD-only**
Left Hemisphere						
Amygdala	.68	.90	.75	.69	.88	.78
ACC (dorsal)	1.08	.90	1.20	.65	**.68***	.95
ACC (perigenual)	1.45	1.07	1.35	**.59***	**.68***	.86
Caudate	1.25	.83	**1.50***	**.55***	**.63***	.87
Cuneus	.87	.86	1.00	1.00	.92	1.08
Insula	1.11	1.00	1.00	**.68***	**.77***	.89
Midbrain						
Nucleus Accumbens	1.10	.83	1.31	**.43***	.80	**.53***
Occipital Cortex	.77	**.73***	1.05	.92	1.00	.91
Orbitofrontal Cortex	1.06	1.15	.92	.86	1.06	.81
Posterior Cingulate Cortex	1.00	.90	1.11	.91	.83	1.09
Precentral Gyrus						
Putamen	1.07	.83	1.29	.64	**.70***	.90
Superior Frontal Gyrus						
Thalamus	.78	.70	1.11	**.58***	**.68***	.85
vmPFC	.92	1.15	.79	.76	.75	1.01
Right Hemisphere						
Amygdala	1.04	1.27	.81	.62	.81	.77
ACC (dorsal)	**1.56***	.99	**1.56***	**.51***	**.70***	.72
ACC (perigenual)	1.49	1.08	1.38	**.48***	**.71***	**.66***
Caudate	1.37	.96	1.42	**.62***	**.66***	.93
Cuneus	1.10	.98	1.11	.90	.89	1.01
Insula	.93	**.81**	1.13	.81	.82	.99
Midbrain						
Nucleus Accumbens	1.46	.93	1.56	**.54***	.72	.75
Occipital Cortex	.92	.85	1.08	.81	.93	.88
Orbitofrontal Cortex	1.21	1.07	1.13	**.52***	.92	**.57***
Posterior Cingulate Cortex	1.02	.84	1.21	.83	**.73***	1.13
Precentral Gyrus						
Putamen	1.43	.81	1.44	.82	.79	1.04
Superior Frontal Gyrus						
Thalamus	1.02	.99	1.10	.67	.79	.85
vmPFC	.94	1.14	.82	.83	.74	1.12

Notes. For the results provided in this table, only a KSADS diagnosis (ODD or CD) was used to classify youth into the DBD group (i.e., CBCL criteria not used).

Table S5. Zero-Inflated Models

	Reward Anticipation		Reward Outcome	
	CU Traits	**DBD Symptomology**	**CU Traits**	**DBD Symptomology**
Left				
Amygdala	-.22 (-.01)	-.01 (-.14)	.05 (-.007)	.01 (-.08)
ACC (dorsal)	-.12 (.004)	-.01 (-.18*)	-.02 (-.03)	-.02 (.08)
ACC (perigenual)	**-.25*** (.001)	.01 (-.14)	-.08 (**-.05***)	-.01 (.03)
Caudate	-.01 (.02)	**-.03* (-.19***)	.08 (-.006)	-.01 (.11)
Cuneus	-.08 (-.01)	-.02 (.02)	.19 (.005)	.01 (.02)
Insula	-.07 (.002)	.001 (**-.20***)	.24 (.004)	.004 (.04)
Midbrain				
Nucleus Accumbens	-.20 (-.02)	-.01 (-.14)	.03 (.01)	-.01 (-.10)
Occipital Cortex	-.02 (.003)	-.01 (-.09)	.01 (.01)	.01 (.16)
Orbitofrontal Cortex	-.14 (.01)	**-.03*** (-.13)	-.02 (-.02)	**.03*** (.09)
Posterior Cingulate Cortex	.02 (-.002)	**-.03*** (-.14)	.03 (-.01)	-.02 (.02)
Precentral Gyrus				
Putamen	-.04 (.01)	-.02 (-.13)	.01 (-.01)	-.01 (.01)
Superior Frontal Gyrus				
Thalamus	.05 (.01)	-.01 (-.13)	.03 (-.02)	.01 (.12)
vmPFC	-.07 (.02)	.01 (-.07)	.20 (-.007)	.01 (-.10)
Right				
Amygdala	-.17 (.002)	.02 (-.12)	-.02 (.001)	**.03*** (-.06)
ACC (dorsal)	-.16 (-.01)	-.01 (**-.22***)	.15 (-.01)	-.01 (.10)
ACC (perigenual)	**-.25*** (-.01)	.01 (-.14)	.05 (-.03)	.002 (.001)
Caudate	-.07 (-.001)	-.02 (-.06)	-.02 (-.004)	-.14 (-.14)
Cuneus	.10 (.01)	-.01 (**.19***)	**.38*** (**.04***)	.01 (.08)
Insula	.04 (-.01)	-.01 (-.17)	-.03 (.007)	**-.02*** (-.10)
Midbrain				
Nucleus Accumbens	-.18 (-.03)	-.01 (-.17)	-.11 (-.01)	.01 (.02)
Occipital Cortex	-.06 (.001)	-.02 (-.04)	.15 (.01)	.01 (.06)
Orbitofrontal Cortex	-.09 (.02)	-.01 (-.16*)	.03 (-.01)	.02 (.06)
Posterior Cingulate Cortex	.01 (.002)	-.02 (-.13)	.24 (.01)	-.02 (.02)
Precentral Gyrus				
Putamen	-.12 (-.008)	-.01 (**-.15***)	.02 (-.01)	-.01 (.01)
Superior Frontal Gyrus				
Thalamus	-.03 (.001)	-.02 (-.14)	.01 (-.01)	-.003 (.07)
vmPFC	-.21 (.005)	.01 (-.05)	.20 (-.02)	.01 (.02)

Notes. CU Traits outcome specified using a negative binomial zero-inflated model.
DBD Symptomology specified using a censored zero-inflated model.
Effects provided in parentheses represent results for the logit portion of the model.

Table S6. Main Study Analyses (ADHD and internalizing problems excluded as covariate)

	Planned Group Comparisons OR (95% CI)					
	Reward Anticipation			**Reward Receipt**		
	TD vs ^DBD+CU	**DBD-only vs. ^DBD+CU**	**TD vs. ^DBD-only**	**TD vs. ^DBD+CU**	**DBD-only vs. ^DBD+CU**	**TD vs. ^DBD-only**
Left Hemisphere						
Amygdala	.98	.94	1.04	1.02	1.11	.91
ACC (dorsal)	1.00	.88	1.14	.96	**.77***	**1.25***
ACC (perigenual)	1.06	.99	1.06	.91	.87	1.04
Caudate	1.00	**.77***	**1.30***	1.02	.82	**1.24***
Cuneus	.90	**.82***	1.09	.86	.83	1.03
Insula	.95	.90	1.05	.89	.84	1.06
Midbrain						
Nucleus Accumbens	.97	.78	**1.23***	.95	1.02	.93
Occipital Cortex	.91	**.77***	1.17	.98	.99	1.00
Orbitofrontal Cortex	**1.26***	1.02	1.23	1.10	1.22	.89
Posterior Cingulate Cortex	.96	.85	1.12	1.01	.85	**1.18***
Precentral Gyrus						
Putamen	.93	.78	1.18	.96	.82	1.17
Superior Frontal Gyrus						
Thalamus	.91	.76	1.20	.91	.76	1.19
vmPFC	1.16	1.17	.98	**.74***	.82	.90
Right Hemisphere						
Amygdala	.88	.94	.93	.94	.86	1.08
ACC (dorsal)	1.03	.86	1.20	1.00	.91	1.05
ACC (perigenual)	1.00	.94	1.05	.89	.94	.94
Caudate	1.09	.84	1.29	1.00	.82	**1.21***
Cuneus	.92	**.81***	1.13	.88	.86	1.02
Insula	**.83***	**.77***	1.08	1.00	.91	1.10
Midbrain						
Nucleus Accumbens	.97	.79	**1.22***	.98	.97	1.01
Occipital Cortex	.99	.82	**1.21***	.90	.88	1.02
Orbitofrontal Cortex	**1.24***	1.01	1.23	.91	1.07	.84
Posterior Cingulate Cortex	.93	**.80***	**1.15***	.95	**.81***	**1.17***
Precentral Gyrus						
Putamen	1.06	.85	**1.24***	1.05	.87	1.20
Superior Frontal Gyrus						
Thalamus	1.05	.88	1.19	.93	.83	1.12
vmPFC	**1.34***	1.19	1.12	**.75***	.83	.91

Table S7. Main Study Analyses (residualized ROIs)

	Planned Group Comparisons OR (95% CI)					
	Reward Anticipation			**Reward Receipt**		
	TD vs ^DBD+CU	**DBD-only vs. ^DBD+CU**	**TD vs. ^DBD-only**	**TD vs. ^DBD+CU**	**DBD-only vs. ^DBD+CU**	**TD vs. ^DBD-only**
Left Hemisphere						
Amygdala	.73	.96	.75	.88	1.18	.75
ACC (dorsal)	1.11	.83	**1.34***	.70	**.75***	.92
ACC (perigenual)	1.57	1.02	1.53	.69	.82	.83
Caudate	1.16	**.73***	**1.58***	.72	.78	.92
Cuneus	0.82	**.78***	1.05	.93	.90	1.03
Insula	1.13	.92	1.24	.78	.88	.90
Midbrain	1.45	.94	**1.53***	.78	.90	.86
Nucleus Accumbens	1.03	**.75***	1.37	**.55***	.95	**.57***
Occipital Cortex	.81	**.72***	1.10	.83	1.01	.81
Orbitofrontal Cortex	.98	.98	1.01	.92	1.23	.75
Posterior Cingulate Cortex	1.03	.83	1.24	.96	.87	1.09
Precentral Gyrus	.78	**.72***	1.08	.98	.85	1.14
Putamen	1.10	**.73***	**1.50***	.76	.82	.94
Superior Frontal Gyrus	.84	.77	**1.09**	.81	.91	.89
Thalamus	0.79	**.67***	1.18	**.57***	.78	.73
vmPFC	1.06	1.14	.92	.71	.79	.89
Right Hemisphere						
Amygdala	.93	1.03	.90	**.58***	.87	.66
ACC (dorsal)	**1.44***	.87	**1.66***	.57	**.81***	**.70***
ACC (perigenual)	1.45	.96	1.51	.64	.90	.72
Caudate	1.24	.81	**1.55***	.75	.78	.96
Cuneus	.98	**.78***	1.22	.81	.89	.91
Insula	.86	**.75***	1.18	.93	.94	.99
Midbrain	1.10	.86	1.29	.63	.82	.76
Nucleus Accumbens	1.35	.78	**1.72***	.70	1.01	.70
Occipital Cortex	.84	**.76***	1.11	.82	.96	.86
Orbitofrontal Cortex	1.11	.91	1.21	**.52***	1.05	**.49***
Posterior Cingulate Cortex	1.01	**.77***	1.31	.92	**.82***	1.12
Precentral Gyrus	.81	**.71***	1.13	.84	**.81***	1.01
Putamen	1.26	.81	**1.54***	.96	.88	1.08
Superior Frontal Gyrus	.79	**.75***	1.06	.91	.89	1.01
Thalamus	1.04	.83	1.25	.83	.90	.92
vmPFC	1.02	1.06	.94	.80	.80	.99

Notes. Covariate effects residualized out of study ROIs prior to analyses

Table S8. Main Study Analyses (inhibitory control included as covariate)

	Planned Group Comparisons OR (95% CI)					
	Reward Anticipation			**Reward Receipt**		
	TD vs ^DBD+CU	**DBD-only vs. ^DBD+CU**	**TD vs. ^DBD-only**	**TD vs. ^DBD+CU**	**DBD-only vs. ^DBD+CU**	**TD vs. ^DBD-only**
Left Hemisphere						
Amygdala	.76	1.00	.76	.87	1.22	.77
ACC (dorsal)	1.11	.86	1.28	.71	**.75***	.95
ACC (perigenual)	1.58	1.07	1.47	.68	.82	.83
Caudate	1.15	.78	**1.48***	.71	**.74***	.95
Cuneus	.80	**.80***	1.00	.95	.89	1.05
Insula	1.14	.96	1.18	.79	.86	.92
Midbrain	1.19	.96	1.24	**.47***	1.05	**.44***
Nucleus Accumbens	.97	**.76***	1.28	**.52***	.95	**.54***
Occipital Cortex	.80	.75*	1.07	.82	.97	.84
Orbitofrontal Cortex	1.00	1.02	.98	.91	1.23	.74
Posterior Cingulate Cortex	1.03	.85	1.21	.96	.86	1.12
Precentral Gyrus	1.77	.73	**2.41***	.77	1.14	.67
Putamen	1.12	.78	1.43	.75	.77	.96
Superior Frontal Gyrus	1.75	.70	**2.47***	.59	1.41	**.41***
Thalamus	.79	**.69***	1.13	**.58***	.75	.77
vmPFC	1.02	1.14	.89	.70	.80	.88
Right Hemisphere						
Amygdala	.99	1.09	.91	**.59***	.89	.66
ACC (dorsal)	1.41	.89	**1.58***	**.56***	**.77***	.72
ACC (perigenual)	1.46	1.00	1.46	.64	.87	.73
Caudate	1.25	.86	1.44	.75	**.76***	.99
Cuneus	.97	.81	1.19	.80	.85	.93
Insula	.90	**.80***	1.13	.96	.93	1.04
Midbrain	.50	.90	.56	**.28***	.64	**.43***
Nucleus Accumbens	1.39	.81	**1.71***	.68	1.00	.67
Occipital Cortex	.85	.79	1.08	.84	.92	.90
Orbitofrontal Cortex	1.04	.89	1.16	**.53***	1.05	**.50***
Posterior Cingulate Cortex	1.00	**.79***	1.25	.94	**.81***	1.15
Precentral Gyrus	.69	.74	.79	1.01	.99	1.01
Putamen	1.25	.87	1.43	.95	.83	1.15
Superior Frontal Gyrus	.75	1.19	.62	**.76***	.97	**.78***
Thalamus	1.05	.87	1.21	.82	.85	.96
vmPFC	1.04	1.09	.95	.81	.81	.99

Notes. Scores on the NIH Toolbox's Flanker Inhibitory Control Test were added to the primary study model to account for potential effects of inhibitory control on study findings.

Table S9. Main Study Analyses (small reward condition)

	Planned Group Comparisons OR (95% CI)		
	Reward Anticipation		
	TD vs ^DBD+CU	**DBD-only vs. ^DBD+CU**	**TD vs. ^DBD-only**
Left Hemisphere			
Amygdala	1.13	1.14	.99
ACC (dorsal)	1.35	1.01	1.33
ACC (perigenual)	1.09	.99	1.09
Caudate	1.10	.83	1.33
Cuneus	.98	.99	.98
Insula	1.03	.85	1.21
Nucleus Accumbens	.79	.90	.87
Occipital Cortex	1.18	.98	1.19
Orbitofrontal Cortex	.79	.87	.90
Posterior Cingulate Cortex	.92	1.01	.91
Putamen	.94	.78	1.20
Thalamus	.82	.83	.99
vmPFC	.84	1.06	.79
Right Hemisphere			
Amygdala	.77	.77	.99
ACC (dorsal)	1.33	1.01	1.31
ACC (perigenual)	1.28	1.13	1.13
Caudate	1.20	.86	1.38
Cuneus	1.10	.94	1.16
Insula	1.04	.86	1.20
Nucleus Accumbens	1.05	.89	1.17
Occipital Cortex	1.46	.93	**1.56***
Orbitofrontal Cortex	1.11	.95	1.17
Posterior Cingulate Cortex	.91	.92	.98
Putamen	1.28	.78	**1.61***
Thalamus	1.13	.86	1.31
vmPFC	1.10	1.10	1.00

Table S10. MID Task behavioral performance

	Diagnostic Group							
	DBD+CU		DBD-only		TD		Total	
	M/%	*SD*	*M/%*	*SD*	*M/%*	*SD*	*M/%*	*SD*
MID Task Performance Variables								
Mean reaction time	273.2_a	*42.24*	275.16_a	*42.20*	270.66_a	*41.34*	272.11	*41.70*
Number of trials	12.26_a	*1.86*	12.36_a	*1.98*	12.31_a	*1.83*	12.35	1.92
Total earnings	20.38_a	*13.72*	19.63_a	*15.09*	20.66_a	*13.33*	20.53	*13.59*

Notes. Matching or absent superscripts [a, b, c] indicate groups that did not differ significantly from each other.
DBD+CU = High DBD/High CU Traits; DBD-only = High DBD/Low CU Traits; TD = Typically Developing.

Table S11. Model fit of latent reward network factors (RNF)

	CFI	RMSEA
Reward Anticipation		
TD Group	.94	.04
DBD-only Group	.90	.06
DBD+CU Group	.89	.07
Reward Receipt		
TD Group	.93	.04
DBD-only Group	.89	.07
DBD+CU Group	.89	.07

Notes. TD = Typically Developing; DBD-only = High DBD/Low CU Traits; DBD+CU = High DBD/High CU Traits

Table S12. Measurement invariance testing of latent reward network factors (RNF)

				Absolute Fit Statistics		Difference Test of Relative Fit			
	χ2	*df*	*p*	CFI	RMSEA	Comp.	^ χ2	*df*	*p*
Anticipation									
Model 1 (configural)	3951.01	1341	<.001	.90	.07	1 vs. 2	61.06	60	.43
Model 2 (metric)	4004.78	1401	<.001	.90	.07	1 vs. 3	122.39	120	.42
Model 3 (scalar)	4099.07	1461	<.001	.90	.07	2 vs. 3	61.49	60	.42
Outcome									
Model 1 (configural)	4238.67	1341	<.001	.88	.07	1 vs. 2	68.98	60	.19
Model 2 (metric)	4303.84	1401	<.001	.88	.07	1 vs. 3	135.15	120	.16
Model 3 (scalar)	4409.97	1461	<.001	.88	.07	2 vs. 3	65.34	60	.29

Notes. ^χ2 = Chi-Square change from Model 1 (configural) to Model 2 (metric) to Model 3 (scalar).

Table S13. Comparing latent reward network factor (RNF) activation across groups

	Group 1 Mean	Group 2 Mean	*p*
Reward Anticipation			
Left Hemisphere			
TD vs DBD-only	.02	-.03	ns
TD vs DBDCU+	.00	.00	ns
DBD-only vs DBDCU+	-.03	.03	ns
Right Hemisphere			
TD vs DBD-only	.02	-.03	≤.05
TD vs DBDCU+	.00	-.01	ns
DBD-only vs DBDCU+	-.03	.04	≤.05
Second-Order RNF			
TD vs DBD-only	.01	-.04	≤.05
TD vs DBDCU+	.00	-.01	ns
DBD-only vs DBDCU+	-.03	.03	≤.05
Reward Receipt			
Left Hemisphere			
TD vs DBD-only	.00	-.03	ns
TD vs DBDCU+	.00	.02	≤.05
DBD-only vs DBDCU+	-.03	.02	ns
Right Hemisphere			
TD vs DBD-only	.01	-.02	ns
TD vs DBDCU+	.00	.01	ns
DBD-only vs DBDCU+	-.02	.02	ns
Second-Order RNF			
TD vs DBD-only	.02	-.01	ns
TD vs DBDCU+	.00	.01	ns
DBD-only vs DBDCU+	-.02	.02	ns

Notes. TD = Typically Developing; DBD-only = High DBD/Low CU Traits; DBDCU+ = High DBD/High CU Traits

Table S14. Main Study Analyses (with confidence intervals provided)

Planned Group Comparisons
OR (95% CI)

	Reward Anticipation				Reward Receipt			
	TD vs Overall ^DBD	**TD vs ^DBD+CU**	**DBD-only vs ^DBD+CU**	**TD vs ^DBD-only**	**TD vs Overall^ DBB**	**TD vs ^DBD+CU**	**DBD-only vs ^DBD+CU**	**TD vs ^DBD-only**
Left Hemisphere								
Amygdala	.72 (.51, 1.01)	.72 (.45, 1.16)	.95 (.74, 1.23)	.75 (.48, 1.17)	**.63* (.43, .92)**	.89 (.56,1.41)	1.18 (.87, 1.59)	.75 (.50, 1.41)
ACC (dorsal)	1.22 (.97, 1.54)	1.11 (.78, 1.58)	.83 (.67, 1.02)	**1.34* (1.00, 1.82)**	.81 (.61, 1.08)	.69 (.47, 1.01)	**.75* (.61, .92)**	.92 (.65, 1.31)
ACC (perigenual)	1.26 (.91, 1.74)	1.57 (.95, 2.60)	1.02 (.80, 1.30)	1.54 (.96, 2.46)	**.64* (.47, .88)**	.68 (.45, 1.02)	.82 (.65, 1.03)	.83 (.57, 1.20)
Caudate	1.17 (.87, 1.56)	1.16 (.78, 1.72)	**.73* (.56, .95)**	**1.58* (1.10, 2.27)**	.77 (.57, 1.04)	.72 (.46, 1.13)	.78 (.61, 1.01)	.92 (.63, 1.35)
Cuneus	.97 (.77, 1.23)	0.82 (.58, 1.13)	**.77* (.63, .96)**	1.04 (.78, 1.41)	.85 (.65, 1.12)	.93 (.65, 1.31)	.90 (.74, 1.09)	1.03 (.75, 1.41)
Insula	1.01 (.79, 1.29)	1.13 (.80, 1.59)	.92 (.76, 1.11)	1.23 (.90, 1.66)	.82 (.63, 1.06)	.78 (.54, 1.13)	.87 (.71, 1.07)	.90 (.64, 1.25)
Midbrain	1.26 (.90, 1.75)	1.44 (.89, 2.33)	.95 (.72, 1.25)	**1.53* (1.01, 2.31)**	.73 (.51, 1.06)	.78 (.48, 1.25)	.90 (.69, 1.16)	.86 (.57, 1.30)
Nucleus Accumbens	1.04 (.77, 1.39)	1.02 (.69, 1.51)	**.75* (.58, .96)**	1.36 (.94, 1.97)	**.60* (.42, .85)**	**.55* (.32, .93)**	.95 (.73, 1.24)	**.57* (.35, .94)**
Occipital Cortex	.95 (.71, 1.28)	0.80 (.51, 1.25)	**.72* (.55, .93)**	1.11 (.74, 1.66)	**.73* (.55, .98)**	.83 (.55, 1.27)	1.01 (.80, 1.27)	.82 (.58, 1.18)
Orbitofrontal Cortex	1.05 (.73, 1.52)	0.97 (.57, 1.67)	.97 (.72, 1.31)	1.00 (.60, 1.66)	.88 (.57, 1.36)	.91 (.49, 1.70)	1.22 (.88, 1.58)	.74 (.43, 1.29)
Posterior Cingulate Gyrus	1.06 (.83, 1.36)	1.03 (.73, 1.46)	.83 (.68, 1.02)	1.24 (.91, 1.68)	1.02 (.81, 1.29)	.96 (.70, 1.31)	.87 (.73, 1.04)	1.09 (.82, 1.46)
Precentral Gyrus	.93 (.72, 1.21)	.78 (.52, 1.16)	**.72* .56(, .92)**	1.08 (.76, 1.55)	.90 (.69, 1.18)	.97 (.69, 1.35)	.85 (.68, 1.05)	1.14 (.84, 1.54)
Putamen	1.29 (.93, 1.79)	1.10 (.68, 1.78)	**.73* (.55, .98)**	**1.50* (1.00, 2.25)**	.77 (.56, 1.06)	.74 (.45, 1.22)	.80 (.61, 1.05)	.92 (.60, 1.41)
Superior Frontal Gyrus	.98 (.74, 1.30)	.84 (.54, 1.29)	.77 (.60, 1.00)	1.08 (.74, 1.57)	.77 (.57, 1.03)	.81 (.53, 1.22)	.90 (.71, 1.15)	.89 (.63, 1.25)
Thalamus	1.03 (.74, 1.43)	0.79 (.49, 1.27)	**.67* (.49, .90)**	1.18 (.77, 1.82)	**.59* (.41, .87)**	**.57* (.35, .93)**	.78 (.59, 1.03)	.73 (.47, 1.12)
vmPFC	.97 (.68, 1.38)	1.06 (.63, 1.77)	1.14 (.89, 1.46)	.92 (.58, 1.48)	.81 (.55, 1.19)	.70 (.42, 1.18)	.79 (.61, 1.02)	.89 (.54, 1.45)
Right Hemisphere								
Amygdala	.88 (.60, 1.29)	.93 (.53, 1.64)	1.03 (.76, 1.37)	.90 (.54, 1.50)	**.62* (.43, .90)**	**.58* (.35, .95)**	.87 (.65, 1.16)	.66 (.43, 1.02)
ACC (dorsal)	**1.32* (1.04, 1.67)**	**1.44* (1.02, 2.04)**	.86 (.69, 1.07)	**1.66* (1.23, 2.25)**	**.64* (.49, .84)**	.69 (.47, 1.01)	**.75* (.61, .92)**	**.70* (.50, .98)**
ACC (perigenual)	1.24 (.90, 1.72)	1.45 (.91, 2.32)	.96 (.75, 1.22)	1.51 (.98, 2.33)	**.66* (.48, .89)**	.64 (.41, 1.02)	.89 (.70, 1.15)	.72 (.48, 1.07)
Caudate	1.30 (.99, 1.71)	1.24 (.84, 1.84)	.80 (.62, 1.03)	**1.55* (1.08, 2.22)**	.78 (.56, 1.07)	.75 (.49, 1.14)	**.78* (.62, .99)**	.95 (.64, 1.42)
Cuneus	1.02 (.80, 1.29)	.97 (.66, 1.40)	**.78* (.62, .99)**	1.23 (.89, 1.69)	.79 (.59, 1.05)	.81 (.55, 1.18)	.89 (.73, 1.08)	.91 (.64, 1.30)
Insula	1.00 (.80, 1.24)	.88 (.64, 1.23)	**.76* (.62, .93)**	1.17 (.87, 1.56)	.96 (.75, 1.22)	.94 (.67, 1.31)	.94 (.78, 1.14)	.99 (.73, 1.35)
Midbrain	1.18 (.83, 1.66)	1.11 (.69, 1.78)	.85 (.66, 1.09)	1.29 (.81, 2.07)	**.65* (.45, .93)**	.63 (.37, 1.05)	.82 (.62, 1.09)	.76 (.49, 1.18)
nACC	1.14 (.80, 1.62)	1.36 (.85, 2.17)	.78 (.62, 1.00)	**1.72* (1.10, 2.70)**	**.67* (.46, .99)**	.70 (.40, 1.22)	1.01 (.75, 1.34)	.69 (.40, 1.18)
Occp	1.08 (.81, 1.42)	.84 (.55, 1.29)	**.76* (.58, .98)**	1.11 (.76, 1.61)	**.75* (.58, .97)**	.82 (.56, 1.20)	.95 (.76, 1.19)	.86 (.61, 1.21)
Orbitofrontal Cortex	1.07 (.75, 1.54)	1.11 (.64, 1.93)	.90 (.67, 1.22)	1.22 (.72, 2.07)	**.54* (.36, .83)**	**.52* (.30, .92)**	1.05 (.75, 1.47)	**.49* (.29, .82)**
Posterior Cingulate Gyrus	1.09 (.86, 1.38)	1.01 (.72, 1.42)	**.77* (.63, .94)**	1.31 (.96, 1.78)	.98 (.76 1.26)	.92 (.67, 1.27)	**.82* (.68, .99)**	1.12 (.83, 1.51)
Precentral Gyrus	1.02 (.80, 1.32)	.80 (.55, 1.16)	**.71* (.56, .89)**	1.13 (.81, 1.56)	.86 (.65, 1.13)	.82 (.58, 1.15)	**.81* (.65, .99)**	1.01 (.73, 1.39)
Putamen	1.30 (.93, 1.82)	1.25 (.79, 1.97)	.81 (.61, 1.07)	**1.54* (1.01, 2.33)**	.86 (.61, 1.20)	.96 (.56, 1.63)	.88 (.67, 1.16)	1.08 (.67, 1.74)
Superior Frontal Gyrus	.95 (.71, 1.25)	.79 (.52, 1.21)	**.75* (.58, .97)**	1.05 (.72, 1.53)	.87 (.65, 1.16)	.90 (.59, 1.38)	.89 (.69, 1.14)	1.01 (.72, 1.42)
Thalamus	1.08 (.76, 1.53)	1.04 (.63, 1.73)	.82 (.62, 1.09)	1.26 (.79, 2.01)	.73 (.52, 1.03)	.82 (.52, 1.30)	.89 (.68, 1.17)	.92 (.62, 1.36)
vmPFC	.98 (.71, 1.37)	1.02 (.64, 1.63)	1.06 (.83, 1.37)	.95 (.62, 1.46)	.85 (.59, 1.24)	.80 (.48, 1.32)	.80 (.61, 1.05)	.99 (.62, 1.59)

Table S15. Missingness due to quality control (QC) procedures

	Diagnostic Group			
	DBD+CU *N(%)*	DBD-only *N(%)*	TD *N(%)*	Total *N(%)*
Quality Control Variables				
Freesurfer QC	16[a] (5%)	13[a] (3%)	32[a] (4%)	61 (4%)
T1w image artifacts	1[a] (.3%)	3[a] (.7%)	1[a] (.1%)	5 (.3%)
MID Task fMRI series	9[a] (3%)	7[a] (2%)	7[a] (1%)	23 (2%)
MID Task Performance	20[a] (8%)	17[a] (5%)	51[a] (6%)	88 (6%)
DOF (reduced by motion censoring)	109[a] (35%)	120[ab] (30%)	240[b] (26%)	469 (29%)

Notes. Matching or absent superscripts [a, b, c] indicate groups that did not differ significantly from each other.
DBD+CU = High DBD/High CU Traits; DBD-only = High DBD/Low CU Traits; TD = Typically Developing.
For additional information on ABCD QC procedures, see method section. In addition, information related to ABCD QC variables are available in Hagler et al. (2019), also see *NDA Annual Release 2.0.1 Notes ABCD Imaging Instruments* for additional details.
The QC variables listed above correspond to the following variables in the ABCD Study dataset:
Freesurfer QC = 'fsqc_qc'; T1w image artifacts = 'iqc_t1_ok_ser'; MID Task fMRI series = 'iqc_mid_ok_ser'; MID Task Performance = 'tfmri_mid_beh_performflag'; ABCD QC Metric = 'tfmri_mid_all_b_dof > 200'.

Table S16. Main Analyses (youth with ADHD diagnosis removed).

	Planned Group Comparisons OR (95% CI)					
	Reward Anticipation			**Reward Receipt**		
	TD vs ^DBD+ CU	**DBD-only vs. ^DBD+ CU**	**TD vs. ^DBD-only**	**TD vs. ^DBD+ CU**	**DBD-only vs. ^DBD+ CU**	**TD vs. ^DBD-only**
Left Hemisphere						
Amygdala	0.64	0.82	0.78	0.71	**0.67***	1.07
dACC (dorsal)	1.01	**0.75***	1.35	0.68	**0.59***	1.15
pACC (perigenual)	1.48	.94	1.56	0.57	1.02	**0.56***
Caudate	1.19	0.77	**1.54***	0.86	0.79	1.09
Cuneus	0.74	**0.70***	1.05	0.67	0.73	0.92
Insula	1.04	0.74	1.24	0.76	0.83	0.91
Midbrain	0.79	0.92	1.50	0.79	0.92	0.86
Nucleus Accumbens	0.94	**0.69***	1.36	0.88	**0.70***	1.25
Occipital Cortex	0.74	**0.65***	1.13	0.82	1.16	0.70
Orbitofrontal Cortex	0.84	0.76	1.09	0.74	0.83	0.90
Posterior Cingulate Cortex	0.96	0.84	1.23	0.67	0.82	0.82
Precentral Gyrus	0.99	0.81	1.11	0.96	0.84	1.14
Putamen	0.94	**0.60***	1.53	1.04	0.79	1.32
Superior Frontal Gyrus	0.81	0.93	1.11	0.81	0.93	0.87
Thalamus	0.73	**0.62***	1.19	0.96	1.26	0.75
vmPFC	1.05	1.11	0.95	0.76	0.83	0.91
Right Hemisphere						
Amygdala	1.18	.75	1.56	0.98	0.90	1.08
dACC (dorsal)	1.24	0.80	1.53	0.76	0.90	0.84
pACC (perigenual)	1.08	0.68	1.57	0.79	0.92	0.86
Caudate	.65	**0.58***	1.11	0.55	0.78	0.71
Cuneus	0.95	0.96	0.99	0.77	0.82	0.93
Insula	1.29	0.83*	1.55	0.63	0.91	0.69
Midbrain	1.04	0.79	1.32	0.65	0.90	0.72
Nucleus Accumbens	1.43	0.95	1.50	0.70	1.01	0.82
Occipital Cortex	0.86	**0.65***	1.31	0.57	0.85	0.67
Orbitofrontal Cortex	0.81	0.86	.94	**0.52***	1.05	0.87
Posterior Cingulate Cortex	0.68	**0.59***	1.16	1.01	0.95	1.06
Precentral Gyrus	0.83	0.71	1.15	0.83	0.84	0.99
Putamen	1.25	**0.72***	**1.73***	0.87	0.81	1.07
Superior Frontal Gyrus	0.71	**0.67***	1.07	0.91	0.92	0.99
Thalamus	1.08	0.86	1.25	0.89	0.89	0.99
vmPFC	1.35	0.80	**1.67***	0.96	0.84	1.14

Note. **p*<.05; DBD = DBD overall; DBD+CU = High DBD/High CU Traits; DBD-only = High DBD/Low CU Traits; TD = Typically Developing; ACC = Anterior Cingulate Cortex; vmPFC = ventromedial prefrontal cortex

^ = Reference group. Odds ratios are reported relative to the reference group. *O.R.'s* > 1 indicate increased activation among the non-reference group relative to the reference group (i.e., less activation in the reference group). *O.R.'s* < 1 indicate decreased activation among the non-reference group relative to the reference group (i.e., greater activation among the reference group).

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