Title: Longitudinal assessment of brain structure and behavior in youth with rapid weight gain: Potential contributing causes and consequences

Shana Adise, PhD[1], Andrew T. Marshall, PhD[2], Sage Hahn, BS[3], Shaomin Zhao, PhD[2], Eric Kan, BS[1], Kyung E. Rhee, MD, MSc, MA[4], Megan M. Herting, PhD[5], and Elizabeth R. Sowell, PhD[2].

[1]Children's Hospital of Los Angeles, Department of Pediatrics, Division of Pediatric Research Administration
[2]Children's Hospital of Los Angeles, Department of Pediatrics, Division of Neurology
[3]University of Vermont, Department of Psychiatry
[4]University of California, San Diego, Department of Pediatrics
[5]University of Southern California, Keck School of Medicine, Departments of Population and Public Health Sciences and Pediatrics

Running title: Brain change in youth with rapid weight gain

Corresponding Author:

Elizabeth Sowell, PhD
Director Developmental Cognitive Neuroimaging Laboratory
Professor of Pediatrics | Keck School of Medicine, University of Southern California
Division of Research on Children, Youth and Families | Department of Pediatrics
Children's Hospital Los Angeles
4650 Sunset Blvd., Mailstop #130 | Los Angeles, CA 90027
Ph: 323-361-7347 | Fax: 323.361.7836 | esowell@chla.usc.edu

SUPPLEMENTAL MATERIALS

Demographic assessments. Caregiver report of the child's race/ethnicity, date of birth, and sex at birth were obtained at the baseline visit. The child's age at the time of each visit was recorded in months. Socioeconomic status was operationalized using the highest education of the household, of which there were 29 categories. Education was collapsed into five groups: <High school (HS), HS/Generalized Education Diploma (GED), Some college, Four-year degree (Bachelor's degree), Postgraduate education. Race and ethnicity had 22 options, which were collapsed into five groups: White, Black, Hispanic, Asian, and Mixed/Other.

Behavioral Inhibition System / Behavioral Approach System (BIS/BAS)*:* Youth completed a modified and original BIS/BAS questionnaire[1], which is commonly used to assess trait-based reward and inhibitory control. The questionnaire consists of 24 questions that are summarized into three BAS subscales and one BIS scale. The behavioral approach system (BAS) assesses goal-directed behaviors with subscales for reward responsiveness, fun seeking, and drive. The behavioral inhibition system (BIS) assesses avoidance-type behaviors and only has one subscale.

Questions for each subscale are scored on a 4-point scale from 1 (very true) to 4 (very false). Answers on the modified and original questionnaires were highly correlated (r=0.9), so only the modified BIS/BAS was used in the analysis. Descriptions of each measure are presented in the **Supplemental Materials Table S3**.

Urgency, Premeditation, Perseverance, Sensation Seeking, and Positive Urgency (UPPS-P): The UPPS-P is a 59-item questionnaire that was answered by youth. The five subscales identify traits as outlined in the scale title. Questions for each subscale are scored on a 4-point scale from 1 (agree strongly) to 4 (disagree strongly). Descriptions of each measure are presented in the **Supplemental Materials Table S3**.

Elastic net regression:

Initially, the entire dataset was randomly split into an 80% training dataset for model construction and a 20% testing set to access model generalizability. Within the training dataset, separate models were trained and evaluated with 5-fold cross-validation (CV), stratified to preserve the ratio of WS_{HW} to WG participants within each fold. A measure of generalizability was accessed by applying the highest performing of the five models, as estimated by performance on their respective validation folds, to the previously unseen testing set. We report performance using the binary classification metric area under the curve (AUC), where AUC_{train} refers to AUC on the model's associated validation fold in the training set and AUC_{test} to AUC as calculated from the testing set. The implementation of the logistic elastic-net regression model included a further nested hyper-parameter search across 60 random combinations of values for both strength of regularization as well as ratio between L1 and L2 regularization. All machine learning models, training, and evaluation were conducted in Python through the Brain Predictability Toolbox package[2]. Brain features made available to the elastic-net model consisted of cortical Destrieux (n=148) and subcortical ROIs (n=14) for cortical thickness, surface area, subcortical volume, DTI FA, and DTI MD estimates (n_{total}=648), as well as intracranial volume and motion estimates for the DTI scan. A set of nonbrain features were also made available as input features, which consisted of sex, age, puberty, highest household education (a proxy for socioeconomic status), race/ethnicity, intracranial volume, motion estimates for the DTI scan, and scanner ID. As a quality control step, the top and bottom 1% of the data for each ROI were winsorized (i.e., values <1% and >99% percentiles, respectively, were set to a truncated value) and then further normalized (each feature scaled to mean=0 and standard deviation=1 within that training sample). Both procedures were performed in a properly nested manner, where estimates of both 1st and 99th quantiles as well as other sample dependent measures were estimated only within training data folds. These analyses were conducted on 747/748 youth because one subject was missing fractional anisotropy estimates for two ROIs. Although the ABCD Study® often enrolled siblings, in this subset of the data, 98% (n=731) of youth were singletons. However, after outlier exclusion, the test set had only 1 sibling pair within the WS_{HW} group, and, thus, independence issues in the test set were not of concern.

Weight gain model confirmation: Previously, one-year weight gain was found to not be confounded by BMI at baseline[3]. Again, to make sure weight status was not confounding results, we removed WG youth who were classified as having overweight or obesity at baseline and

reran the elastic-net regression. To account for a decrease in sample size, we increased the number of folds 10, otherwise, the parameters remained the same.

Matched sample confirmation mixed effects analysis: Our sample differed on several key demographics and the elastic-net regression identified age, puberty, and highest caregiver education as non-brain predictors of youth with WG, we chose to match on these key demographics. A 1-to-1 matching using the nearest neighbor method was performed in Python using pymatch (https://github.com/benmiroglio/pymatch). This resulted in a sample of 198 WG youth and 221 WS youth. Mixed models were then run on this matched sample and controlled for the following covariates: BMI, sex, race/ethnicity, caregiver report of prenatal exposure to alcohol and tobacco. Effects modeled were group (e.g., WS vs. WG) and Group x Time (e.g., baseline, two-year follow-up). Random effects included scanner serial ID and subject. Categorical variables were dummy coded with the largest group as the reference. Dependent variables were either the brain regions of interest of the two-year prediction or subscales from the BIS/BAS and UPPS questionnaire. Models that included cortical data included intracranial volume as a covariate, whereas DTI models included DTI motion as a covariate.

Correlations between behavioral measurements and the brain: We ran mixed models to determine if subscales of the UPPS were correlated with brain structure. Covariates entered into the model were weight stable group (e.g., weight stable vs. weight gainer), sex, BMI, age, puberty, race/ethnicity, and caregiver report of highest education. Categorical variables consisted of sex, race/ethnicity, and caregiver report of highest education. Models were adjusted for random effects of scanner (i.e., site) and subject.

Supplemental Results:

UPPS correlation with the brain: Lack of perseverance was related to 4 surface area regions and 1 cortical thickness region. Lack of planning was related to 2 surface area regions. Negative urgency was related to 1 surface area and 1 cortical thickness region. Positive urgency was related to 1 fractional anisotropy. 1 surface area and 1 cortical thickness region. Sensation seeking was related to 1 surface area region. **Table S13** lists the *t* and *p* values for each region.

Matched sample: When matching on age, puberty, and highest caregiver education, there was no longer a group effect of FA in the parieto-occipital sulcus right hemisphere. All other Group and Group x Time interactions remained unchanged (see **Table S10**). Similarly, the results of the BIS/BAS (see **Table S12**) and UPPS (see **Table S15**) remained unchanged, but no longer survived multiple comparisons correction, possibly due to a smaller sample size

Table S1. The number of subjects available based on each exclusion criterion applied.

	n
Y2 released data	6571
Not underweight (i.e., BMI %ile >5)	5882
No medications known to affect food intake	5882
No learning disabilities or psychiatric disorders	5882
No eating disorders based on caregiver report on the KSADS	4941
Complete data for sex, age, puberty, race, education	4709
No height measurement error (i.e., decrease in height between visits)	4617
Met WS_{HW}/WG criteria	1034

	WS_{HW} (n=709)	WG (n = 316)
Passed FreeSurfer QC	587	256
Acceptable T_1	584	254
Acceptable T_2	544	238
Acceptable DTI	529	226
No missing tabulated data	527	221
Final sample	527	221

Note. Y2 = year 2; BMI %ile = Body mass index percentile according to the CDC sex-age-height-weight-specific growth curves for youth; WS_{HW} = Healthy weight, Weight Stable; WG = Weight Gain; QC = quality control; T_1 = T_1-weighted image; T_2 = T_2-weighted image; DTI = diffusion tensor imaging. KSADS = Kiddie schedule for affective disorders and schizophrenia for school-age youth.

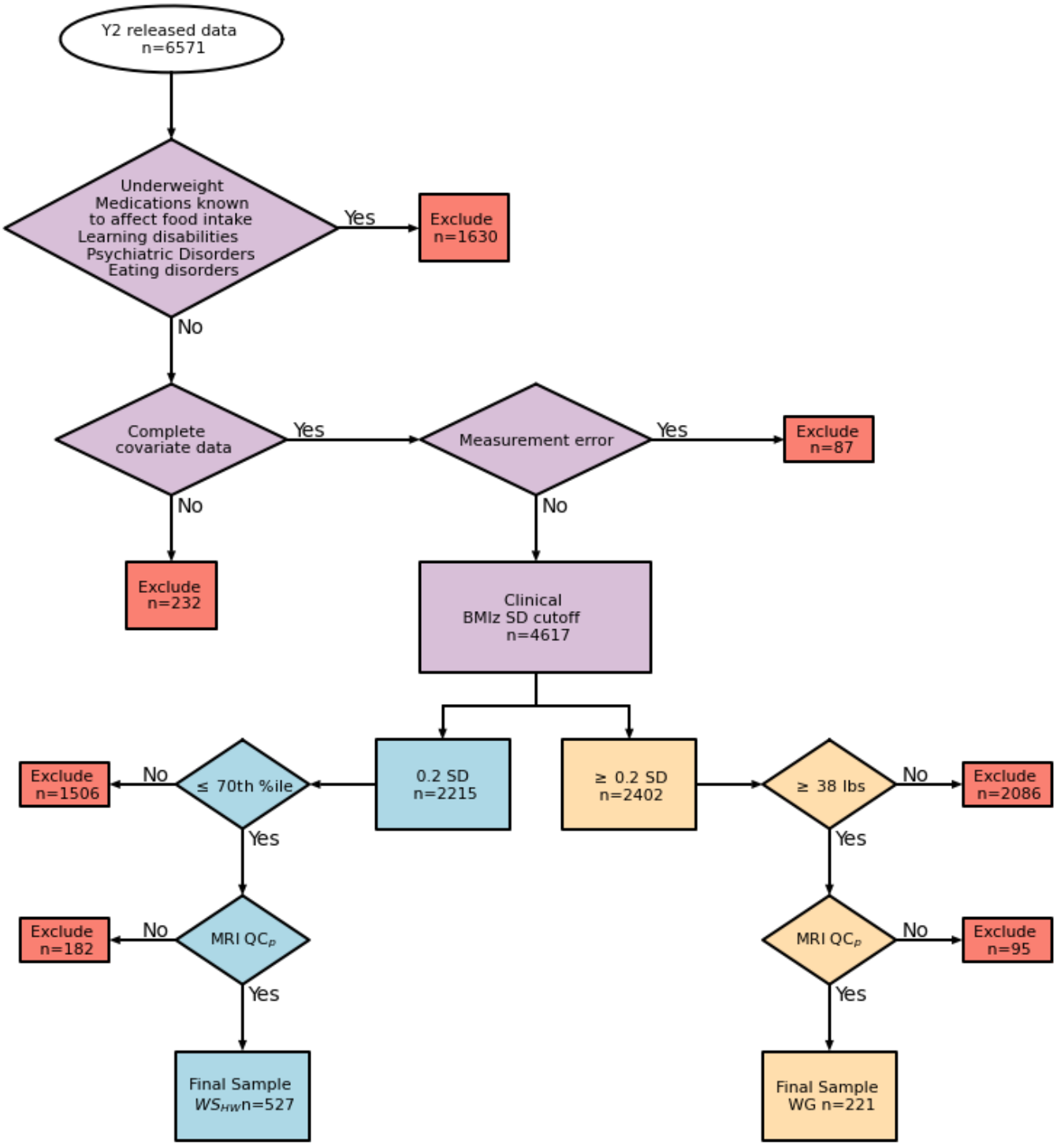

Figure S1: An overview of group selection. Y2= year 2; BMIz = BMI z-score; SD = standard deviation; %ile = BMI percentile; MRI = Magnetic Resonance Imaging; MRI QC_p = passed MRI quality control parameters; WG = weight gain; WS_{HW} = Healthy Weight, Weight Stable.

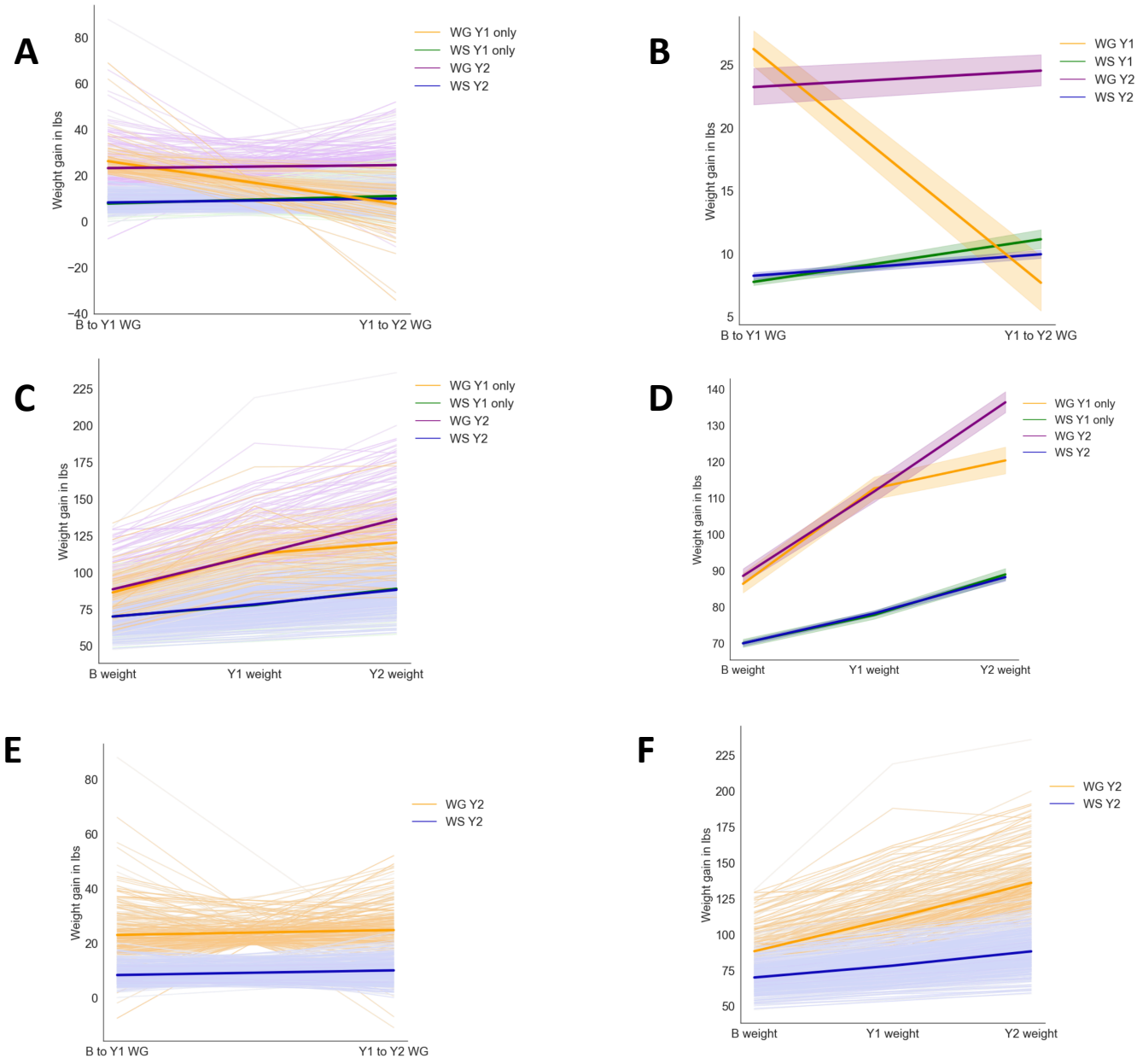

Figure S2: A) Spaghetti plots that depict weight gain in lbs from baseline (B) to one-year follow-up (Y1) and Y1 to the two-year follow-up (Y2) **B)** Group means for weight gain by year. **C)** Spaghetti plots of weight in pounds (lbs) at each time point collected. **D)** Group means for weight in pounds at each time point collected. **E)** Spaghetti plots for weight gain for youth included in the manuscript. **F)** Spaghetti plots for weight at each time point for the youth included in the manuscript. Bold lines indicate the mean for each group. WG Y1 only = youth who had extreme weight gain (WG) from baseline to one-year follow-up but not beyond this point. WS Y1 = youth who were weight stable from baseline to year 1 but not beyond. WG Y2 = youth with extreme weight gain from baseline to the two-year follow-up (included in the manuscript). WS Y2 = youth who were weight stable from baseline to the two-year follow-up (included in this manuscript).

Table S2. The number of youth in the health weight, Weight Stable (WS_{HS}) and Weight Gain (WG) groups as defined in Adise et al., (2021) [19] that met criteria for WS and WG by the criteria outlined in this manuscript

	WS_{HW} at Y1 (n=637)	WG at Y1 (n=172)
Had BMI data at Y2	617	165
No missing covariates at any time point	615	163
No eating disorders at Y1 or Y2	536	157
No medications known to affect food intake at Y1 or Y2	536	157
Had MRI data at Y2	475	140
Passed FreeSurfer QC at Y2	473	138
Passed T_1 MRI QC at Y2	473	137
Passed T_2 MRI QC at Y2	460	127
Passed DTI QC at Y2	456	127
Had BMI data at Y2	452	126
No BMI measurement error	448	126
Met BMIz SD criteria from baseline to Y2	277	113
Met WS_{HW}/WG criteria	249	58
No missing tabulated MRI data	249	56

Note. Weight criteria for youth in the WS_{HW} group corresponded to a BMI percentile < 70% at all time points and a BMIz SD <0.2 (clinical cut off). Weight criteria for youth in the WG group corresponded to weight gain > 38 lbs. across all time points in addition to a BMIz SD >=0.2 (clinical cutoff). BMI = Body Mass Index. BMIz = BMI z-score; T_1 = T_1-weighted image; T_2 = T_2-weighted image; DTI = diffusion tensor imaging; Y1 = year 1; Y2 = year 2. MRI = Magnetic resonance imaging; QC = quality control; STD = standard deviation.

Table S3. Variable descriptions.

Variable Groupings and Names in Data Release	Variable Descriptions
Kiddy schedule for affective disorders and schizophrenia (KSADS)	
Binge eating disorder	Eating much more than normal in a short period of time, eating when not hungry.
Anorexia nervosa	Restrictive eating, underweight (BMI<18.5 or 5th %ile)
Bulimia nervosa	Binging (i.e., eating a lot) and purging (i.e., getting rid of) behavior
Eating disorder not otherwise specified (EDOS) or Other Specified Feeding or Eating Disorder (OSFED)	Captures individuals who do not meet diagnostic criteria for anorexia nervosa or bulimia nervosa but still present with eating disorder-like symptoms
Behavioral Inhibition System/ Behavioral Approach System	
Reward responsiveness	Sensitivity to pleasant reinforcers in the environment
Fun seeking	Motivation to find novel rewards spontaneously
Drive	Motivation to follow goals
Inhibition	Inhibitory control
Urgency, Premeditation, Perseverance, Sensation Seeking, and Positive Urgency (UPPS-P)	
Negative urgency	The tendency to act rashly (i.e., impulsively) under an intense negative mood
Positive urgency	The tendency to act rashly (i.e., impulsively) while under an intense positive mood
Sensation seeking	The tendency to seek out novel and thrilling experiences
Lack of planning/premeditation	The tendency to not take into account the consequences of actions
Lack of perseverance	The tendency to quit a task when it becomes difficult, long, or boring.

Table S4. Baseline brain regions predictive of one-year and two-year weight gain

Brain regions at baseline (9/10-years-old) predictive of youth with 1-year weight gain at 10/11-years-old	Brain regions at baseline (9/10-years-old) predictive of youth with 2-year weight gain at 11/12-years-old
Cortical thickness	
Frontomarginal gyrus RH**	Frontomarginal gyrus RH**
	Medial orbito-olfactory sulcus RH
	Orbital gyrus LH
	Parieto-occipital sulcus LH
Pericallosal sulcus LH	
	Posterior ramus of the lateral sulcus RH
Posterior collateral transverse sulcus LH	
	Posterior ventral cingulate gyrus RH
Rectal gyrus LH	Rectal gyrus LH
	Rectal gyrus RH**
Sulcus intermedius primus (of Jensen) LH	
	Sulcus intermedius primus (of Jensen) RH
	Superior frontal sulcus LH
Surface Area	
Anterior occipital sulcus RH	Anterior occipital sulcus RH
	Frontomarginal gyrus RH
Inferior circular insula sulcus RH	Inferior circular insula sulcus RH
	Inferior frontal opercular gyrus RH
Inferior parietal angular gyrus RH	
	Inferior temporal gyrus LH
	Lateral orbital sulcus RH
	Middle temporal gyrus LH
Occipital temporal medial parahippocampal gyrus LH	
	Pericallosal sulcus RH
	Planum polare of the superior temporal gyrus LH
	Postcentral sulcus LH
	Precuneus gyrus LH
	Superior frontal sulcus LH
	Superior occipital sulcus and transverse occipital sulcus LH
Superior temporal transverse gyrus LH	
Fractional anisotropy	
	Accumbens area LH

	Anterior transverse temporal gyrus LH
Intraparietal and P transverse sulcus LH	
Lateral orbital sulcus LH	
Paracentral gyrus and sulcus LH	
	Parieto-occipital sulcus RH**
	Posterior ventral cingulate gyrus RH**
	Subcallosal gyrus RH
	Superior part of the precentral sulcus RH
Mean diffusivity	
	Accumbens area RH**
Anterior cingulate gyrus and sulcus RH	
	Anterior cingulate gyrus and sulcus LH
	Anterior occipital sulcus RH
Long insular gyrus and central sulcus of the insula LH	
	Long insular gyrus and central sulcus of the insula RH
Orbital medial olfactory gyrus RH	
Pallidum	
	Rectal gyrus LH
	Subcallosal gyrus LH
	Superior circular insula sulcus LH
Superior parietal gyrus RH	
	Supramarginal gyrus LH
	Temporal pole RH
Intracranial volume	

Note: Salmon colored rows highlight the brain regions at baseline that were predictive of youth who had extreme weight gain by 10/11-years-old (i.e., one-year weight gain) and 11/12-years-old (i.e., two-year weight gain). ** = brain regions that showed change after two-years of weight gain.

Table S5. Prenatal characteristics for youth in the Healthy Weight, Weight Stable (WS_{HW}) and Weight Gain (WG) groups and the rest of the sample with available data for year 2 (Other).

	WS_{HW} (n=527)	**WG (n=225)**	***p group***	**Other**	***p all***
Birth Weight [*M* (*SD*)]	13.9 (4.5)	14.1 (4.4)	0.6	13.7 (4.4)	0.3
Born Premature [*n* (%)]					
No	415 (78.9)	176 (79.6)	0.6	3070 (79.3)	0.6
Yes	106 (20.2)	41 (18.6)		768 (19.9)	0.5
Refused to Answer	5 (1.0)	4 (1.8)		31 (0.8)	
Weeks Premature [*M* (*SD*)]	4.6 (2.2)	5.3 (2.1)	0.7	15.3 (101.0)	
Prenatal tobacco (short) exposure [*n* (%)]					
No	467 (88.6)	173 (78.3)	0.001	3343 (86.4)	0.005
Yes	52 (9.9)	40 (18.1)		452 (11.7)	
Refused to Answer	8 (1.5)	8 (3.6)		73 (1.9)	
Prenatal tobacco (continued) exposure [*n* (%)]					
No	498 (94.5)	198 (89.6)	0.04	2679 (69.3)	0.7
Yes	22 (4.2)	15 (6.8)		973 (25.2)	
Refused to Answer	7 (1.3)	8 (3.6)		216 (5.6)	
Prenatal alcohol (short) exposure [*n* (%)]					
No	356 (67.6)	152 (68.8)	0.8	3656 (94.5)	0.03
Yes	133 (25.2)	56 (25.3)		151 (3.9)	
Refused to Answer	38 (7.2)	13 (5.9)		61 (1.6)	
Prenatal alcohol (continued) exposure [*n* (%)]					
No	506 (96.0)	208 (94.1)	0.03	3710 (95.9)	0.09
Yes	16 (3.0)	5 (2.3)		100 (2.6)	
Refused to Answer	5 (0.9)	8 (3.6)		58 (1.5)	

Note. p_{group} = significant group differences between WG and WS. p_{all} = significant differences between WS_{HW}, WG, and the rest of the sample. *M* = mean; *SD* = standard deviation; *n* = sample size; % = Percent. Short = substance use discontinued after pregnancy knowledge; continued = substance use continued throughout pregnancy. *p*-values represent significance testing for *t*-tests and chi-squared testing.

Table S6. Results from the mixed effects model examining how brain regions that were predictive of one-year weight gain [3] changed in response to two-years of weight gain.

ROI		*F*	*p*
Cortical Thickness			
Anterior transverse collateral sulcus LH			
	Group	0.61	0.433
	Time	0.16	0.685
	Group x Time	0.13	0.718
Frontomarginal gyrus and sulcus RH			
	Group	19.2	< 0.001 [a] ***
	Time	2.18	0.140
	Group x Time	9.86	< 0.001 [a] ***
Pericallosal sulcus LH			
	Group	0.52	0.467
	Time	0.08	0.774
	Group x Time	0.97	0.322
Rectal gyrus LH			
	Group	1.87	0.171
	Time	0.07	0.783
	Group x Time	0.31	0.574
Sulcus intermedius primus (of Jensen) LH			
	Group	2.25	0.133
	Time	3.10	0.078
	Group x Time	2.53	0.111
Surface Area			
Angular gyrus RH			
	Group	0.00	0.983
	Time	0.58	0.444
	Group x Time	0.98	0.321
Anterior occipital sulcus RH			
	Group	0.15	0.698
	Time	1.53	0.215
	Group x Time	0.92	0.335
Anterior transverse temporal gyrus LH			
	Group	0.00	0.969
	Time	0.12	0.722
	Group x Time	4.02	0.045 *
Parahippocampal gyrus LH			
	Group	2.74	0.098
	Time	0.01	0.911
	Group x Time	0.78	0.374
Superior segment of the circular sulcus of the insula RH			
	Group	0.29	0.586
	Time	0.00	0.987
	Group x Time	0.05	0.809
Fractional Anisotropy			.
Intraparietal sulcus and transverse parietal sulci RH			
	Group	1.36	0.243
	Time	2.34	0.125
	Group x Time	2.30	0.129
Lateral orbital sulcus LH			
	Group	0.11	0.739
	Time	1.55	0.212
	Group x Time	0.00	0.977

Paracentral gyrus and sulcus LH			
	Group	0.58	0.445
	Time	3.25	0.071
	Group x Time	0.19	0.662
Mean Diffusivity			
Anterior cingulate gyrus and sulcus RH			
	Group	0.28	0.593
	Time	1.93	0.164
	Group x Time	0.05	0.818
Long insular gyrus and central sulcus of the insula LH			
	Group	0.73	0.391
	Time	4.23	0.039 *
	Group x Time	0.02	0.882
Medial orbital sulcus RH			
	Group	0.99	0.317
	Time	7.92	0.004 **
	Group x Time	0.09	0.755
Pallidum RH			
	Group	2.05	0.151
	Time	0.41	0.521
	Group x Time	0.03	0.862
Superior parietal sulcus RH			
	Group	0.06	0.804
	Time	0.07	0.779
	Group x Time	0.62	0.428

Note. Results of the main effects and interactions from the mixed model testing for whether regions identified with predicting youth with rapid weight gain at the one-year time point (Adise et al., 2021)[3] exhibit structural changes in response to sustained, two-year, weight gain onset. Effects are independent of BMI, age, sex, baseline puberty, race/ethnicity, and highest household education and random effects (i.e., scanner and subject change). Reference variables for categorical variables: Healthy Weight, Weight Stable (WS_{HW}), Male, White, and Bachelor's Degree. Time was not corrected for multiple comparisons because it was not an effect of interest but is reported for reader interpretation. G=gyrus; S=sulcus; RH=right hemisphere; LH=left hemisphere. ROI labels correspond to the Destrieux atlas labels. *=p<0.05; **=p<0.01; ***=p<0.001. p values are derived from the F-statistic. [a] =survived correction for multiple comparisons (n_{tests}=36) for group and Group x Time interactions.

Table S7. The model estimates for the training and test dataset for the prediction analysis in which baseline features were used to predict group membership at two-years.

	Training (n = 605, n $_{WG}$ = 187)			Testing (n = 142, n $_{WG}$ = 33)			
Model	AUC	MCC	Bal Acc	AUC	MCC	Bal Acc	# of features
Brain only	0.68	0.22	0.61	0.65	0.20	0.61	240
Nonbrain only	0.74	0.32	0.67	0.77	0.45	0.76	37
Brain + Nonbrain	0.76	0.38	0.70	0.72	0.23	0.63	44

Note. The area under the curve (AUC), Matthews Correlation Coefficient (MCC), and balanced accuracy (Bal acc) as well as the number of features selected from the model are presented. Covariates were dummy coded for Race, sex, highest household education, and MRI scanner serial number. The brain features included region of interest (ROI) estimates for cortical thickness, surface area, diffusion tensor imaging (DTI) estimates of fractional anisotropy (FA) and mean diffusivity (MD), and subcortical volume regions. WG = weight gain.

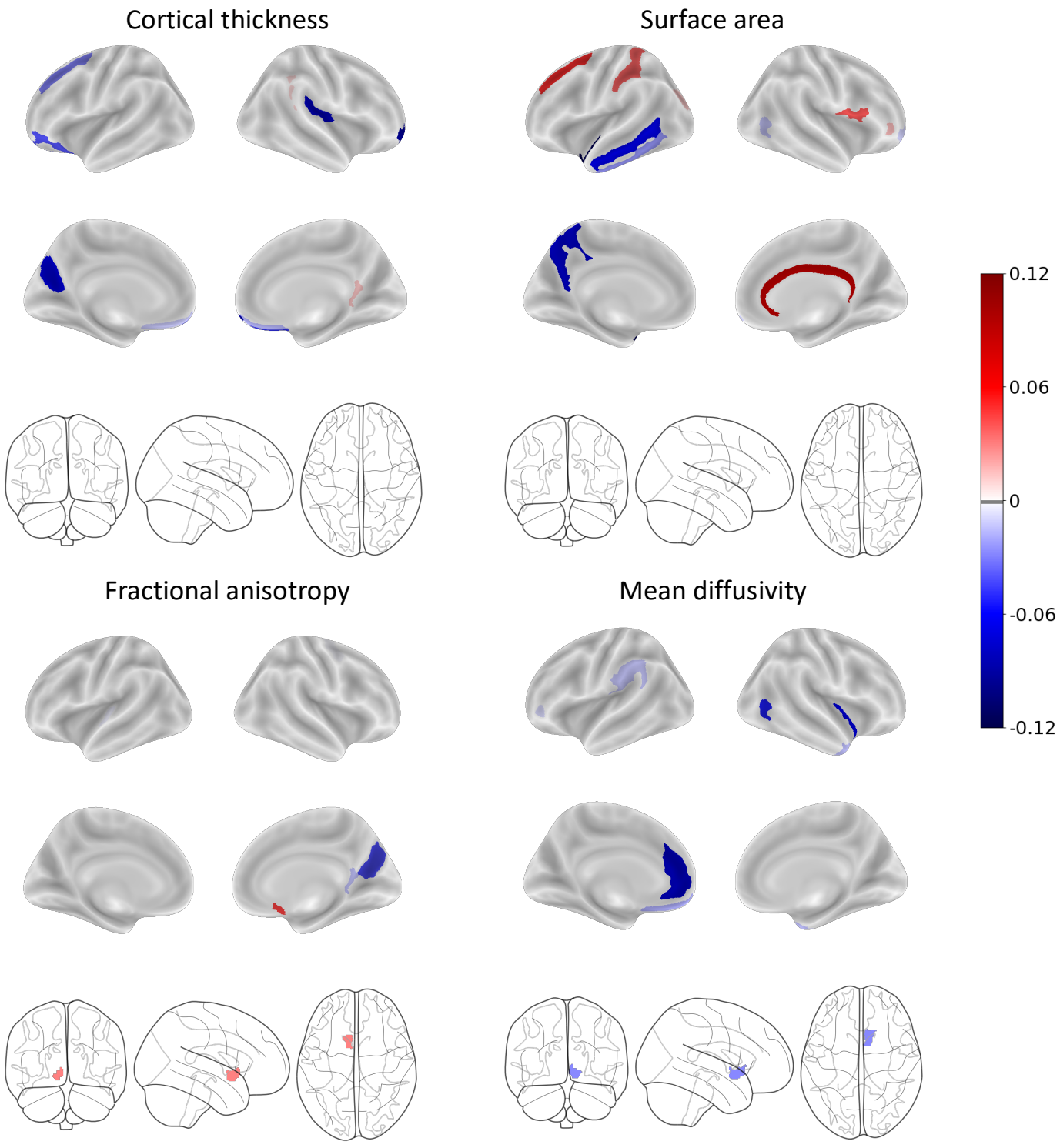

Figure S3. Visualization of the baseline brain features across each modality identified from the elastic net regression that predicted youth in the WG group after two-years of sustained, extreme weight gain. Colors correspond to the beta weights of the regression model.

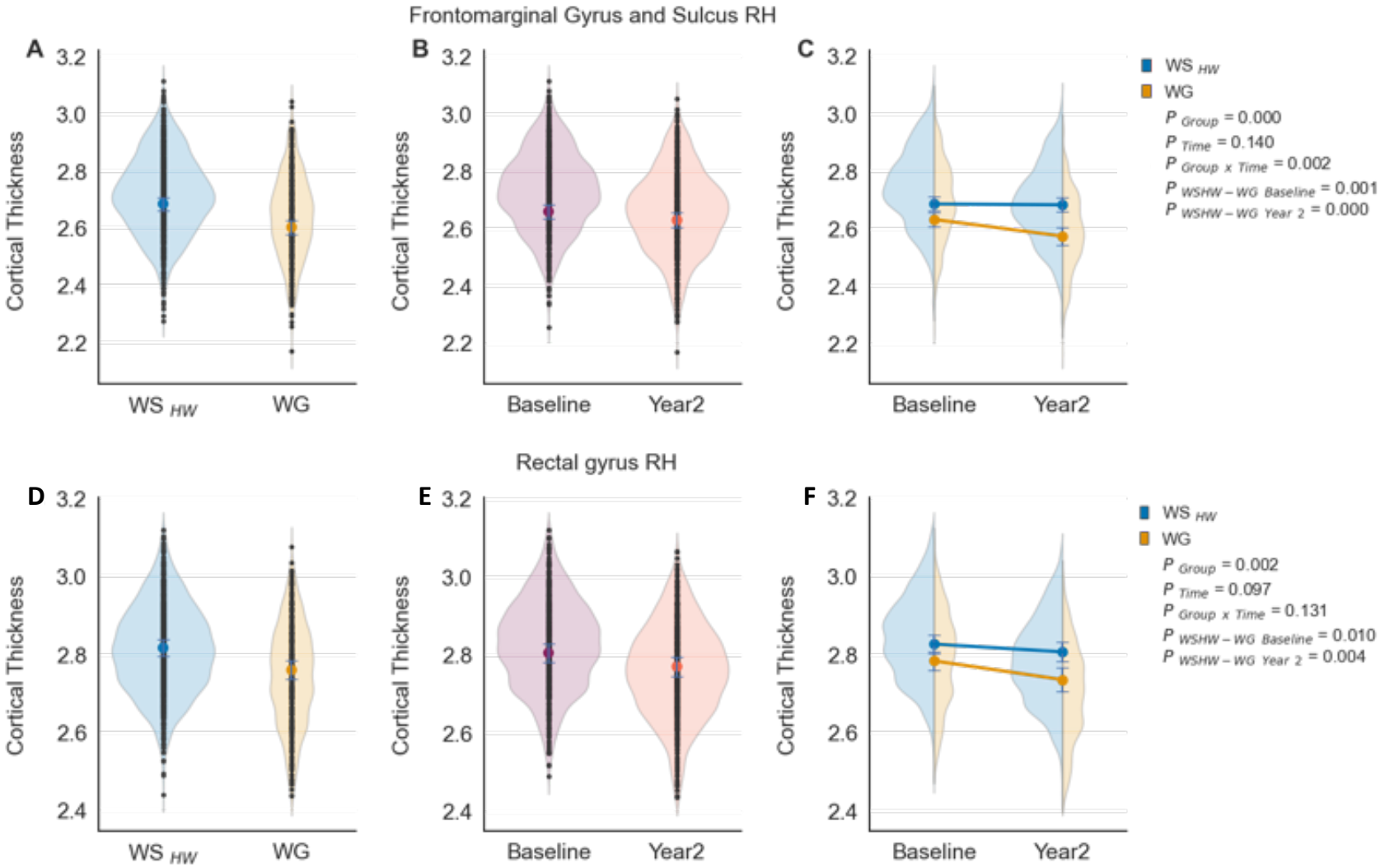

Figure S4. The distribution of estimates (i.e., violin plots and black dots) and means of the main effects and interactions adjusted for all covariates (e.g., age, sex, baseline puberty, BMI, race/ethnicity, highest household education, and caregiver report of prenatal exposure to alcohol and tobacco) and random effects (e.g., scanner and subject ID). **A** and **D)** Main effects of Group (Healthy Weight, Weight Stable [WS_{HW}], Weight Gain [WG]) collapsed across time (baseline, year 2). **B** and **E)** Main effects of Time collapsed across group. **C** and **F)** Interactions between Group (WS_{HW} vs. WG) by Time (baseline vs. year 2). RH = right hemisphere

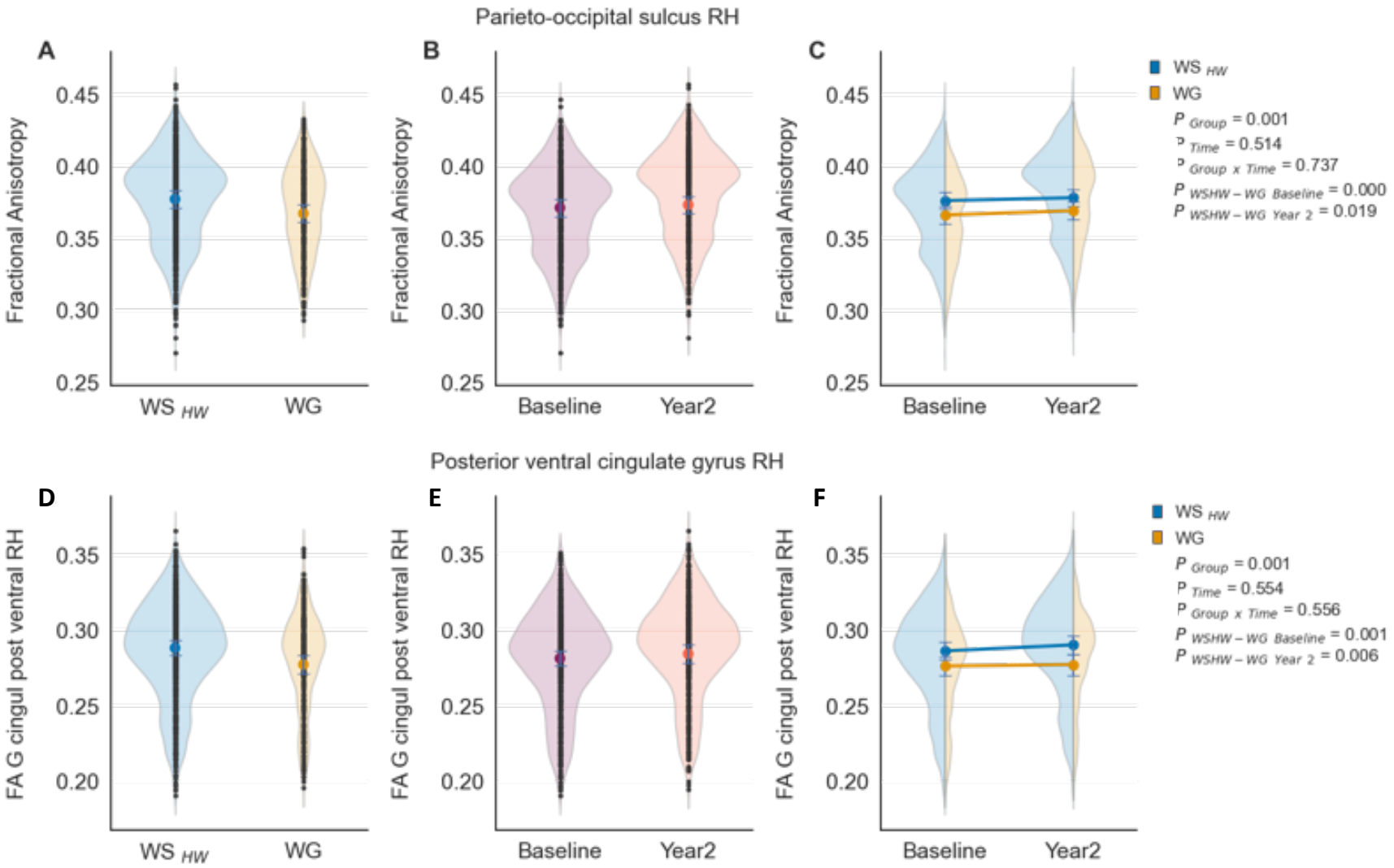

Figure S5. The distribution of estimates (i.e., violin plots and black dots) and means of the main effects and interactions adjusted for all covariates (e.g., age, sex, puberty, BMI, race/ethnicity, highest household education, and caregiver report of prenatal exposure to alcohol and tobacco) and random effects (e.g., scanner and subject ID). **A** and **D)** Main effects of Group (Healthy Weight, Weight Stable [WS_{HW}], Weight Gain [WG]) collapsed across time (baseline, year 2). **B** and **E)** Main effects of Time collapsed across group. **C** and **F)** Interactions between Group (WS_{HW} vs. WG) by Time (baseline vs. year 2). RH = right hemisphere

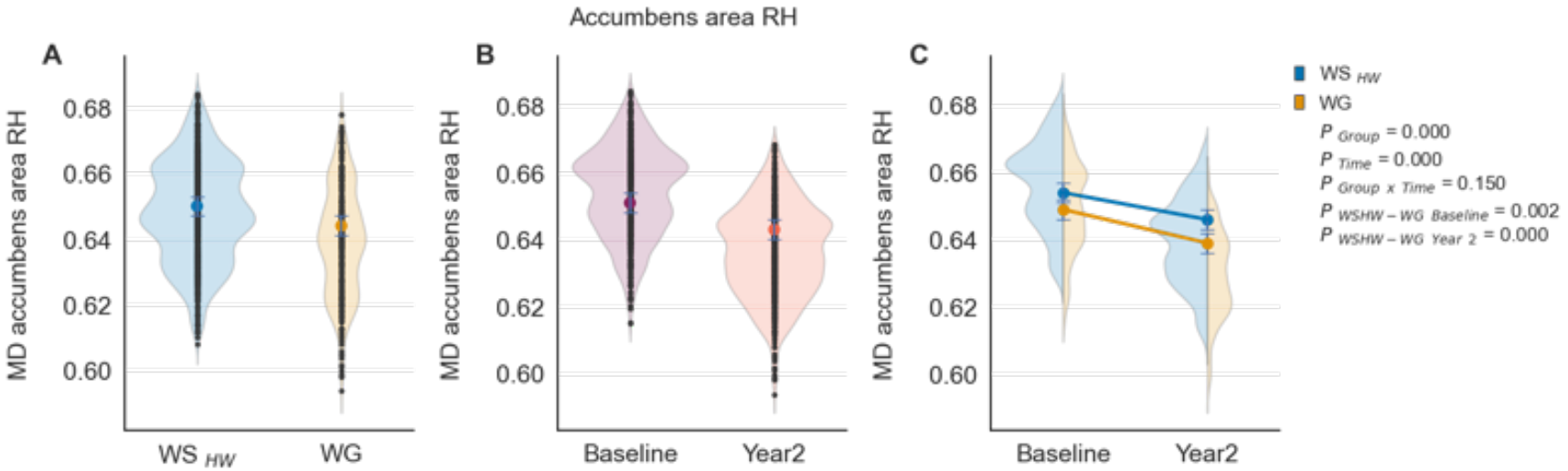

Figure S6. The distribution of estimates (i.e., violin plots and black dots) and means of the main effects and interactions adjusted for all covariates (e.g., age, sex, puberty, BMI, race/ethnicity, highest household education, and caregiver report of prenatal exposure to alcohol and tobacco) and random effects (e.g., scanner and subject ID). **A)** Main effects of Group (Weight Stable [WS_{HW}], Weight Gain [WG]) collapsed across time (baseline, year 2). **B)** Main effects of Time collapsed across group. **C)** Interactions between Group (WS_{HW} vs. WG) by Time (baseline vs. year 2). RH = right hemisphere

Table S8. Results of the main effects and interactions from the mixed model testing for whether regions identified at baseline as predictive of WG at the two-year period exhibited structural changes in response to WG onset.

ROI		*F*	*p*
Cortical Thickness			
Frontomarginal gyrus RH			
	Group	19.2	<0.001 [a] ***
	Time	2.18	0.140
	Group x Time	9.86	0.001 [a] ***
Posterior ventral cingulate gyrus RH			
	Group	3.08	0.079
	Time	1.17	0.277
	Group x Time	0.00	0.930
Orbital gyrus LH			
	Group	3.85	0.049 *
	Time	2.04	0.152
	Group x Time	0.48	0.485
Rectal gyrus LH			
	Group	1.87	0.171
	Time	0.07	0.783
	Group x Time	0.31	0.574
Rectal gyrus RH			
	Group	9.21	0.002 [a] **
	Time	2.75	0.097
	Group x Time	2.28	0.130
Posterior ramus of the lateral sulcus RH			
	Group	5.76	0.016 *
	Time	0.01	0.898
	Group x Time	1.04	0.307
Superior frontal sulcus LH			
	Group	1.54	0.214
	Time	2.49	0.998
	Group x Time	0.08	0.770
Sulcus intermedius primus (of Jensen) RH			
	Group	0.11	0.731
	Time	0.29	0.590
	Group x Time	0.24	0.620
Medial orbito-olfactory sulcus RH			
	Group	7.43	0.006 **
	Time	0.17	0.676
	Group x Time	0.46	0.495
Parieto-occipital sulcus LH			
	Group	6.05	0.014 *
	Time	1.47	0.224
	Group x Time	0.10	0.743
Surface Area			
Frontomarginal gyrus RH			
	Group	0.04	0.829
	Time	0.04	0.825
	Group x Time	0.09	0.757
Inferior frontal opercular gyrus RH			
	Group	0.34	0.555
	Time	2.49	0.114
	Group x Time	1.83	0.175

Precuneus gyrus LH			
	Group	0.49	0.481
	Time	0.45	0.499
	Group x Time	0.76	0.382
Planum polare of the superior temporal gyrus LH			
	Group	0.23	0.630
	Time	0.24	0.617
	Group x Time	2.86	0.090
Inferior temporal gyrus LH			
	Group	5.05	0.024 *
	Time	2.44	0.118
	Group x Time	0.87	0.349
Middle temporal gyrus LH			
	Group	0.22	0.636
	Time	2.74	0.097
	Group x Time	1.33	0.247
Inferior circular insula sulcus RH			
	Group	0.29	0.586
	Time	0.00	0.987
	Group x Time	0.05	0.809
Superior frontal sulcus LH			
	Group	1.54	0.214
	Time	0.37	0.538
	Group x Time	0.18	0.663
Superior occipital sulcus and transverse occipital sulcus LH			
	Group	0.00	0.934
	Time	0.02	0.868
	Group x Time	4.42	0.035 *
Anterior occipital sulcus RH			
	Group	0.15	0.698
	Time	1.53	0.215
	Group x Time	0.92	0.335
Lateral orbital sulcus RH			
	Group	2.74	0.097
	Time	2.11	0.145
	Group x Time	2.64	0.104
Pericallosal sulcus RH			
	Group	1.12	0.288
	Time	0.19	0.655
	Group x Time	0.43	0.511
Postcentral sulcus LH			
	Group	2.38	0.123
	Time	3.24	0.072
	Group x Time	0.00	0.968
Fractional Anisotropy			
Accumbens area LH			
	Group	1.96	0.161
	Time	43.4	<0.001 ***
	Group x Time	1.75	0.186
Posterior ventral cingulate gyrus RH			
	Group	10.7	0.001 [a] **
	Time	0.35	0.553
	Group x Time	0.34	0.555
Subcallosal gyrus RH			
	Group	0.92	0.336
	Time	17.1	<0.001 ***

	Group x Time	2.45	0.117
Anterior transverse temporal gyrus LH			
	Group	3.42	0.064
	Time	0.36	0.546
	Group x Time	0.66	0.415
Parieto-occipital sulcus RH			
	Group	10.2	0.001 [a] **
	Time	0.42	0.514
	Group x Time	0.11	0.736
Superior part of the precentral sulcus RH			
	Group	2.83	0.092
	Time	3.80	0.051
	Group x Time	1.41	0.235
Mean Diffusivity			
Accumbens area RH			
	Group	15.4	<0.001 [a] ***
	Time	22.6	<0.001 ***
	Group x Time	2.07	0.150
Anterior cingulate gyrus and sulcus LH			
	Group	1.13	0.286
	Time	0.39	0.530
	Group x Time	0.00	0.923
Long insular gyrus and central sulcus of the insula RH			
	Group	1.45	0.227
	Time	7.58	0.005 **
	Group x Time	0.13	0.713
Supramarginal gyrus LH			
	Group	0.42	0.515
	Time	0.14	0.706
	Group x Time	0.01	0.890
Rectal gyrus LH			
	Group	0.05	0.817
	Time	6.54	0.010 *
	Group x Time	1.25	0.263
Subcallosal gyrus LH			
	Group	4.18	0.041 *
	Time	15.8	<0.001 ***
	Group x Time	0.21	0.642
Temporal pole RH			
	Group	4.67	0.030 *
	Time	0.02	0.883
	Group x Time	0.33	0.560
Superior circular insula sulcus LH			
	Group	1.69	0.192
	Time	0.24	0.618
	Group x Time	0.49	0.482
Anterior occipital sulcus RH			
	Group	1.72	0.189
	Time	0.22	0.633
	Group x Time	2.80	0.094
Lateral orbital sulcus LH			
	Group	0.43	0.507
	Time	0.03	0.849

	Group x Time	1.11	0.291

Note. Effects are independent of BMI, age, sex, baseline puberty, race/ethnicity, and highest parental education, caregiver report of prenatal exposure to alcohol and tobacco and random effects (e.g., scanner and subject). Reference variables for categorical variables: Healthy Weight, Weight Stable (WS_{HW}), male, White, and Bachelor's Degree. Time was not corrected for multiple comparisons because it was not an effect of interest but is reported for reader interpretation. CI = confidence interval; G = gyrus; S = sulcus; RH = right hemisphere; LH = left hemisphere. ROI labels correspond to the Destrieux atlas labels. * = $p<0.05$; ** = $p<0.01$; *** = $p<0.001$. p values are derived from the F-statistic. [a] = survived correction for multiple comparisons ($n_{tests} = 78$) for Group and Group x Time interactions.

Table S9. Post-hoc comparisons for the mixed effects models looking at group effects of brain structure change over time.

			WG		WS_{HW}	
Feature	***t***	***p***	***M***	**95% CI**	***M***	**95% CI**
Cortical thickness						
Frontomarginal gyrus RH	4.4	<0.001	2.602±0.025	[2.545, 2.66]	2.684±0.023	[2.631, 2.736]
Rectal gyrus RH	3.04	0.001	2.759±0.024	[2.704, 2.814]	2.816±0.022	[2.766, 2.866]
Fractional anisotropy						
Parieto-occipital sulcus RH	3.66	<0.001	0.367±0.006	[0.354, 0.38]	0.377±0.006	[0.365 ,0.39]
Posterior ventral cingulate gyrus RH	3.31	0.001	0.277±0.006	[0.265, 0.29]	0.288±0.005	[0.276, 0.3]
Mean diffusivity						
Accumbens area RH	4.42	<0.001	0.643±0.003	[0.637,0.65]	0.65±0.003	[0.644,0.657]

Note. Results of the corrected main effects from the mixed model testing for whether regions identified at baseline as predictive of weight gain group membership at the two-year follow-up exhibited structural changes in response to weight gain onset. Effects are independent of BMI, age, sex, baseline puberty, race/ethnicity, highest household education, random effects (e.g., scanner and subject), and caregiver report of prenatal exposure to alcohol and tobacco. Reference variables for categorical variables: weight stable, male, White, and Bachelor's degree. CI=confidence interval; RH=right hemisphere; ROI labels correspond to the Destrieux atlas labels. *=p<0.05; **=p<0.01; ***=p<0.001. p values are derived from the t-statistic. [a] =survived correction for multiple comparisons (n_{tests}=78) for Group and Group x Time interactions.

Table S10. Results of the main effects and interactions from the mixed model testing for whether regions identified at baseline as predictive of WG at the two-year period exhibited structural changes in response to WG onset for the matched sample.

ROI		*F*	*p*
Cortical Thickness			
Frontomarginal gyrus RH			
	Group	17.33	<0.001 [a] ***
	Group x Time	9.83	< 0.001 [a] ***
Posterior ventral cingulate gyrus RH			
	Group	3.40	0.07
	Group x Time	0.14	0.70
Orbital gyrus LH			
	Group	3.56	0.06
	Group x Time	0.34	0.56
Rectal gyrus LH			
	Group	2.16	0.14
	Group x Time	1.10	0.29
Rectal gyrus RH			
	Group	11.07	<0.001 [a] **
	Group x Time	2.91	0.08
Posterior ramus of the lateral sulcus RH			
	Group	5.00	0.02 *
	Group x Time	0.32	0.60
Superior frontal sulcus LH			
	Group	2.35	0.12
	Group x Time	1.22	0.27
Sulcus intermedius primus (of Jensen) RH			
	Group	0.32	0.54
	Group x Time	0.09	0.76
Medial orbito-olfactory sulcus RH			
	Group	11.30	<0.001 [a] **
	Group x Time	0.10	0.75
Parieto-occipital sulcus LH			
	Group	5.00	0.02 *
	Group x Time	0.61	0.43
Surface Area			
Frontomarginal gyrus RH			
	Group	0.00	0.97
	Group x Time	0.78	0.38
Inferior frontal opercular gyrus RH			
	Group	0.16	0.69
	Group x Time	3.57	0.06
Precuneus gyrus LH			
	Group	0.59	0.44
	Group x Time	0.38	0.54
Planum polare of the superior temporal gyrus LH			
	Group	0.03	0.85
	Group x Time	2.58	0.11
Inferior temporal gyrus LH			
	Group	2.78	0.10
	Group x Time	1.78	0.18
Middle temporal gyrus LH			
	Group	1.19	0.28
	Group x Time	2.05	0.15

Inferior circula insula sulcus RH			
	Group	0.03	0.87
	Group x Time	0.26	0.61
Superior frontal sulcus LH			
	Group	0.80	0.37
	Group x Time	0.17	0.68
Superior occipital sulcus and transverse occipital sulcus LH			
	Group	0.12	0.73
	Group x Time	1.95	0.16
Anterior occipital sulcus RH			
	Group	2.71	0.10
	Group x Time	1.61	0.20
Lateral orbital sulcus RH			
	Group	1.62	0.20
	Group x Time	1.00	0.32
Pericallosal sulcus RH			
	Group	0.69	0.41
	Group x Time	0.02	0.88
Postcentral sulcus LH			
	Group	1.56	0.21
	Group x Time	0.07	0.79
Fractional Anisotropy			
Accumbens area LH			
	Group	0.26	0.61
	Group x Time	1.40	0.24
Posterior ventral cingulate gyrus RH			
	Group	8.39	<0.001 [a] ***
	Group x Time	0.00	0.98
Subcallosal gyrus RH			
	Group	0.77	0.38
	Group x Time	1.35	0.25
Anterior transverse temporal gyrus LH			
	Group	3.11	0.08
	Group x Time	0.21	0.65
Parieto-occipital sulcus RH			
	Group	3.05	0.08
	Group x Time	0.01	0.94
Superior part of the precentral sulcus RH			
	Group	0.55	0.46
	Group x Time	0.61	0.43
Mean Diffusivity			
Accumbens area RH			
	Group	16.19	<0.001 [a] ***
	Group x Time	1.16	0.28
Anterior cingulate gyrus and sulcus LH			
	Group	0.99	0.32
	Group x Time	0.84	0.36
Long insular gyrus and central sulcus of the insula RH			
	Group	2.93	0.09
	Group x Time	0.29	0.59
Supramarginal gyrus LH			
	Group	0.12	0.73
	Group x Time	1.25	0.26
Rectal gyrus LH			

	Group	0.92	0.34
	Group x Time	2.10	0.15
Subcallosal gyrus LH			
	Group	6.40	0.01*
	Group x Time	0.00	0.96
Temporal pole RH			
	Group	4.95	0.03
	Group x Time	0.02	0.89
Superior circular insula sulcus LH			
	Group	1.56	0.21
	Group x Time	0.97	0.33
Anterior occipital sulcus RH			
	Group	5.07	0.02*
	Group x Time	0.04	0.84
Lateral orbital sulcus LH			
	Group	0.51	0.47
	Group x Time	0.52	0.47

Note. Sample was matched on age, puberty, and caregiver highest education. Effects are independent of BMI, sex, race/ethnicity, caregiver report of prenatal tobacco and alcohol exposure and random effects (e.g., scanner and subject). Reference variables for categorical variables: Healthy Weight, Weight Stable (WS_{HW}), male, White, and Bachelor's Degree. Time was not corrected for multiple comparisons because it was not an effect of interest but is reported for reader interpretation. CI = confidence interval; G = gyrus; S = sulcus; RH = right hemisphere; LH = left hemisphere. ROI labels correspond to the Destrieux atlas labels. * = $p<0.05$; ** = $p<0.01$; *** = $p<0.001$. p values are derived from the F-statistic. [a] = survived correction for multiple comparisons.

Table S11. Results for the linear random mixed effects models for each subscale of the BIS/BAS questionnaire.

Measure		*F*	*p*
BIS/BAS			
drive			
	Group	0.24	0.617
	Time	1.60	0.204
	Group x Time	0.48	0.488
reward			
	Group	0.00	0.982
	Time	1.94	0.163
	Group x Time	0.08	0.771
inhibition			
	Group	2.08	0.148
	Time	17.2	< 0.001 ***
	Group x Time	3.14	0.076
fun seeking			
	Group	0.65	0.416
	Time	5.71	0.016 *
	Group x Time	1.06	0.303

Note. Results for the linear random mixed effects models for each subscale of the BIS/BAS questionnaire. Group = Weight Stable (WS_{HW}) versus Weight Gain (WG). Time = Baseline vs. Year 2. Covariates entered into the model were age, sex, BMI, baseline puberty, race/ethnicity, caregiver report of highest education, and caregiver report of prenatal tobacco and alcohol exposure. Categorical variables consisted of sex, race/ethnicity, caregiver highest education, and caregiver report of prenatal tobacco and alcohol exposure. Models were adjusted for random effects of scanner (i.e., site) and subject. [a] = survived correction for multiple comparisons (n_{tests} = 8) for group and Group x Time interactions.

Table S12. Results for the linear random mixed effects models for each subscale of the BIS/BAS questionnaire for the matched sample.

Measure		*F*	*p*
BIS/BAS			
drive			
	Group	0.99	0.312
	Group x Time	0.32	0.572
reward			
	Group	0.04	0.838
	Group x Time	0.31	0.580
inhibition			
	Group	0.32	0.569
	Group x Time	4.56	0.033
fun seeking			
	Group	0.59	0.721
	Group x Time	1.7	0.192

Note. Group = Weight Stable (WS_{HW}) versus Weight Gain (WG). Time = Baseline vs. Year 2. Covariates entered into the model were sex, BMI, race/ethnicity, and caregiver report of prenatal exposure to tobacco and alcohol. Categorical variables consisted of sex, race/ethnicity, and caregiver report of prenatal exposure to tobacco and alcohol. Models were adjusted for random effects of scanner (i.e., site) and subject. [a] = survived correction for multiple comparisons (n_{tests} = 8) for group and Group x Time interactions.

Table S13. Main effects for each subscale of the UPPS on brain region by modality.

UPPS subscale	Brain region	T-stat	P-val	Sig
Lack of perseverance				
	Fractional anisotropy			
	Accumbens area lh	-1.804	0.072	.
	G cingul post ventral rh	0.938	0.349	
	G subcallosal rh	0.139	0.889	
	G temp sup g t transv lh	0.113	0.91	
	S parieto occipital rh	-1.242	0.214	
	S precentral sup part rh	-0.882	0.378	
	Mean diffusivity			
	Accumbens area rh	0.472	0.637	
	G and S cingul ant lh	-0.063	0.95	
	G ins lg and S cent ins rh	-1.505	0.133	
	G pariet inf supramar lh	-0.751	0.453	
	G rectus lh	1.117	0.264	
	G subcallosal lh	-0.872	0.384	
	Pole temporal rh	0.41	0.682	
	S circular insula sup lh	-1.147	0.252	
	S occipital ant rh	0.416	0.678	
	S orbital lateral lh	-0.701	0.483	
	Surface area			
	G and S frontomargin rh	0.042	0.967	
	G front inf opercular rh	-0.83	0.407	
	G precuneus lh	-1.75	0.08	.
	G temp sup plan polar lh	-1.986	0.047	*
	G temporal inf lh	-2.069	0.039	*
	G temporal middle lh	0.11	0.912	
	S circular insula inf rh	-1.994	0.046	*
	S front sup lh	-1.016	0.31	
	S oc sup and transversal lh	0.693	0.489	
	S occipital ant rh	-1.421	0.156	
	S orbital lateral rh	0.056	0.955	
	S pericallosal rh	0.864	0.388	
	S postcentral lh	-2.401	0.017	*
	Cortical thickness			
	G and S frontomargin rh	0.239	0.811	
	G cingul post ventral rh	-1.611	0.107	
	G orbital lh	0.091	0.928	
	G rectus lh	1.326	0.185	
	G rectus rh	2.046	0.041	*
	Lat fis post rh	-0.222	0.824	
	S front sup lh	-0.19	0.849	
	S interm prim jensen rh	-1.52	0.129	
	S orbital med olfact rh	0.515	0.607	
	S parieto occipital lh	1.662	0.097	.
Lack of planning				
	Fractional anisotropy			
	Accumbens area lh	-0.327	0.744	
	G cingul post ventral rh	1.438	0.151	
	G subcallosal rh	-0.274	0.784	
	G temp supG t transv lh	-0.544	0.586	
	S parieto occipital rh	-1.07	0.285	
	S precentral sup part rh	-0.517	0.605	
	Mean diffusivity			

	Accumbens area rh	0.201	0.841	
	G and S cingul ant lh	1.076	0.282	
	G ins lg and S cent ins rh	-0.934	0.35	
	G pariet inf supramar lh	0.446	0.656	
	G rectus lh	0.605	0.546	
	G subcallosal lh	-0.388	0.698	
	Pole temporal rh	1.478	0.14	
	S circular insula sup lh	0.119	0.905	
	S occipital ant rh	0.227	0.821	
	S orbital lateral lh	0.418	0.676	
	Surface area			
	G and S frontomargin rh	-1.017	0.309	
	G front inf opercular rh	0.436	0.663	
	G precuneus lh	-0.711	0.477	
	G temp sup plan polar lh	-0.707	0.48	
	G temporal inf lh	-0.872	0.384	
	G temporal middle lh	2.729	0.006	**
	S circular insula inf rh	-1.165	0.244	
	S front sup lh	-0.284	0.776	
	S oc sup and transversal lh	1.619	0.106	
	S occipital ant rh	0.85	0.395	
	S orbital lateral rh	0.822	0.411	
	S pericallosal rh	1.7	0.089	.
	S postcentral lh	-3.078	0.002	**
	Cortical thickness			
	G and S frontomargin rh	-0.822	0.411	
	G cingul post ventral rh	-0.368	0.713	
	G orbital lh	-1.637	0.102	
	G rectus lh	-0.834	0.404	
	G rectus rh	0.562	0.574	
	Lat fis post rh	-0.158	0.875	
	S front sup lh	-1.811	0.07	.
	S interm prim jensen rh	-0.007	0.994	
	S orbital med olfact rh	1.565	0.118	
	S parieto occipital lh	-1.19	0.234	
Negative urgency				
	Fractional anisotropy			
	Accumbens area lh	-0.978	0.328	
	G cingul post ventral rh	-0.053	0.958	
	G subcallosal rh	-1.399	0.162	
	G temp supG t transv lh	-0.478	0.633	
	S parieto occipital rh	1.28	0.201	
	S precentral sup part rh	-1.341	0.18	
	Mean diffusivity			
	Accumbens area rh	-0.406	0.685	
	G and S cingul ant lh	0.793	0.428	
	G ins lg and S cent ins rh	0.03	0.976	
	G pariet inf supramar lh	-0.66	0.509	
	G rectus lh	-0.599	0.55	
	G subcallosal lh	-0.459	0.647	
	Pole temporal rh	-0.98	0.327	
	S circular insula sup lh	-0.925	0.355	
	S occipital ant rh	0.78	0.435	
	S orbital lateral lh	-0.698	0.485	
	Surface area			
	G and S frontomargin rh	1.476	0.14	

	G front inf opercular rh	0.296	0.768	
	G precuneus lh	-0.554	0.58	
	G temp sup plan polar lh	-1.311	0.19	
	G temporal inf lh	1.329	0.184	
	G temporal middle lh	0.19	0.85	
	S circular insula inf rh	-3.757	0	***
	S front sup lh	-0.093	0.926	
	S oc sup and transversal lh	0.004	0.996	
	S occipital ant rh	1.081	0.28	
	S orbital lateral rh	-0.763	0.446	
	S pericallosal rh	0.906	0.365	
	S postcentral lh	-1.769	0.077	.
	Cortical thickness			
	G and S frontomargin rh	1.714	0.087	.
	G cingul post ventral rh	0.389	0.697	
	G orbital lh	1.356	0.175	
	G rectus lh	0.173	0.863	
	G rectus rh	1.453	0.146	
	Lat fis post rh	0.852	0.395	
	S front sup lh	0.994	0.32	
	S interm prim jensen rh	-0.275	0.784	
	S orbital med olfact rh	2.162	0.031	*
	S parieto occipital lh	1.129	0.259	
Positive urgency				
	Fractional anisotropy			
	Accumbens area lh	-0.882	0.378	
	G cingul post ventral rh	0.093	0.926	
	G subcallosal rh	-2.149	0.032	*
	G temp supG t transv lh	-0.479	0.632	
	S parieto occipital rh	0.794	0.428	
	S precentral sup part rh	-1.368	0.172	
	Mean diffusivity			
	Accumbens area rh	1.114	0.265	
	G and S cingul ant lh	-0.162	0.871	
	G ins lg and S cent ins rh	-1.13	0.258	
	G pariet inf supramar lh	0.111	0.912	
	G rectus lh	-0.736	0.462	
	G subcallosal lh	-0.08	0.936	
	Pole temporal rh	0.698	0.485	
	S circular insula sup lh	-1.172	0.241	
	S occipital ant rh	-1.36	0.174	
	S orbital lateral lh	-1.103	0.27	
	Surface area			
	G and S frontomargin rh	0.345	0.731	
	G front inf opercular rh	0.076	0.939	
	G precuneus lh	-0.002	0.999	
	G temp sup plan polar lh	-0.764	0.445	
	G temporal inf lh	1.165	0.244	
	G temporal middle lh	-0.689	0.491	
	S circular insula inf rh	-2.849	0.004	**
	S front sup lh	-0.449	0.654	
	S oc sup and transversal lh	0.258	0.797	
	S occipital ant rh	-0.082	0.934	
	S orbital lateral rh	-0.89	0.373	
	S pericallosal rh	-0.347	0.729	
	S postcentral lh	-1.576	0.115	

	Cortical thickness			
	G and S frontomargin rh	0.402	0.688	
	G cingul post ventral rh	-0.513	0.608	
	G orbital lh	0.943	0.346	
	G rectus lh	0.867	0.386	
	G rectus rh	1.356	0.175	
	Lat fis post rh	-0.294	0.769	
	S front sup lh	0.479	0.632	
	S interm prim jensen rh	0.497	0.619	
	S orbital med olfact rh	2.022	0.043	*
	S parieto occipital lh	-1.953	0.051	.
Sensation seeking				
	Fractional anisotropy			
	Accumbens area lh	0.476	0.634	
	G cingul post ventral rh	-1.509	0.132	
	G subcallosal rh	-1.528	0.127	
	G temp supG t transv lh	-0.783	0.434	
	S parieto occipital rh	1.143	0.253	
	S precentral sup part rh	-0.243	0.808	
	Mean diffusivity			
	Accumbens area rh	-0.761	0.447	
	G and S cingul ant lh	-0.099	0.921	
	G ins lg and S cent ins rh	-1.267	0.205	
	G pariet inf supramar lh	-0.26	0.795	
	G rectus lh	-1.208	0.227	
	G subcallosal lh	-1.191	0.234	
	Pole temporal rh	0.987	0.324	
	S circular insula sup lh	-0.63	0.529	
	S occipital ant rh	0.01	0.992	
	S orbital lateral lh	-1.034	0.301	
	Surface area			
	G and S frontomargin rh	0.743	0.457	
	G front inf opercular rh	0.34	0.734	
	G precuneus lh	-0.172	0.864	
	G temp sup plan polar lh	-0.11	0.912	
	G temporal inf lh	0.564	0.573	
	G temporal middle lh	-0.029	0.977	
	S circular insula inf rh	-0.262	0.793	
	S front sup lh	2.12	0.034	*
	S oc sup and transversal lh	0.051	0.959	
	S occipital ant rh	0.345	0.731	
	S orbital lateral rh	0.567	0.571	
	S pericallosal rh	-1.437	0.151	
	S postcentral lh	-0.958	0.338	
	Cortical thickness			
	G and S frontomargin rh	0.152	0.879	
	G cingul post ventral rh	-0.489	0.625	
	G orbital lh	-0.013	0.99	
	G rectus lh	-1.194	0.233	
	G rectus rh	-0.803	0.422	
	Lat fis post rh	-0.503	0.615	
	S front sup lh	-0.326	0.745	
	S interm prim jensen rh	0.021	0.983	
	S orbital med olfact rh	0.316	0.752	
	S parieto occipital lh	-0.625	0.532	

Note: Covariates entered into the model were weight stable group (e.g., weight stable vs. weight gainer), sex, BMI, age, puberty, race/ethnicity, and caregiver report of highest education. Categorical variables consisted of sex, race/ethnicity, and caregiver report of highest education. Models were adjusted for random effects of scanner (i.e., site) and subject. Rh = right hemisphere. Lh = left hemisphere. G = gyrus. S = sulcus. Brain regions reflect the naming mechanism for the destrieux atlas.

Table S14. Results for the linear random mixed effects models for each subscale of the UPPS-P questionnaire.

Measure		*F*	*p*
UPPS-P			
Negative urgency			
	Group	0.11	0.739
	Time	17.2	< 0.001 ***
	Group x Time	0.91	0.337
Lack of planning			
	Group	3.87	0.049 *
	Time	0.97	0.323
	Group x Time	1.54	0.214
Sensation seeking			
	Group	0.21	0.646
	Time	1.47	0.224
	Group x Time	0.28	0.590
Positive urgency			
	Group	0.00	0.936
	Time	11.5	< 0.001 ***
	Group x Time	10.9	< 0.001 [a] ***
Lack of perseverance			
	Group	7.61	0.005 [a] **
	Time	1.84	0.174
	Group x Time	3.43	0.064

Note. Results for the linear random mixed effects models for each subscale of the UPPS-P questionnaire. Group=Weight Stable (WS_{HW}) vs. Weight Gain (WG). Time=Baseline vs. Year 2. Covariates entered into the model were age, sex, BMI, puberty, race/ethnicity, highest household education, and caregiver report of prenatal exposure to alcohol and tobacco. Categorical variables consisted of sex, race/ethnicity, highest household education, and caregiver report for prenatal alcohol and tobacco. Models were adjusted for random effects of scanner (i.e., site) and subject. [a] =survived correction for multiple comparisons (n_{tests}=10) for group and Group x Time interactions.

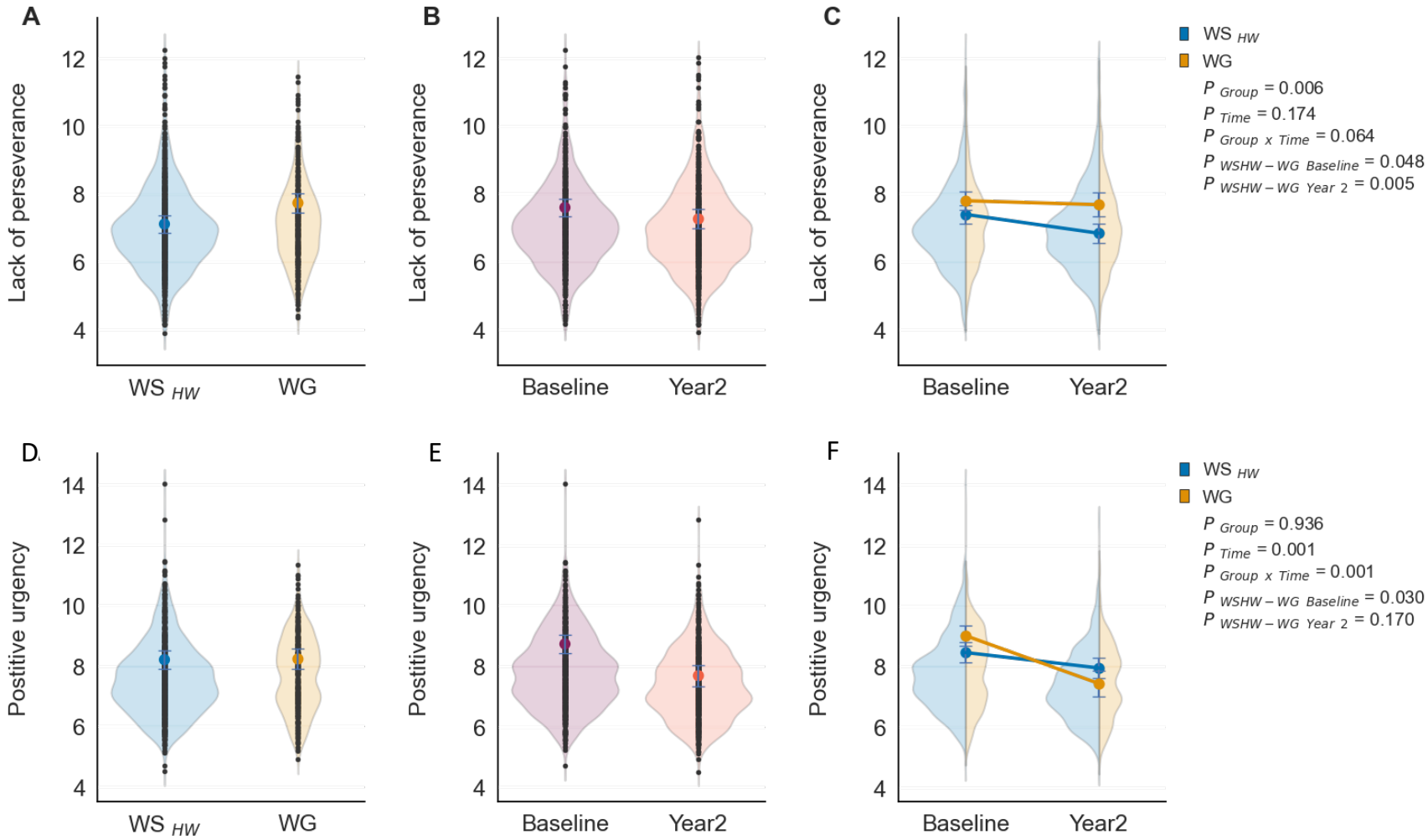

Figure S7. The distribution of estimates (i.e., violin plots) and means (i.e., circles) for the positive urgency subscale of the UPPS-P. Positive urgency is the tendency to be impulsive during positive affect states. **A)** Main effect of Group (i.e., Weight Stable [WS_{HW}] vs. Weight Gain [WG]) collapsed across time (i.e., baseline vs. year 2); **B)** Main effect of time collapsed across Group; **C)** Interaction between Group x Time. Effects were independent of age, sex, BMI, puberty, race/ethnicity, highest household education, and caregiver report of prenatal exposure to alcohol and tobacco. For **A** and **B**, the circle and error bars depict that marginal means and standard errors for the WS_{HW} and WG groups collapsed across time point (i.e., baseline to year 2). The black dots represent individual subject fit estimates. For **C**, the lines connecting the means indicate the change from baseline to year 2.

Table S15. Results for the linear random mixed effects models for each subscale of the UPPS questionnaire for the matched sample.

Measure		*F*	*p*
UPPS-P			
Negative urgency			
	Group	0.61	0.433
	Group x Time	1.01	0.314
Lack of planning			
	Group	2.35	0.125
	Group x Time	1.75	0.186
Sensation seeking			
	Group	0.03	0.847
	Group x Time	0.03	0.871
Positive urgency			
	Group	0.01	0.900
	Group x Time	7.82	0.005**
Lack of perseverance			
	Group	4.41	0.036*
	Group x Time	0.96	0.326

Note. Results for the linear random mixed effects models for each subscale of the UPPS-P questionnaire for the matched sample. The elastic net regression identified puberty, age, and highest caregiver education as non-brain features that were predictive of weight gain. Therefore, the groups were matched on these variables at baseline and a linear mixed effects analyses was conducted to determine Group and Group x Time interactions. Group=Weight Stable (WS_{HW}) vs. Weight Gain (WG). Time=Baseline vs. Year 2. Covariates entered into the model were sex, BMI, race/ethnicity, and caregiver report of prenatal exposure to alcohol and tobacco. Categorical variables consisted of sex, race/ethnicity, and caregiver report for prenatal alcohol and tobacco. Models were adjusted for random effects of scanner (i.e., site) and subject. [a] =survived correction for multiple comparisons (n_{tests}=10) for group and Group x Time interactions.

References:

1. Barch, D. M. *et al.* Demographic, physical and mental health assessments in the adolescent brain and cognitive development study: Rationale and description. *Developmental Cognitive Neuroscience* **32**, 55–66 (2018).
2. Hahn, S. *et al.* Brain Predictability toolbox: a Python library for neuroimaging-based machine learning. *Bioinformatics* **37**, 1637–1638 (2021).
3. Adise, S. *et al.* Multimodal brain predictors of current weight and weight gain in children enrolled in the ABCD study ®. *Developmental Cognitive Neuroscience* **49**, 100948 (2021).