Supporting information

Resting-state brain connectivity predicts weight loss and cognitive control of eating behavior following bariatric surgery

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Supplementary Methods

Participants

For this study, exclusion criteria included type 2 diabetes, neurological disease, major psychiatric illness, current illicit drug use, previous bariatric surgery, treatment with investigational medications/devices, females currently pregnant/nursing, claustrophobia, weight of >550 lbs. or >75 in. body circumference, and MRI scanning contraindications.

In total, 19 candidates were recruited and completed an MRI scanning session (including rsfMRI) as part of their baseline visit and underwent SG procedures between October 2013 and June 2015. Of the original 19 participants, 15 also completed an rsfMRI scan at their 12-month follow-up visit. In total, 3 participants were excluded due to excessive motion (please see: *Motion artifact detection and first-level FC analysis*) leaving 16 participants at baseline (pre-surgery) and 12 participants at 12-month follow-up visit (post-surgery). Analyses comparing rsfMRI data pre-surgery and 12-month follow-up post-surgery were conducted on data from 12 participants with adequate rsfMRI data at both visits. Out of the 16 participants at baseline, self-report data (i.e., Dutch Eating Behavior Questionnaire) and weight loss (%TWL) data were collected from 14 participants at 12-month follow-up visit. Therefore, examination of the associations between baseline rsfMRI and self-report/weight loss data was conducted on data from 14 participants with adequate rsfMRI data at baseline *and* cognitive control of eating/weight loss data at both visits.

MRI acquisition

Participants underwent a resting fMRI scan for 6:29 minutes with the instructions: “Keep your eyes open staring at the blank screen. Please keep your head as still as possible and don’t fall asleep.” Resting state scans were obtained parallel to anterior commissure-posterior commissure (AC-PC) covering the entire brain during the T2*-weighed echo planar imaging (EPI) sequence (TR=6270 ms, TE=32 ms, flip angle=90°, voxel size=2.4x2.4x2.3 mm, 67 slices, 62 volumes). T1-weighted 3D MPRAGE was acquired for co-registration to

the EPI images (TR=1800 ms, TE=2.19 ms, flip angle=7°, FOV=256x256mm, voxel size=1.0x1.0x1.0 mm, 176 sagittal slices).

Motion artifact detection and first-level FC analysis

ART (https://www.nitrc.org/projects/artifact_detect/) was used to identify outlier data points, defined as volumes that exceed 3 z-normalized standard deviations away from mean global brain activation across the entire volume or a composite movement threshold of 0.5mm scan-to-scan frame-wise displacement. After exclusion of 3 participants at baseline due to excessive motion as defined above, mean number of outliers at was 8 at baseline, and 4 at 12-month follow-up. There was no significant difference in the mean outliers between baseline and 12-month follow-up ($p>0.05$).

Functional connectivity analysis was performed using the CONN Toolbox v17b. A band-pass filter of 0.008-0.09Hz was applied to the data to reduce interference of physiological noise and linear detrending was performed. The denoising step in CONN Toolbox included elimination of WM and CSF noise using aCompCor (27) and regression of confounding effects (all first-level covariates, i.e., nuisance removal, motion-correction, scrubbing). Following denoising, residual BOLD time courses from *a priori* seeds were extracted to obtain first-level correlation maps. This was followed by computation of Pearson's correlation coefficients between seed time courses and time courses of all other voxels in the brain, converted to normally distributed z-scores using Fisher's transformations (for use in second-level GLM analyses).

Table S1. Complete list of the tested nodes in CONN Toolbox v17.b from pre- to post-surgery.

Network	Node/Seed
Default Mode Network	
	Medial Prefrontal Cortex
	Left Lateral Parietal Cortex
	Right Lateral Parietal Cortex
	Posterior Cingulate Cortex
Salience Network	
	Left Supramarginal Gyrus
	Right Supramarginal Gyrus
	Left Rostrolateral Prefrontal Cortex
	Right Rostrolateral Prefrontal Cortex
	Left Anterior Insula
	Right Anterior Insula
	Anterior Cingulate Cortex
Frontoparietal Network	
	Left Posterior Parietal Cortex
	Right Posterior Parietal Cortex
	Left Lateral Prefrontal Cortex
	Right Lateral Prefrontal Cortex

Table S2. Correlations Between Pre-Surgery Functional Connectivity and Changes in the Cognitive Control of Eating Behavior from Pre- to Post-Surgery

Positive correlations					
Seed	**Cluster**	**MNI (x, y, z)**	**Cluster size**	**ß**	**T (p-FDR)[1]**
Emotional Eating					
Default mode network – Medial Frontal Cortex	Precuneus Cortex	+8, -66, +42	189	0.26	**6.65 (0.003)**
	Precuneus Cortex	+2, -60, +54	166	0.33	**5.31 (0.004)**
	Supramarginal Gyrus, R anterior division	+58, -32, +40	143	0.23	**6.89 (0.006)**
Default mode network - Posterior Cingulate Cortex	Frontal Medial Cortex, L/R Paracingulate Gyrus	+6, +52, -12	478	0.27	**6.53 (<0.001)**
	Cingulate gyrus, posterior division	+2, -48, +32	199	0.29	**5.58 (<0.001)**
	Middle Temporal Gyrus, posterior division left	-52, -24, -14	93	0.23	**8.53 (0.030)**
	R Planum Polare	+46, -14, -2	80	0.28	**5.65 (0.041)**
Default mode network - R Lateral Parietal Cortex	R Frontal Pole	+16, +46, -20	124	0.21	**6.81 (0.032)**
R Hippocampus	R Lingual Gyrus	+14, -54, -6	123	0.19	**7.60 (0.019)**
	R Paracingulate Gyrus	+12, +14, +34	97	0.19	**6.97 (0.031)**
	R Frontal Pole	+30, +48, +34	83	0.22	**5.56 (0.041)**
Restraint Eating					
Frontoparietal network - R Posterior Parietal Cortex	R Lingual Gyrus	+14, -38, -8	86	0.15	**8.42 (0.037)**

	L Cerebellum	-12, -46, -48	76	0.15	**8.02 (0.037)**
External Eating					
R Hippocampus	R Precentral Gyrus	+4, -22, +68	113	0.17	**7.56 (0.018)**
Default mode network - Medial Frontal Cortex	R Planum Polare	+46, -10, -2	115	0.22	**7.22 (0.030)**
Frontoparietal network - R Posterior Parietal Cortex	Brainstem	-20, -20, -46	71	0.15	**6.97 (0.045)**

Negative correlations

Seed	**Cluster**	**MNI (x, y, z)**	**Cluster size**	**ß**	**T (p-FDR)[1]**
External Eating					
Frontoparietal network - L Posterior Parietal Cortex	Vermis/Cerebellum	0, -52, -44	136	-0.18	**-6.66 (0.009)**
	L Cerebellum	-20, -86, -46	105	-0.22	**-6.40 (0.016)**
Frontoparietal network - R Posterior Parietal Cortex	L Lingual Gyrus	+4, -96, -10	275	-0.20	**-9.66 (<0.001)**
	L Frontal Pole	-42, +38, +8	161	-0.19	**-7.69 (0.002)**

[1] Height threshold $p<0.001$, p-uncorrected and cluster threshold $p<0.05$, cluster-size p-FDR corrected.