

Table S1
Demographics, Neuropsychological Tasks, and Questionnaire Statistics

		obese	lean	statistics			
		mean (sd)	mean (sd)	t-value	df	p-value	
Demographics	Age	30.76 (5.90)	30.60 (5.78)	1.312	78	0.903	
	N male	14	14				
	Years of education	17.38 (4.84)	17.51 (2.75)	1.215	78	0.886	
	BMI	33.70 (2.77)	22.87 (1.70)	-20.242	78	< 0.001	
Neuropsychological Tasks	IQ	105.61 (10.06)	109.64 (9.03)	-1.514	78	0.067	
	TMT A (sec)	20.28 (4.59)	19.84 (4.65)	0.467	78	0.679	
	TMT B (sec)	40.01 (14.04)	41.95 (10.39)	-0.014	78	0.494	
	DS forward (level)	6.41 (1.18)	6.64 (1.32)	-0.201	78	0.421	
	DS backward (level)	5.23 (1.40)	5.33 (1.26)	0.632	78	0.735	
	DSST (N corr. symbol)	83 (12.85)	83.38 (11.41)	1.232	78	0.889	
	Questionnaires	EDEQ	total	1.40 (0.81)	0.66 (0.56)	-4.355	75
BDI		total	6.61 (5.21)	3.58 (3.95)	-2.622	77	0.005
BIS		anxiety	13.64 (3.21)	14.58 (2.87)	-0.915	77	0.182
		fear	5.02 (1.33)	5.37 (2.36)	-0.623	77	0.267
BAS		drive	11.67 (2.16)	11.63 (2.36)	1.625	77	0.946
		reward	15.92 (2.28)	16.66 (1.98)	-1.111	77	0.135
		fun seeking	11.49 (1.68)	11.53 (2.12)	1.482	77	0.929
BIS15		planning	10.13 (2.92)	10.53 (3.05)	1.152	77	0.560
		motor	11.23 (2.71)	9.92 (2.64)	-1.831	77	0.035
		attention	9.38 (2.79)	9.87 (3.02)	-0.082	77	0.468
		total	30.74 (5.91)	30.32 (7.22)	0.764	77	0.776
UPPS		urgency	26.21 (5.42)	24.95 (5.51)	-0.478	76	0.317
		premeditation	21.55 (3.45)	22.21 (4.51)	-0.058	76	0.477
		perseverance	18.71 (4.54)	18.76 (5.51)	1.823	76	0.964
		sensation seeking	32.58 (7.78)	32.87 (7.78)	1.143	76	0.872
mYFAS2			0.44 (1.23)	0.13 (0.41)	-1.033	77	0.152
FCQ		plan	7.33 (2.99)	6.34 (2.64)	-1.147	77	0.128
		positive reactions	12.62 (4.26)	11.71 (3.95)	-0.422	77	0.337
		negative reaction	6.49 (2.35)	6.00 (2.71)	-0.250	77	0.402
		control	10.31 (3.86)	8.76 (3.66)	-1.449	77	0.076
		thoughts	11.62 (5.02)	10.97 (4.55)	0.149	77	0.559
	hunger	11.36 (3.47)	10.11 (3.85)	-1.101	77	0.137	
	emotion	9.59 (3.54)	7.76 (4.05)	-1.795	77	0.038	
	environment	12.10 (3.80)	11.42 (3.73)	-0.177	77	0.430	
	guilt	6.28 (2.92)	4.55 (1.76)	-2.889	77	0.003	
	total	89.85 (25.39)	79.50 (25.69)	-1.422	77	0.080	

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		mean (sd)	mean (sd)	t-value	df	p-value
TFEQ	restrain	8.85 (5.03)	5.87 (4.53)	-2.403	73	0.009
	disinhibition	6.20 (2.94)	4.34 (2.60)	-2.604	73	0.005
	hunger	4.97 (2.73)	4.55 (2.32)	-0.047	73	0.481
DFSQ		54.87 (11.84)	55.74 (11.77)	0.674	77	0.749
STAI		37.56 (8.68)	35.92 (9.36)	-0.185	77	0.427
NEOFFI	neuroticism	8.38 (3.56)	9.50 (3.38)	-0.988	77	0.163
	extraversion	14.26 (3.39)	14.74 (3.44)	0.097	77	0.539
	openness	15.00 (4.12)	15.71 (4.72)	-0.041	77	0.484
	agreeableness	17.31 (3.87)	17.92 (4.15)	0.010	77	0.504
	conscientiousness	18.59 (3.88)	18.37 (4.14)	0.880	77	0.809

Note: TMT = Trailmaking Test (part A + B, Reitan, 1955); DS = Digit Span Test (Wechsler, 2008); DSST = Digit Symbol Substitution Test (Wechsler, 2008). EDEQ = Eating Disorder Examination Questionnaire (Hilbert et al., 2007, 2012). BDI = Beck Depression Inventory (Beck et al., 1996). STAI = State-Trait Anxiety Inventory (Spielberger et al., 1971; Laux et al., 1981). BIS15 = Barratt Impulsiveness Scale (Meule, Vögele, & Kübler, 2011). UPPS = Urgency, Premeditation, Perseverance, Sensation Seeking Impulsive Behavior Scale (Schmidt et al., 2008). BIS/BAS = Behavioral Inhibition and Behavioral Activation System Scales (Carver & White, 1994; Strobel et al., 2006). mYFAS2= modified Yale Food Addiction Scale 2.0 (Schulte & Gearhardt, 2017), FCQ-T = Food Craving Questionnaire Trait (Cepeda-Benito et al., 2000), TFEQ = Three-Factor Eating Questionnaire (Pudel & Westhöfer, 1989; Stunkard & Messick, 1985). DFSQ = Dietary Fat and Free Sugar Questionnaire (Francis & Stevenson, 2013; Fromm & Horstmann, 2019). NEOFFI = NEO personality inventory (Costa & McCrae, 2008; Körner et al., 2008).

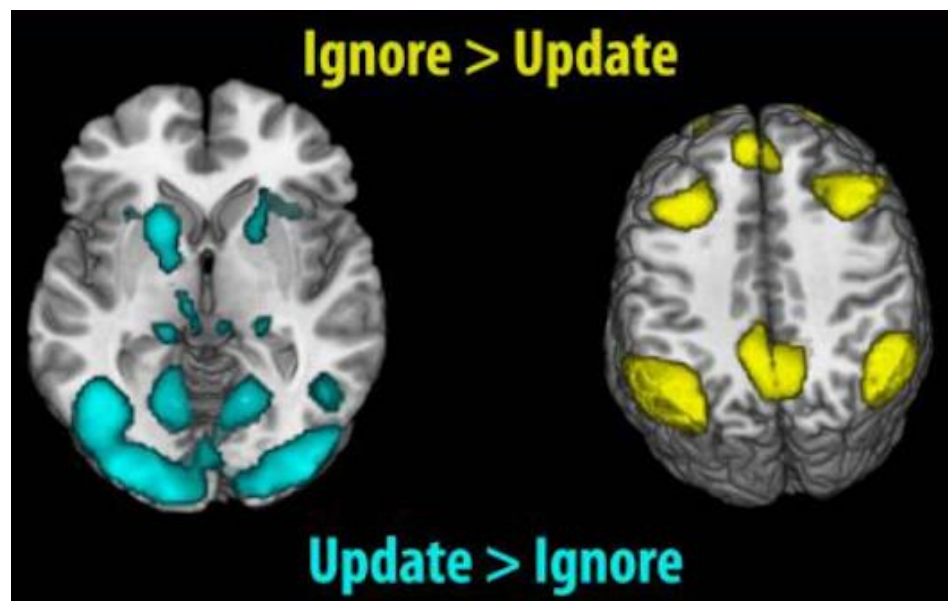


Figure S1. Activation-based t-maps used for our ROI analysis (see imaging data analysis). The Figure is from Fallon et al. (2017).

Table S2*Full output for the model including possible cofounds*

Predictors	accuracy				
	Odds Ratios	Std. Error	CI	z-value	p
Intercept	10.67	0.428	2.93 – 22.23	5.528	<0.001
Group	1.07	0.103	0.86 – 1.27	0.625	0.532
Interference	1.09	0.033	1.03 – 1.17	2.735	0.006
Delay	0.84	0.033	0.79 – 0.90	-5.217	<0.001
Digit span	1.05	0.066	0.92 – 1.19	0.704	0.481
Tiredness (z-scored)	0.74	0.099	0.61 – 0.90	-3.061	0.002
Concentration (z-scored)	1.32	0.096	1.12 – 1.63	2.920	0.003
Age (z-scored)	1.09	0.081	0.92 – 1.28	1.003	0.316
IQ (z-scored)	0.92	0.098	0.76 – 1.13	-0.881	0.378
BDI	0.99	0.019	0.96 – 1.03	-0.380	0.703
EDEQ total	0.88	0.195	0.61 – 1.32	-0.643	0.520
BIS motor	0.98	0.019	0.95 – 1.09	-0.888	0.374
FEV disinhibition	0.95	0.040	0.87 – 1.02	-1.351	0.177
FEV restraint	0.98	0.021	0.94 – 1.02	-0.900	0.368
FCQ guilt	0.98	0.050	0.89 – 1.08	-0.441	0.659
FCQ emotion	1.05	0.030	0.99 – 1.12	1.636	0.102
Group * Interference	1.03	0.033	0.96 – 1.10	0.841	0.400
Group * Delay	0.97	0.033	0.91 – 1.04	-0.854	0.393
Interference * Delay	1.01	0.033	0.94 – 1.07	0.166	0.868
Group * Interference * Delay	1.06	0.033	0.99 – 1.13	1.735	0.083
Observations	9970				
Marginal R2 / Conditional R2	0.073 / 0.175				

Behavioral data analysis with gene-equilibrium model

To follow our original analysis plan, we extended our main model (model 1) with the factor balance (unbalanced vs. balanced). The model hence was:

$$performance \sim group * interference * delay * balance + (1|subject)$$

Results show no significant interactions (all $p > 0.069$). The main factor of delay and interference remain significant ($ps < 0.004$).

Table S3

Full output for the model including balanced vs. unbalanced genotypes

Predictors	accuracy				
	Odds	Std. Error	CI	z-value	p
Intercept	9.04	0.096	7.48 – 10.93	22.699	<0.001
Group	1.10	0.096	0.91 – 1.32	0.943	0.346
Interference	1.10	0.032	1.03 – 1.17	2.859	0.004
Delay	0.83	0.032	0.78 – 0.88	-5.860	<0.001
Balance	1.16	0.096	0.96 – 1.40	1.543	0.123
Group * Interference	1.04	0.032	0.98 – 1.11	1.293	0.196
Group * Delay	0.98	0.032	0.92 – 1.04	-0.736	0.462
Interference * Delay	1.00	0.032	0.94 – 1.07	0.033	0.974
Group * Balance	1.13	0.096	0.93 – 1.36	1.253	0.210
Interference * Balance	1.02	0.032	0.96 – 1.09	0.709	0.479
Delay * Balance	1.04	0.032	0.98 – 1.11	1.188	0.235
Group * Interference * Delay	1.05	0.032	0.98 – 1.11	1.415	0.157
Group * Interference * Balance	1.04	0.032	0.98 – 1.11	1.192	0.233
Group * Delay * Balance	0.94	0.032	0.89 – 1.00	-1.821	0.069
Interference * Delay * Balance	0.97	0.032	0.91 – 1.03	-1.091	0.275
Group * Interference * Delay * Balance	0.95	0.032	0.89 – 1.01	-1.643	0.100
Observations	9970				
Marginal R2 / Conditional R2	0.027 / 0.180				

Imaging data analysis including control conditions

For the sake of transparency, we conducted the imaging analysis as described in our pre-registration. Results look pretty comparable to what we find in our analysis reported above. Update contrasted with its control condition ("control short) elicits activity in the left putamen, thalamus as well as middle frontal and parietal areas. There was no activity in the right putamen, however. Ignore vs. its temporal control (control long) elicited activity in the occipital lobe, insula, thalamus, inferior parietal, and frontal gyri, as well as in the cingulate and middle frontal gyrus. Contrasting these two contrasts, led to activation mainly in the occipital lobe and in small clusters in the superior and middle frontal gyrus. Similar to our main analysis, this analysis did not reveal any group differences. See Table S4. for all significant clusters and statistical values.

Table S4. Significant clusters for the contrasts condition of interest minus control

contrast	cluster extent	p (FWE-corr)	T	MNI coordinates		
				x	y	z
update > ctrl_short	502	0	9.54	-44	-46	44
	398	0	9.4	48	-40	48
	86	0	6.44	-46	4	48
	23	0	6.25	34	20	2
	10	0	5.95	-24	0	66
	27	0.001	5.65	-2	22	44
	5	0.003	5.4	28	2	62
	4	0.004	5.32	-32	20	2
	15	0.008	5.14	-16	-2	16
	3	0.023	4.86	-26	-60	46
	3	0.028	4.79	30	-56	42
	1	0.034	4.75	-20	2	58
	2	0.034	4.75	-24	0	54
	1	0.036	4.73	2	12	58
1	0.047	4.66	-16	-6	14	
ignore > ctrl_long	13055	0	22.08	12	-90	-2
	82	0	15.35	-20	-30	-2
	39	0	15.15	22	-28	-2
	3186	0	14.45	-2	12	50
	379	0	12.74	32	0	52
	164	0	11.01	34	20	2
	7	0	9.89	-10	-70	-14
	465	0	9.42	44	8	28
	571	0	9.23	-32	20	2
	2	0	8.53	34	42	24
	125	0	7.52	-46	34	18
	31	0	6.96	6	4	28
	40	0	6.7	44	40	14
	18	0	6.64	8	-28	-2
21	0	5.87	18	8	10	
1	0.011	5.05	16	-24	-6	
[ignore - ctrl_long] > [update - ctrl_short]	11262	0	19.17	-14	-84	-10
	39	0	14.48	22	-28	-2
	82	0	14.36	-20	-28	-2
	2490	0	8.57	-4	10	50
	6	0	8.51	-10	-70	-14
	203	0	7.22	32	0	52
	112	0	6.07	42	8	24
	37	0	6	54	0	38
	21	0.004	5.31	36	14	4
	1	0.004	5.27	16	-24	-6

Exploratory psychophysiological interaction (PPI) analysis

Because we speculated that the interaction between condition and beta in the putamen, might be due to top-down PFC interaction, we further decided to run an additional exploratory psychophysiological interaction (PPI) analysis. The aim of this analysis was to look at condition-specific interaction between putamen and PFC.

We employed a generalized PPI approach, as described in Kuhnke, Kiefer & Hartwigsen (2021). We defined the two putamen clusters identified in the above analysis as seed regions. In order to extract subject-specific activation time series of these two group-based seeds, we employed a dynamic approach where individual seed ROIs were defined as the 10% most active voxels for the conceptual contrast within the respective overall group seed mask. After that, individual subject data were modeled separately using the gPPI toolbox (version 13.1; <https://www.nitrc.org/projects/gppi>). This first-level GLM included: 1) “Psychological” regressors for each task event, that is, stick functions at event onsets convolved with the canonical hemodynamic response function; 2) A “physiological” regressor formed by the first eigenvariate of the respective seed ROI time series; and 3) PPI regressors for each task event created by multiplying the deconvolved BOLD signal of the seed ROI with the condition onsets and convolving with the canonical HRF (Gitelman et al. 2003; McLaren et al. 2012). Finally, we also included all six nuisance regressors i.e. the six head motion parameters. Contrast images were computed for each participant and submitted to t-tests at the group level. To test for functional coupling at the time of ignore vs. update, we compared the interaction of putamen and other areas at the time of ignore minus update. To investigate if any potential interactions would be behaviorally relevant, we also added condition-specific accuracy as a covariate of interest. We did not include the factor group, since our previous analyses point towards no group differences. All activation maps were thresholded at a cluster-wise $p < 0.05$ family-wise error (FWE) corrected for multiple comparisons.

Results showed that for the right as well as left putamen seed there were significant interactions with the thalamus, the (rest of the) putamen, the parietal lobe, as well as frontal areas. See Figure S2 for a visual overview and Table S5 for all cluster statistics. There was no difference among conditions for these interactions, however (i.e. there were no significant PPI clusters when looking at the contrast ignore minus update). Moreover, there was no significant interaction with behavior.

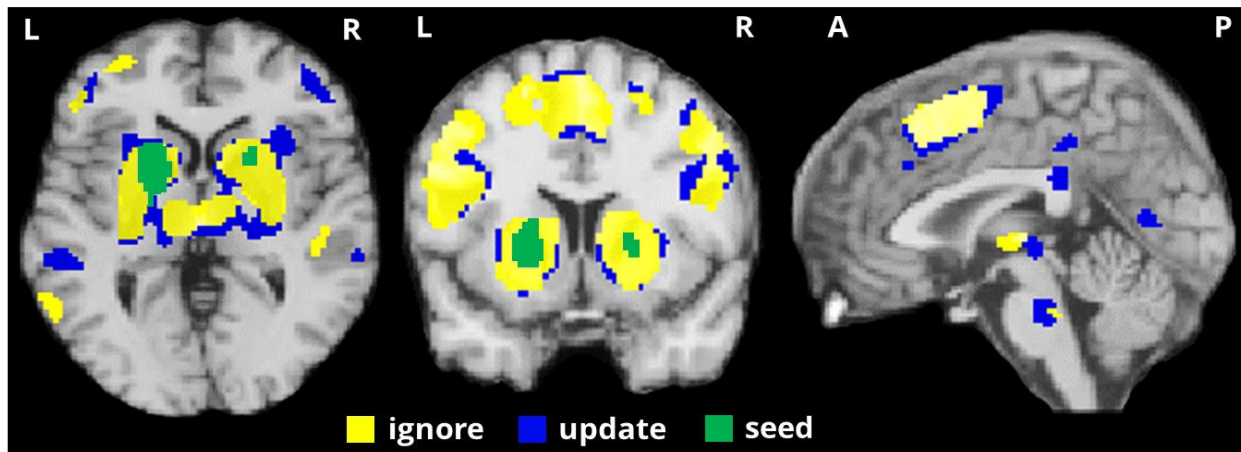


Figure S2. Significant clusters resulting from PPI analysis. Activation of (combined) left and right putamen seeds (green) interact with thalamus, parietal lobe, and frontal areas during ignore (yellow) and update (blue).

Table S4 Significant clusters for psychophysiological interaction with putamen seed

seed	condition	cluster extent	p (FWE-corr)	T	MNI coordinates		
					x	y	z
putamen right	ignore	5478	0	16.19	22	10	6
		223	0	7.02	-46	34	16
		233	0	6.43	32	-42	42
		310	0	6.37	-50	8	24
		92	0	6.07	48	28	-10
		472	0	6.02	-4	0	62
		104	0	5.85	-48	-6	46
		76	0	5.82	26	-8	50
		113	0	5.79	56	-10	-4
		74	0	5.6	-58	-38	8
		26	0.005	5.54	58	-18	30
		88	0	5.53	44	2	44
		134	0	5.46	40	28	16
		10	0.015	5.42	-4	-28	-26
		109	0	5.38	-46	-36	48
		12	0.013	5.35	-50	36	4
		9	0.016	5.31	30	36	-12
		1	0.039	5.3	-38	2	-40
		39	0.002	5.3	-62	-56	2
		13	0.012	5.29	-30	-46	50
		19	0.008	5.22	-20	-2	54
		31	0.004	5.18	-48	-18	-8
		2	0.033	5.15	-16	-58	-34
		12	0.013	5.13	-52	-48	40
		8	0.018	5.11	-4	30	50
		18	0.008	5.07	48	-28	0
	3	0.029	5.02	42	18	18	
	3	0.029	4.94	54	-22	40	
	3	0.029	4.93	-2	38	28	
	1	0.039	4.92	-18	12	60	
	update	1803	0	14.2	20	8	6
		3086	0	11.56	-18	10	4
		655	0	7.74	-46	-6	46
		3245	0	7.1	-6	4	60
		257	0	6.6	60	-26	-4
		744	0	6.5	-52	24	14
		459	0	6.04	-50	-48	44
		55	0.001	5.96	-6	-28	40
		197	0	5.81	-54	-42	12
		27	0.005	5.56	-10	-30	-34
		109	0	5.53	-50	-36	0
		19	0.007	5.53	48	-42	8
		22	0.006	5.49	-2	-24	-26
		19	0.007	5.4	42	52	4
		21	0.007	5.33	-40	-48	-18
		29	0.004	5.3	6	24	32
15		0.01	5.27	-2	42	26	
5		0.023	5.11	8	-14	42	
6		0.021	5.1	-2	-66	10	
9		0.016	5.08	-18	10	58	
4	0.026	5.07	48	-44	22		
11	0.013	5.06	48	34	16		
5	0.023	5.05	34	50	22		
8	0.017	5	48	38	-4		
1	0.038	4.95	6	-36	46		

Table S4 Significant clusters for psychophysiological interaction with putamen seed

seed	condition	cluster extent	p (FWE-corr)	T	MNI coordinates		
					x	y	z
putamen left	ignore	5238	0	12.34	-24	-4	6
		4897	0	8	-46	34	16
		1806	0	7.49	-46	-40	46
		1930	0	7.21	36	0	48
		1180	0	7.16	40	-44	50
		141	0	6.18	-60	-58	6
		67	0.001	5.83	-2	-32	-30
		27	0.006	5.4	-64	-40	-10
		35	0.004	5.33	56	-6	-12
		21	0.008	5.22	-38	-52	-12
		10	0.017	5.21	-44	-50	-22
		29	0.005	5.2	48	-28	2
		3	0.031	5.1	48	44	-6
		8	0.02	5.1	-8	-46	44
		8	0.02	5.1	8	-22	-28
		2	0.035	5.06	46	30	38
		6	0.023	5.01	14	-26	64
		2	0.035	4.93	-10	-30	60
		2	0.035	4.91	20	-24	-2
		2	0.035	4.9	-66	-34	0
		2	0.035	4.88	14	-64	54
		11731	0	13.13	-18	10	4
		5224	0	8.19	52	-26	46
		2177	0	7.19	-50	-30	44
	276	0	6.29	-6	-30	-30	
	26	0.006	5.99	-16	-62	-32	
	81	0.001	5.87	-48	-44	-18	
	40	0.003	5.79	-34	34	44	
	207	0	5.79	-56	-34	0	
	292	0	5.75	-10	-76	10	
	200	0	5.71	-58	-48	18	
	29	0.005	5.56	30	-58	-8	
	12	0.015	5.49	66	-38	-8	
	152	0	5.48	54	-30	-2	
	12	0.015	5.46	-28	-8	-32	
	35	0.004	5.31	-46	-78	12	
	21	0.008	5.29	48	-74	14	
	8	0.02	5.29	38	-32	-22	
	25	0.007	5.21	-22	20	46	
	31	0.005	5.19	58	-44	26	
	12	0.015	5.17	-28	-60	-12	
	3	0.031	5.13	26	-20	-26	
	19	0.009	5.09	14	-66	20	
	4	0.028	5.09	48	-18	-8	
	9	0.018	5.06	-8	-48	46	
	6	0.023	5.06	-12	-32	68	
	7	0.021	5.05	62	-10	-14	
	7	0.021	5.03	8	-52	54	
1	0.04	5.02	-30	4	-36		
2	0.035	4.99	-40	0	-38		
4	0.028	4.97	32	10	-36		
1	0.04	4.9	46	-40	8		
1	0.04	4.87	-28	0	-36		