

Supplementary Online Content

Supplementary Methods

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Supplementary Methods

Description of Monetary and Food Incentive Delay Task (MID/ FID task)

There were four blocks of reward tasks, consisting of 55 trials each. The block sequence was either SMSM (S=Snacks, M=Money), or MSMS, and was counterbalanced over the participants. The degree of potential rewards varied on three levels as indicated via graphical cues (Figure 1). In both tasks, each trial started with the presentation of a symbol (750 ms) indicating the amount of money/ number of snack-points (SP) they could win with a correct response (i.e., 1 EUR, 20 cents, 0 EUR, or 10 SP, 2 SP, 0SP, respectively). After an anticipation period (3.000 ms) participants had to correctly react to one of two symbols (triangle inclined to the right or to the left) with a left or right button press corresponding to the direction of the triangle (index or middle finger of dominant hand) within a fixed interval of 1.000 ms. This leads to a low task-difficulty with a very high success rate, independently of the reaction speed of the participant. In order to guarantee a steady rate of reward vs. non-reward throughout all participants, we used a probabilistic reward pattern, i.e. reward was not paid out in 30 predefined trials (out of the 80 reward trials). Immediately after target presentation, feedback appeared (1.500 ms), notifying participants about the amount of money/ snack points they had won and about their cumulative total. In order to increase statistical efficiency, trials were separated by jittered intertrial intervals (ITIs) ranging from 1 to 8 s, with a mean of 3.5 s. An incorrect button press resulted in zero pay-out, a penalty of -1 EUR/ -10 SP was applied if participants failed to react. In the MID task, participants were able to win a maximum of 30 EUR. In the FID task, the maximum amount to be won was 300 SP, with any snack of the basket being 50 SP worth. Before entering the scanner, participants performed a practice version of the task lasting three minutes for each

condition for which they received neither payment nor snacks (Figure 1). Additionally, participants performed a response inhibition task; the results of this task are reported elsewhere. During scanning, participants viewed visual stimuli on a projection screen via a mirror fixed to the head coil.

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Table S1. Significant Clusters of Group Activation in Reward Processing during the Food Incentive Delay Task using Whole-Brain Analysis

Area	Anticipation of 10 vs. 0 Snack Points ^a					Receipt of 10 vs. 0 Snack Points ^b				
	MNI Coordinates ^c				No. of voxels	MNI Coordinates ^c				No. of voxels
	t	x	y	z		t	x	y	z	
Healthy Controls (n=55)										
Right occipital medial cortex	5.24	33	-70	18	1174					
Left occipital cortex	4.75	-24	-64	30	481					
Left anterior insula	4.24	-30	17	-10	173					
Right inferior parietal lobule						7.02	30	-67	46	339
Left inferior parietal lobule						5.47	-27	-61	42	256
Right lateral orbitofrontal cortex						5.18	39	38	-10	193
Right inferior prefrontal cortex						4.74	51	32	30	192

Left inferior prefrontal cortex	4.4	-45	8	30	259
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Patients (n=56)

Right occipital cortex	6.57	27	-88	-2	319
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Left occipital cortex	4.84	-15	-94	2	122
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Left thalamus	4.3	-3	-22	2	120
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Left inferior occipital cortex	10.8	-39	-67	-10	1285
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Right inferior parietal lobule	8.37	33	-58	38	194
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Left medial orbitofrontal cortex	7.7	-6	29	-10	105
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Left inferior prefrontal cortex	7.59	-42	5	30	151
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Anterior cingulate cortex	7.57	0	-1	30	34
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Right inferior prefrontal cortex	7.54	39	32	18	54
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Left anterior insula	7.47	-33	11	-10	24
Right anterior insula	7.44	33	14	-10	72
Right frontal inferior operculum	7.35	45	14	30	41
Medial cingulate cortex	6.94	0	-34	34	39
Left anterior cingulate cortex	6.86	-3	38	26	83
Left medial prefrontal cortex	6.74	-6	59	10	18

^athresholded at $p < 0.001$ uncorrected for the control and patient group.

^bthresholded at $p < 0.001$ FWE corrected for the patient group and at $p < 0.001$ uncorrected for the control group.

^cMNI=Montreal Neurological Institute.

Table S2. Significant Clusters of Group Activation in Reward Processing during the Food Incentive Delay Task using a Region of Interest Analysis^a

Area	Anticipation of 10 vs. 0 Snack Points ^b					Receipt of 10 vs. 0 Snack Points ^c				
	MNI Coordinates ^d				No. of voxels	MNI Coordinates ^d				No. of voxels
	t	x	y	z		t	x	y	z	
Healthy Controls (n=55)										
Right nucleus caudatus	4.03	15	8	18	26					
Left nucleus caudatus	3.96	-15	23	2	29					
Right lateral orbitofrontal cortex						5.18	39	38	-10	102
Left lateral orbitofrontal cortex						4.31	-45	47	-2	78
Patients (n=56)										
Medial orbitofrontal cortex						7.7	-6	29	-10	219
Right lateral orbitofrontal cortex						7.37	30	35	-14	134

Left lateral orbitofrontal cortex

6.59 -39 41 -14 90

^aRegions of interest: bilateral striatum during the expectation of a reward, medial and lateral orbitofrontal cortex during the receipt of a reward.

^bthresholded at $p < 0.001$ uncorrected for the control and patient group.

^cthresholded at $p < 0.001$ FWE corrected for the patient group and at $p < .001$ uncorrected for the control group.

^dMNI=Montreal Neurological Institute.

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Table S3. Significant Clusters of Group Activation in Reward Processing during the Monetary Incentive Delay Task using Whole-Brain Analysis

Area	Anticipation of 1 vs. 0 Euro ^a					Receipt of 10 vs. 0 Euro ^b				
	MNI Coordinates ^c				No. of voxels	MNI Coordinates ^c				No. of voxels
	t	x	y	z		t	x	y	z	
Healthy Controls (n=55)										
Right occipital medial cortex	5.67	33	-73	10	321					
Left occipital medial cortex	5.12	-30	-82	18	278					
Thalamus	4.64	0	-34	-2	184					
Right dorsolateral prefrontal cortex						8.83	45	38	18	710
Left frontal inferior operculum						8.04	-42	5	26	220
Right angular gyrus						7.82	33	-61	42	385
Left angular gyrus						7.62	-30	-61	42	262

Right anterior cingulate cortex	6.86	9	35	14	375
Right medial cingulate cortex	6.58	3	-40	34	62
Left insula	5.74	-30	11	-14	20
Right nucleus caudatus	5.73	12	11	6	19
Left nucleus caudatus	5.49	-12	8	6	16

Patients (n=56)

Left thalamus	6.2	-6	-22	2	605
Left occipital medial cortex	5.12	-33	-79	26	259
Right occipital inferior cortex	4.91	30	-88	-6	601
Left insula	4.78	-30	23	-2	103
Right angular gyrus	8.4	36	-67	46	424

Left angular gyrus	7.41	-30	-64	42	234
Right temporal medial cortex	7.72	57	-49	-6	200
Right occipital inferior cortex	6.13	27	-94	-2	15
Left occipital inferior cortex	7.64	-45	-64	-14	282
Right frontal inferior operculum	7.3	48	14	30	372
Left frontal inferior operculum	6.25	-48	8	34	171
Right medial cingulate cortex	6.25	3	-1	26	25
Right hippocampus	5.75	21	-34	-2	24
Anterior cingulate cortex	5.43	0	38	-2	70
Medial cingulate cortex	5.27	0	-31	38	12
Parahippocampal gyrus	5.19	-6	-31	6	10

^athresholded at $p < 0.001$ uncorrected for the control and patient group.

^bthresholded at $p < 0.001$ FWE corrected for the control and patient group.

^cMNI=Montreal Neurological Institute.

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Table S4. Significant Clusters of Group Activation in Reward Processing during the Monetary Incentive Delay Task using a Region of interest Analysis^a

Area	Anticipation of 1 vs. 0 Euro ^b					Receipt of 1 vs. 0 Euro ^c				
	MNI Coordinates ^d				No. of voxels	MNI Coordinates ^a				No. of voxels
	t	x	y	z		t	x	y	z	
Healthy Controls (n=55)										
Medial orbitofrontal cortex						6.57	6	35	-2	108
Right lateral medial orbitofrontal cortex						6.53	24	47	-14	116
Patients (n=56)										
Medial orbitofrontal cortex						5.43	0	38	-2	31
Right lateral orbitofrontal cortex						6.02	42	53	-2	28

^aRegions of interest: bilateral striatum during the expectation of a reward, medial and lateral orbitofrontal cortex during the receipt of a reward.

^bthresholded at $p < 0.001$ uncorrected for the control and patient group.

^cthresholded at $p < 0.001$ FWE corrected for the control and patient group

^dMNI=Montreal Neurological Institute.

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Table S5. Significant Clusters of Group Differences in Reward Processing during the Food Incentive Delay

Task using Whole-Brain Analyses

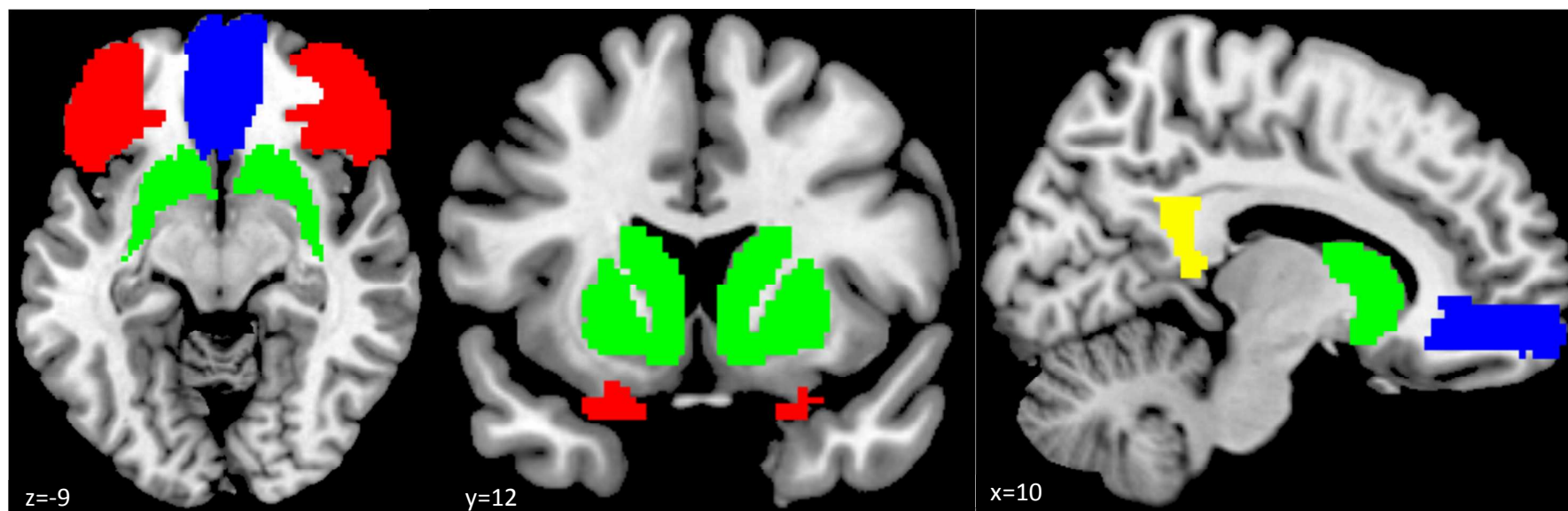
Contrast and Area	Anticipation of 10 vs. 0 Snack Points					Receipt of 10 vs. 0 Snack Points				
	t	MNI Coordinates ^a			No. of voxels	t	MNI Coordinates ^a			No. of voxels
		x	y	z			x	y	z	
Healthy Controls > Patients										
Right posterior cingulate cortex	4.72	9	-40	14	102					
Patients > Healthy Controls										
Left posterior cingulate cortex						4.85	-6	-55	6	413
Left anterior medial prefrontal cortex						4.29	-3	59	10	69
Left supramarginal/ angular gyrus						4.05	-48	-52	30	61

^a MNI=Montreal Neurological Institute.

Table S6. Overall performance during the FID and MID tasks.

	BTE patients (N=55)				Healthy controls (N=56)				P reaction time	P errors
	Mean reaction time (ms)	SD reaction time (ms)	Mean errors	SD errors	Mean reaction time (ms)	SD reaction time (ms)	Mean errors	SD errors		
10 Snack points	477	82	.87	1.62	481	84	.67	1.2	.773	.457
0 Snack points	485	83	.54	.91	483	73	.82	1.17	.895	.159
EUR 1	476	88	.61	1.04	475	87	.63	1.13	.966	.887
EUR 0	484	83	.45	.89	480	69	.6	1.05	.791	.407

Figure S1: Masks used in Region of Interest Analysis and Extraction of Percent Signal Change



Bilateral striatum mask depicted in green (consisting of the bilateral caudatus and bilateral putamen taken from the AAL atlas), medial orbitofrontal cortex mask depicted in blue (consisting of portions of the frontal medial OFC and anterior cingulate cortex taken from the AAL atlas. To ensure specificity, portions of the mOFC ROI which were located dorsal from the MNI $z = 0$ line were subtracted), lateral orbitofrontal cortex mask depicted in red (consisting of the bilateral orbital part of the inferior frontal gyrus and the orbital part of the middle frontal gyrus taken from the AAL atlas) and posterior cingulate cortex depicted in yellow (taken from the AAL atlas). The posterior cingulate cortex was only used for the extraction of percent signal change.