

Supplementary Material

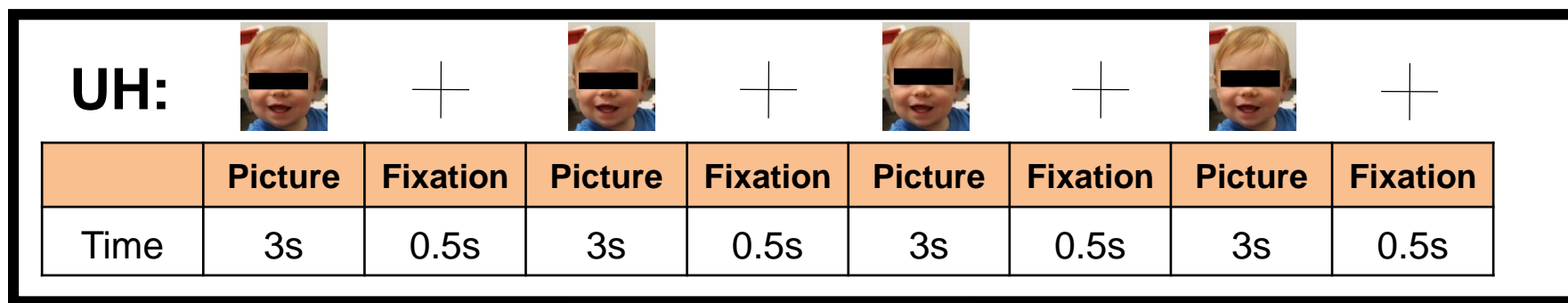
Preparation of OT, AVP and placebo

Intranasal OT: 3.6 ml of 40 IU/ml OT (Syntocinon-Spray, Novartis) was added to 2.4 ml OT placebo to make 6.0 ml of 24 IU/ml OT. 6 ml was transferred to a plastic bottle with a nasal applicator.

Intranasal OT placebo: The OT placebo consisted of the Syntocinon vehicle only. Each 5 ml of OT placebo consists of: chlorobutanol hemihydrate 12.5 mg, methyl-4-hydroxy-benzoate 2.0 mg, propyl-4-hydroxybenzoate 1.0 mg, 85% ethanol 125 μ l, sodium acetate 14.0 mg, purified water 4.8455 g. 6 ml were transferred to a plastic bottle with nasal applicator.

Intranasal AVP: six ml of 20 unit/ml AVP (American Reagent Laboratories, Shirley, NY, USA; JHP Pharmaceuticals, Rochester, MI, USA) were transferred to a plastic bottle with nasal applicator.

Intranasal AVP placebo: The AVP placebo consisted of the vasopressin vehicle only, and was prepared by adding 125 mg of 0.5% chlorobutanol to 50 ml saline, followed by acetic acid until the pH fell within the range of 2.5-4.5 as measured with a pH meter. The solution was then sterilized using a 0.22 μ filter. 6 ml were transferred to a plastic bottle with nasal applicator.



One block = 14s



UH	AH	UH	AH	OH	OH
AS	US	AS	US	OS	OS
UN	AN	UN	AN	ON	ON
AN	UN	AN	UN	ON	ON
US	AS	US	AS	OS	OS
AH	UH	AH	UH	OH	OH
Fixation	Fixation	Fixation	Fixation	Fixation	Fixation

Fig. S1. Schematic of child task. AH, unknown adult's happy face; AN, unknown adult's neutral face; AS, unknown adult's sad face; OH, own infant's happy face; ON, own infant's neutral face; OS, own infant's sad face; UH, unknown infant's happy face; UN, unknown infant's neutral face; US, unknown infant's sad face.

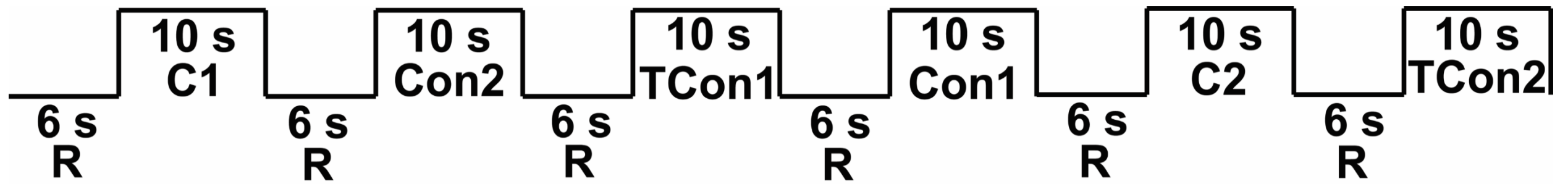
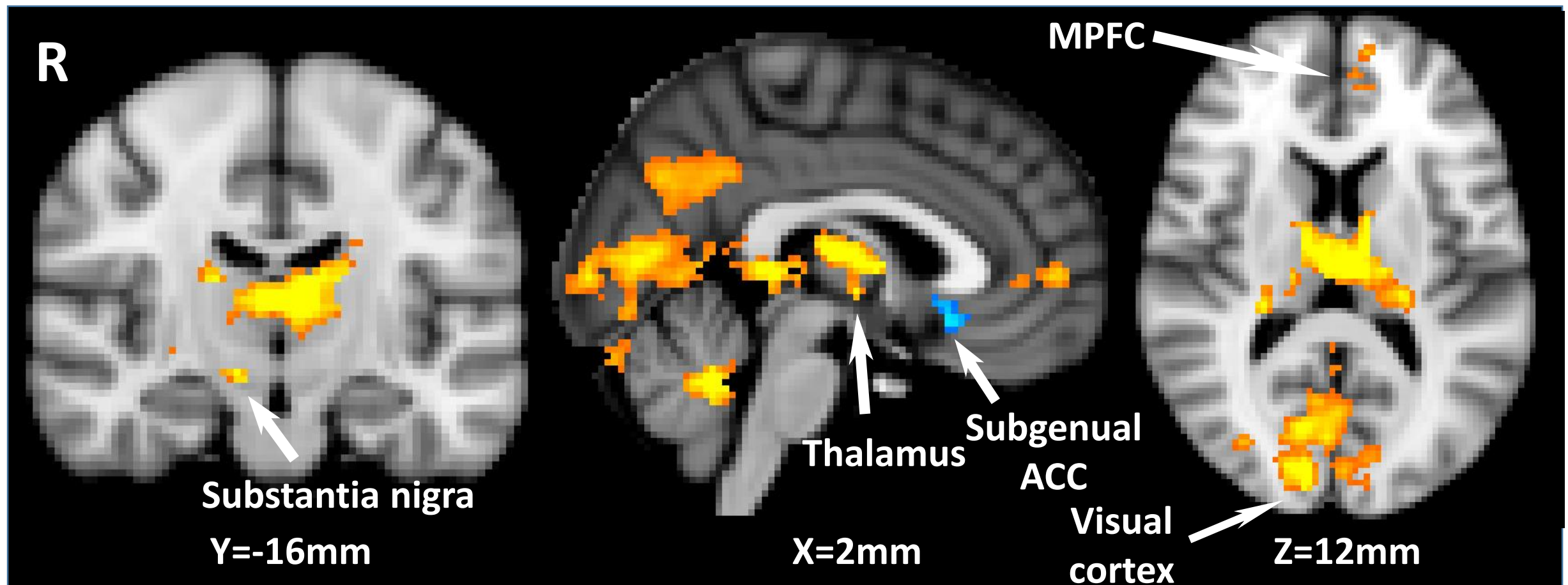


Fig. S2 Schematic of block design structure. C, cry; Con, control; TCon, tone control; R, rest.

A)



B)

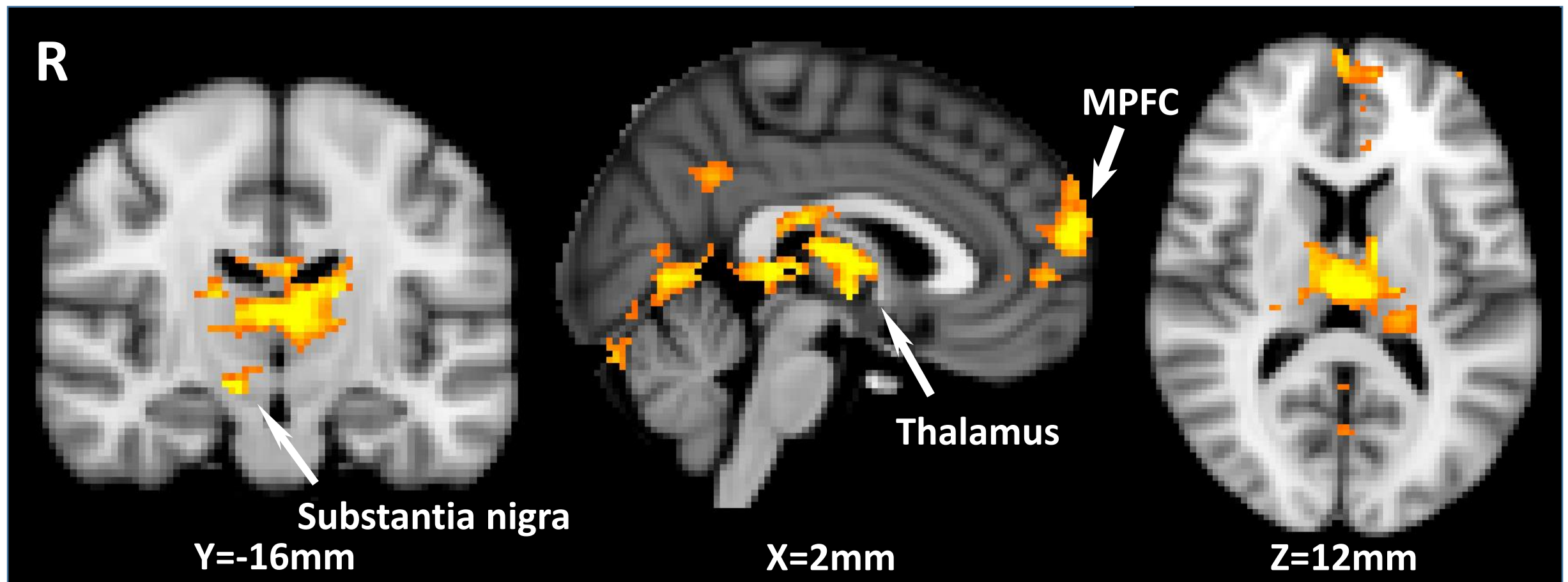


Fig. S3 Main effect of viewing child picture stimuli for the placebo treatment. Brain regions activated for a) the contrast between viewing pictures of own children and viewing pictures of sex and ethnicity-matched adults, and b) the contrast between viewing pictures of own children and viewing pictures of unknown children.

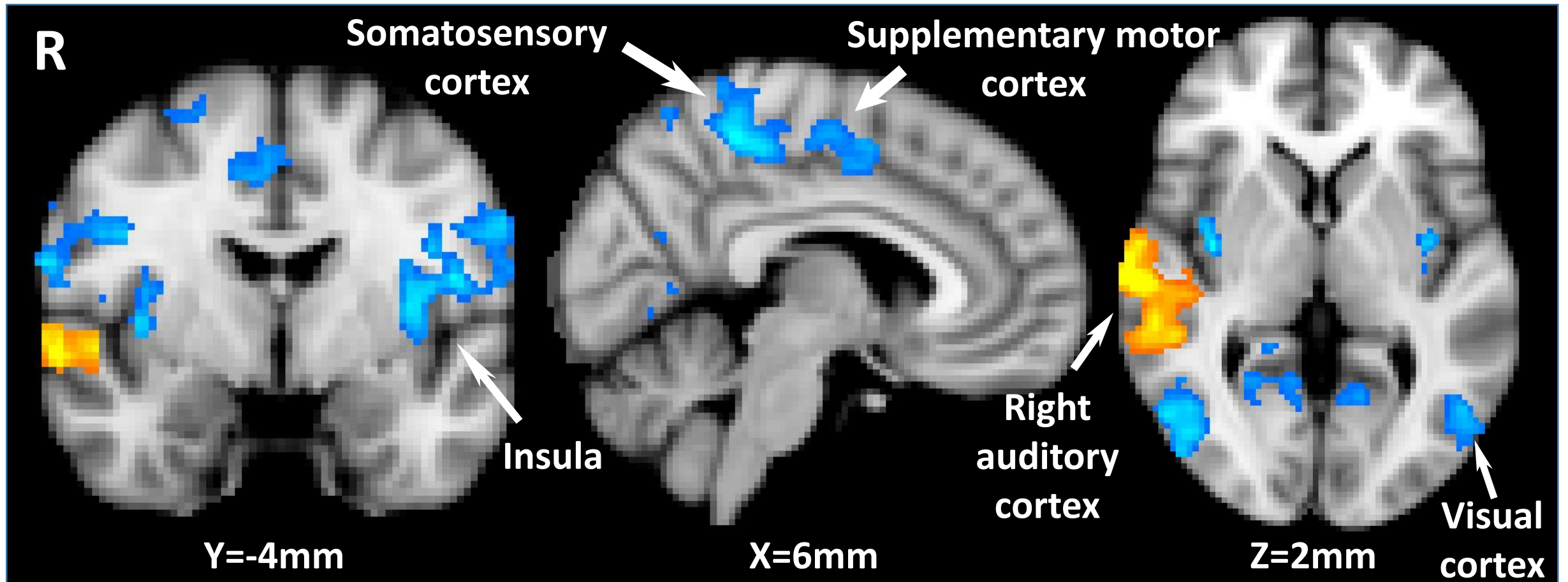


Fig. S4 Main effect of listening to infant cry stimuli in placebo group. Brain regions activated (yellow) or deactivated (blue) for the contrast between listening to infant cries and listening to the auditory tone control.

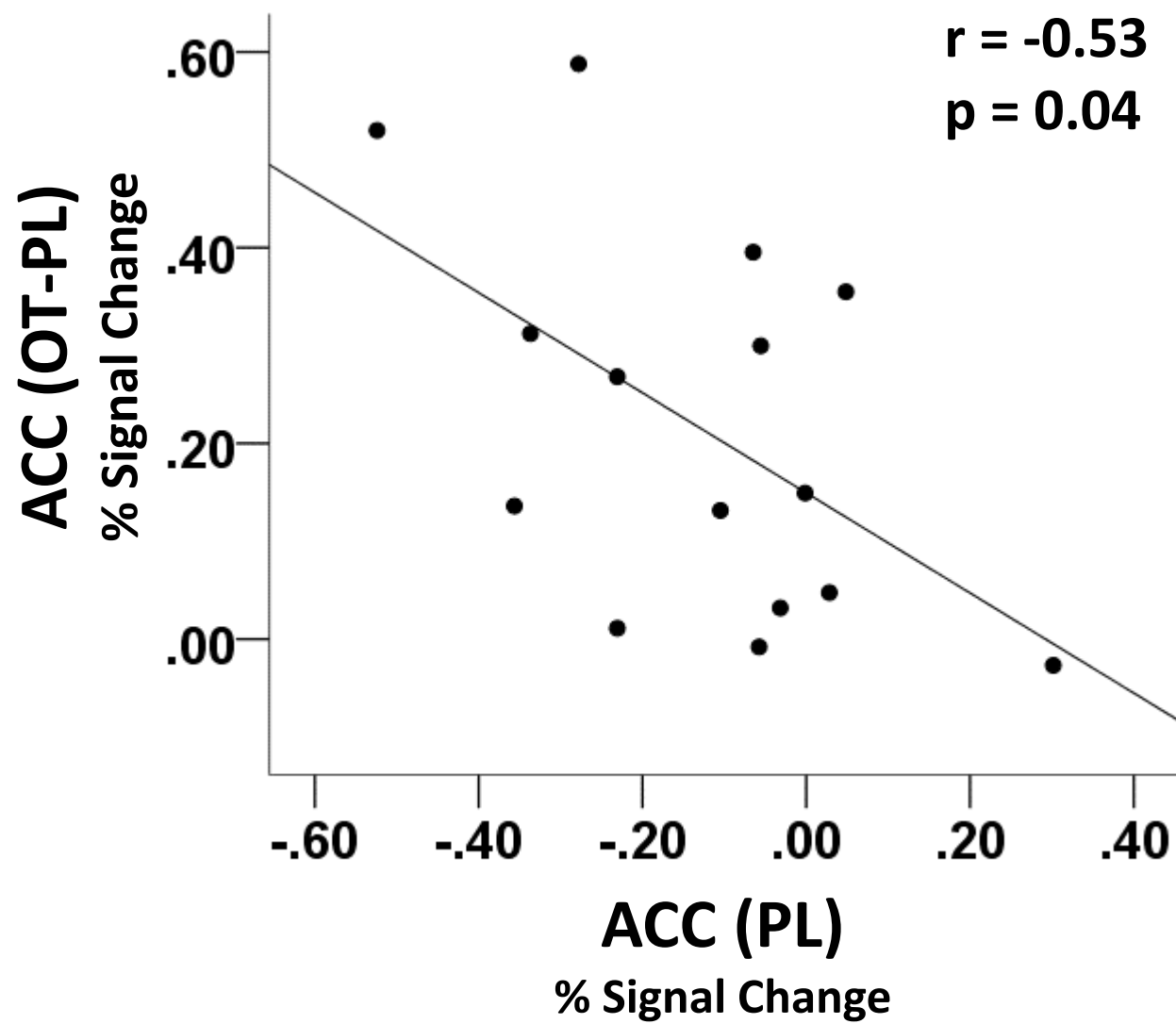
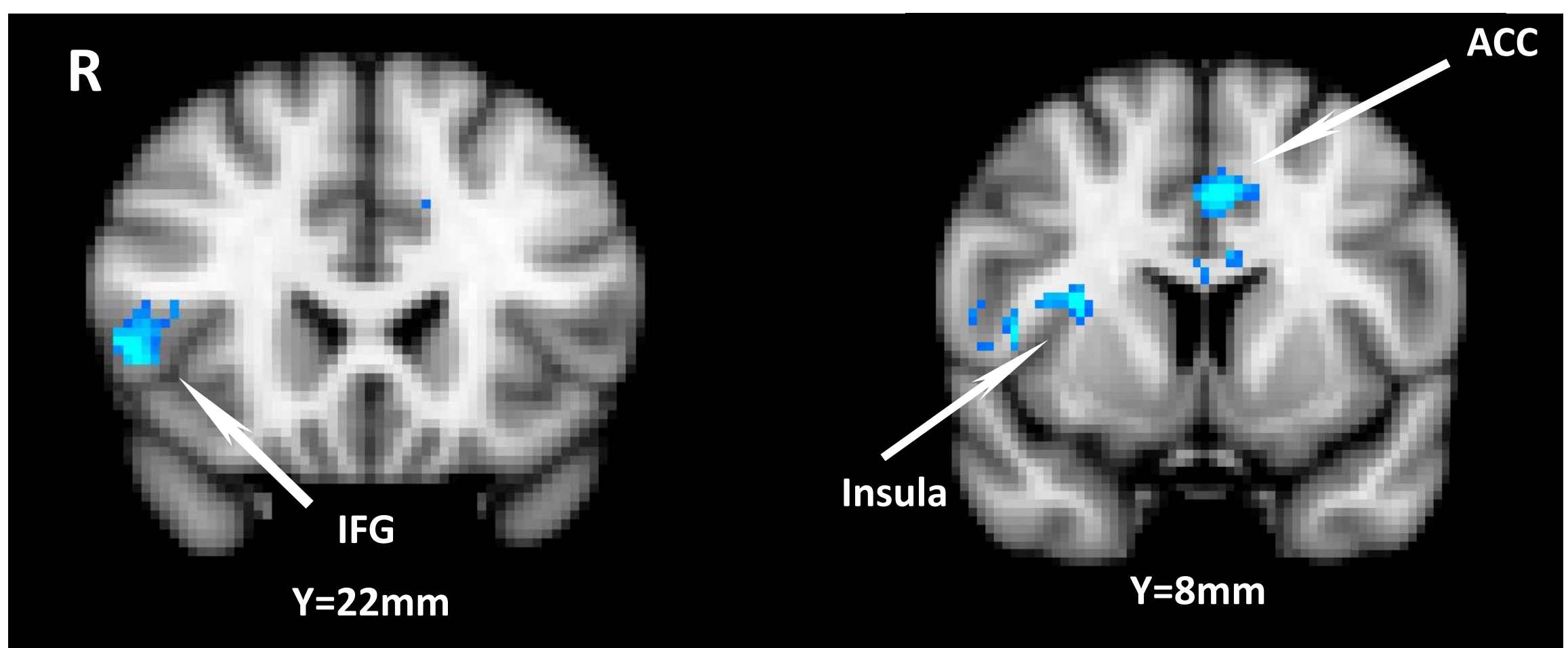


Fig. S5 OT effects as a function of baseline brain activation. Plot of ACC activation in the placebo group vs. OT-induced changes in ACC activation.

A)



B)

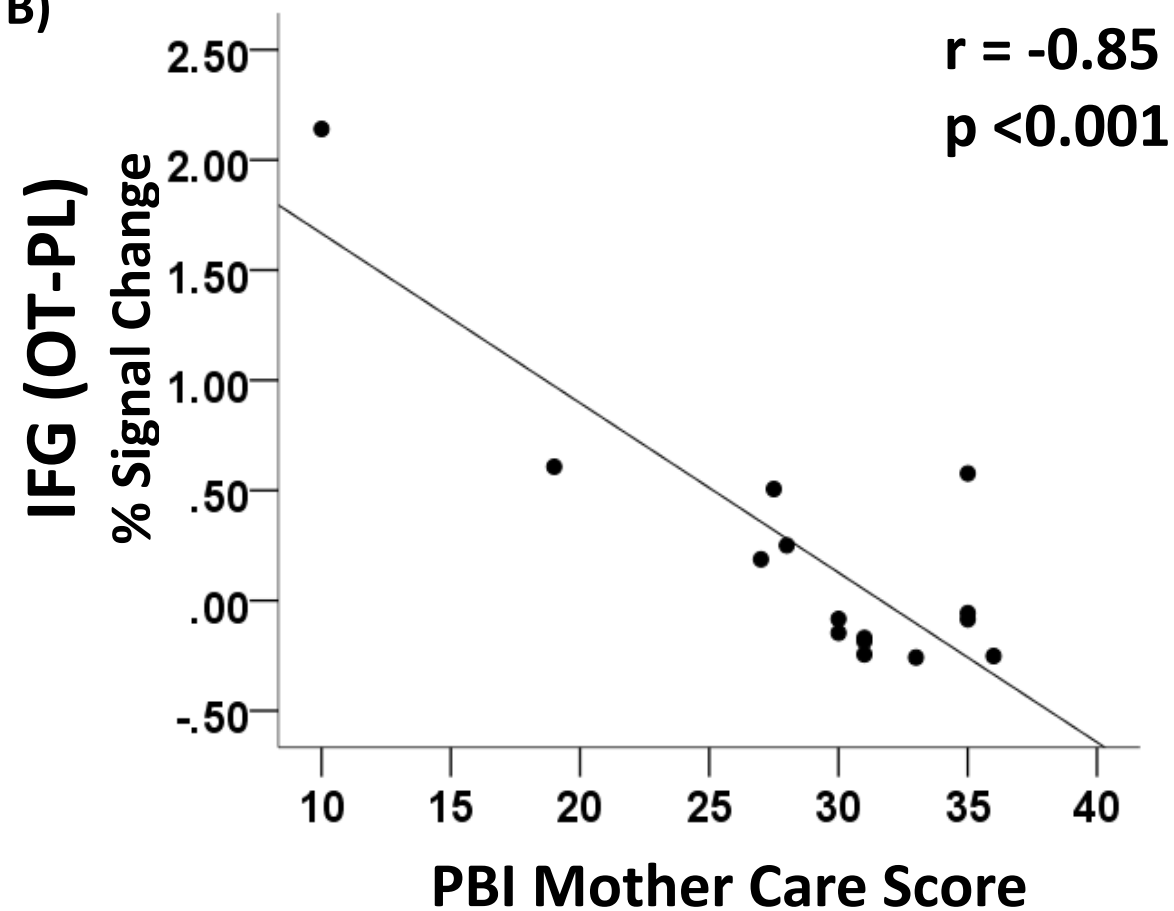


Fig. S6 a) Negative correlations between maternal care on the parental bonding instrument (PBI) and OT-induced increases in activation to own child picture stimuli compared to adult pictures. b) Plot of percent signal change in inferior frontal gyrus (IFG) vs. maternal care measured by PBI. (The upper left data point is not considered an outlier by our criteria ($3 \times \text{IQR}$), however it has considerable leverage in the regression. Nevertheless, the correlation remains significant after removing that point ($r = -0.548$, $p = 0.042$).)

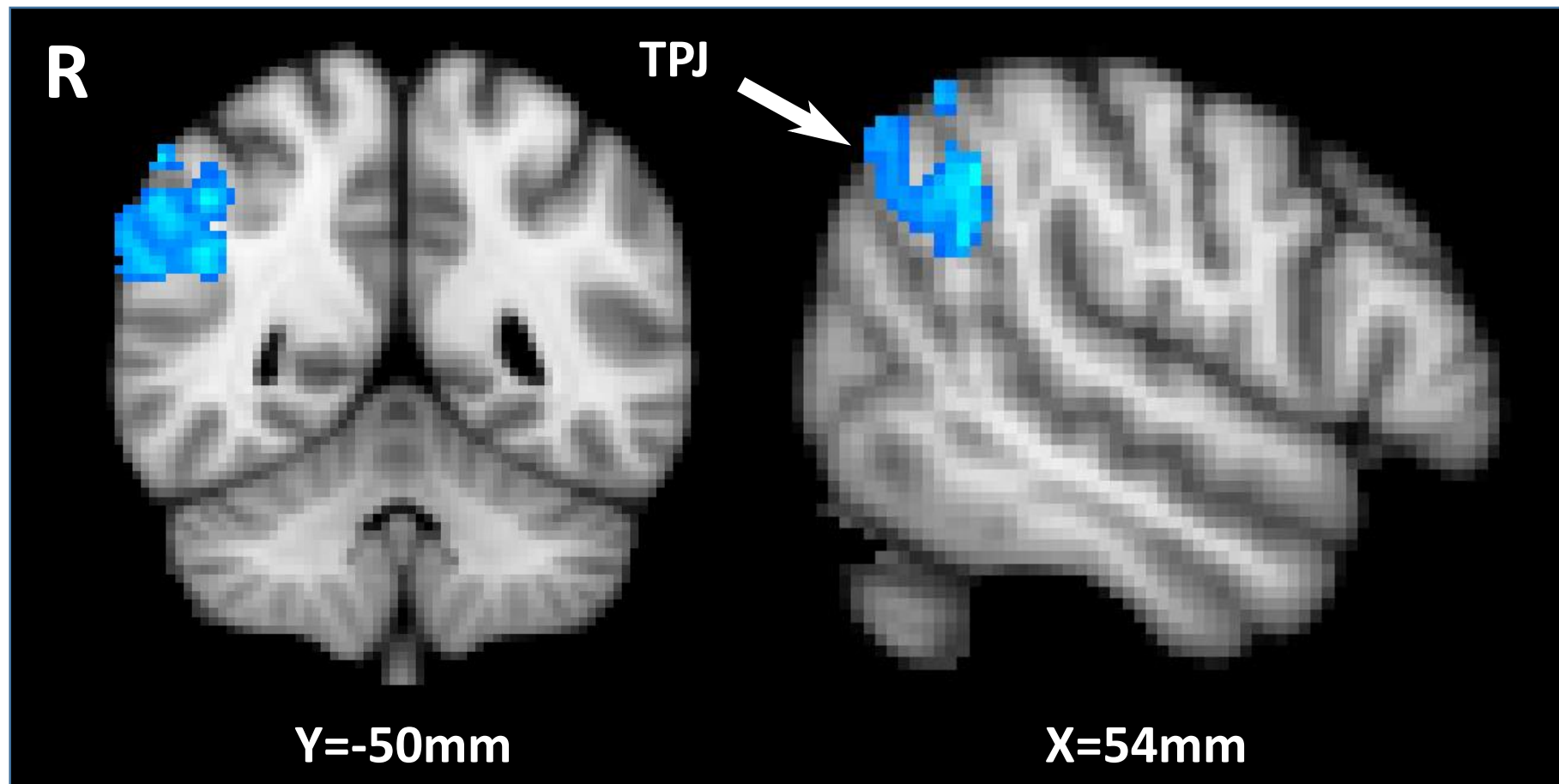


Fig. S7 Negative correlation between maternal care on the parental bonding instrument (PBI) and OT modulation of activation to infant cry stimuli compared to the tone control. TPJ = temporo-parietal junction

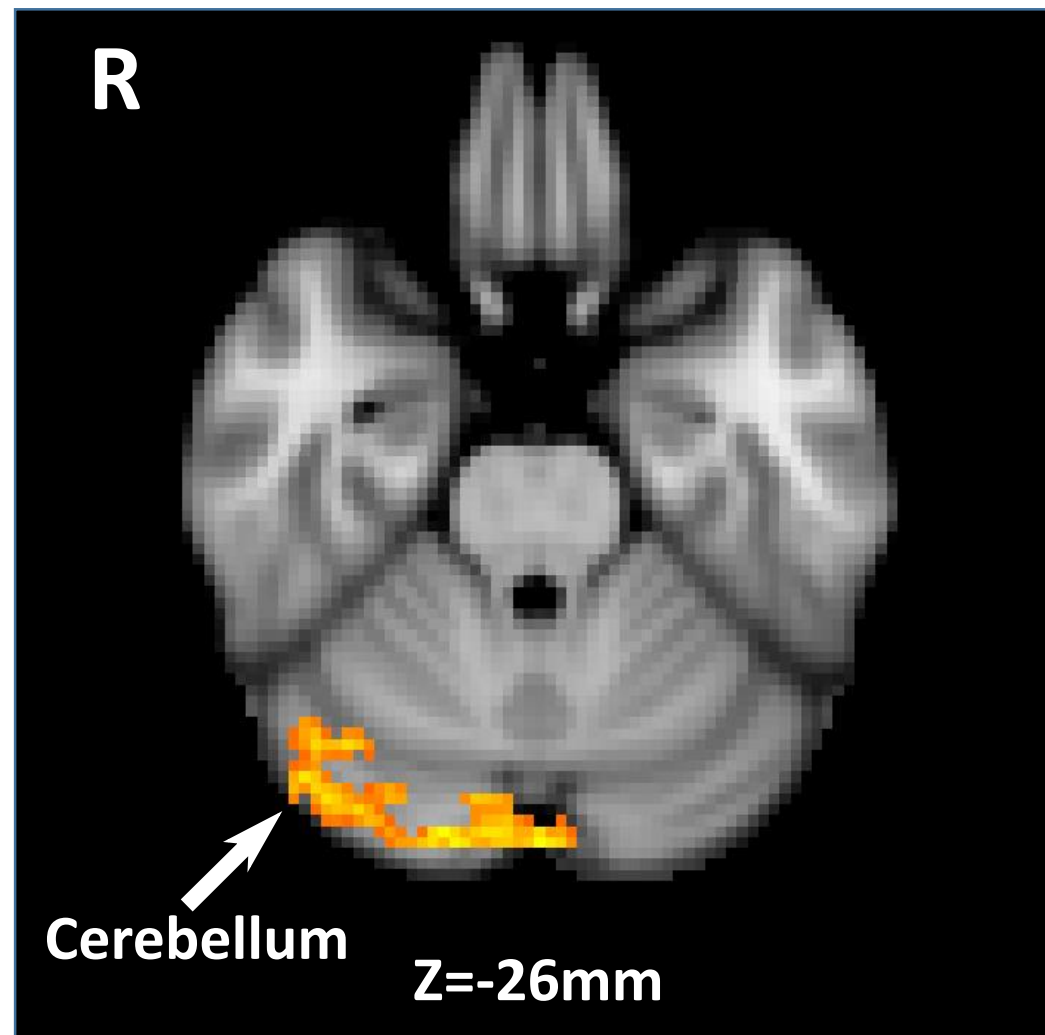


Fig. S8 Positive correlation between maternal love withdrawal and OT modulation of activation to cry stimuli compared to the tone control.

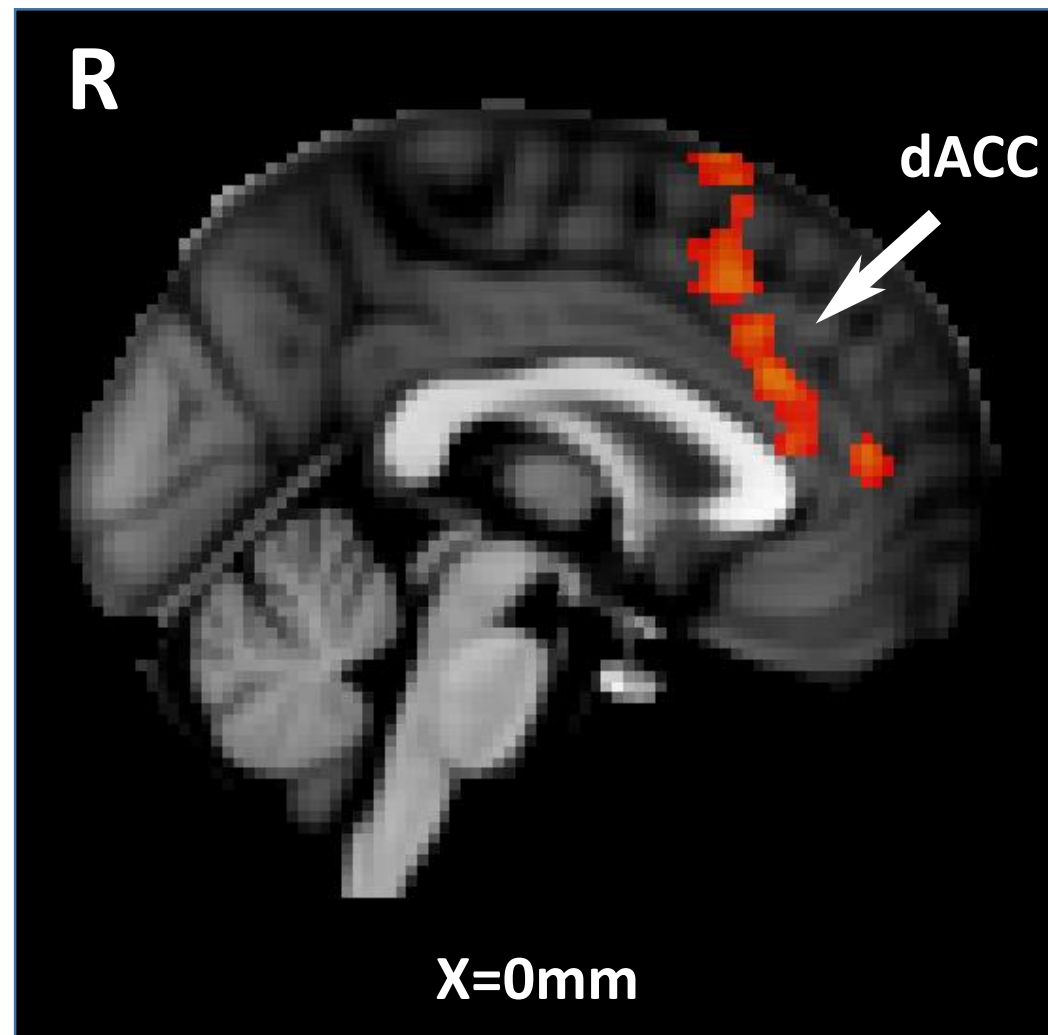


Fig. S9 OT increases the dACC response to same-sex positive social interactions among men, thresholded at $p < 0.05$ corrected.

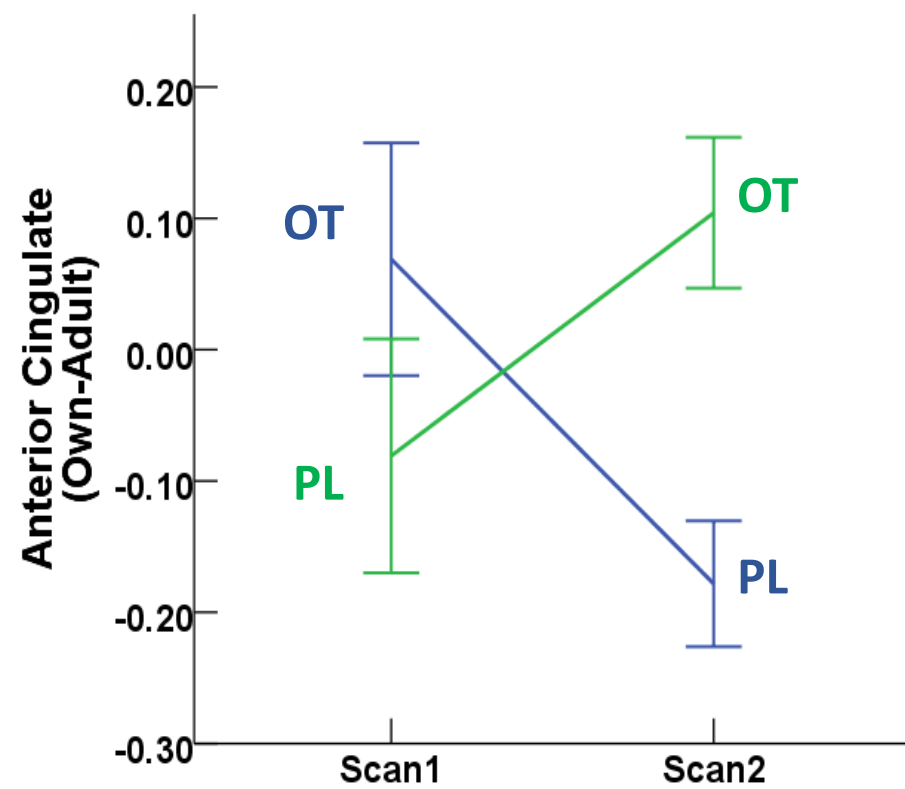
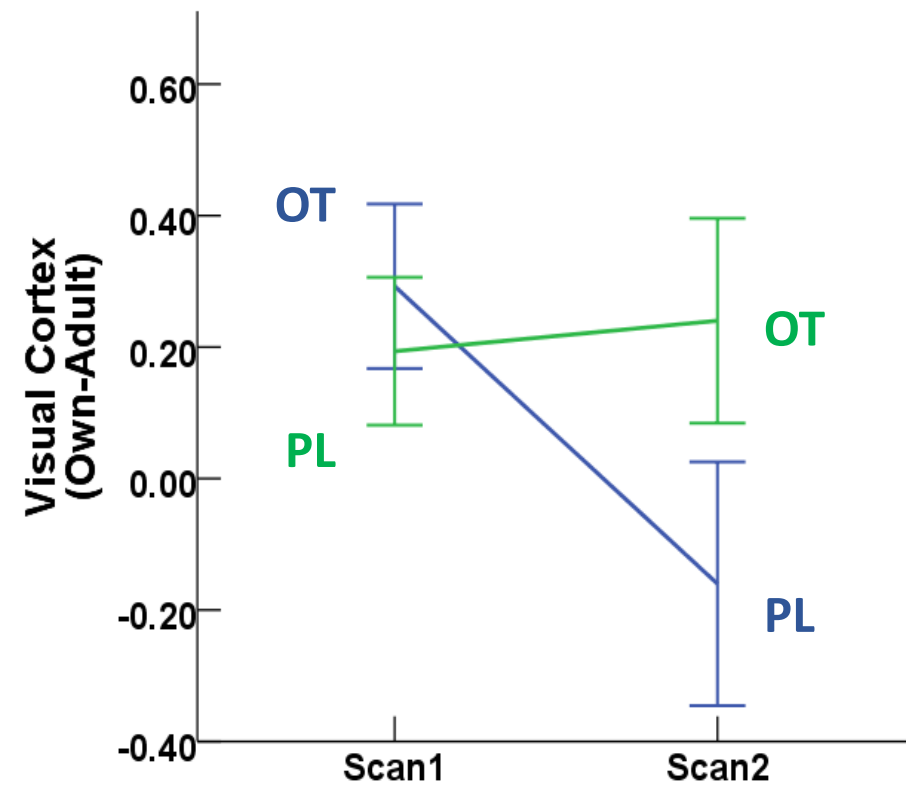
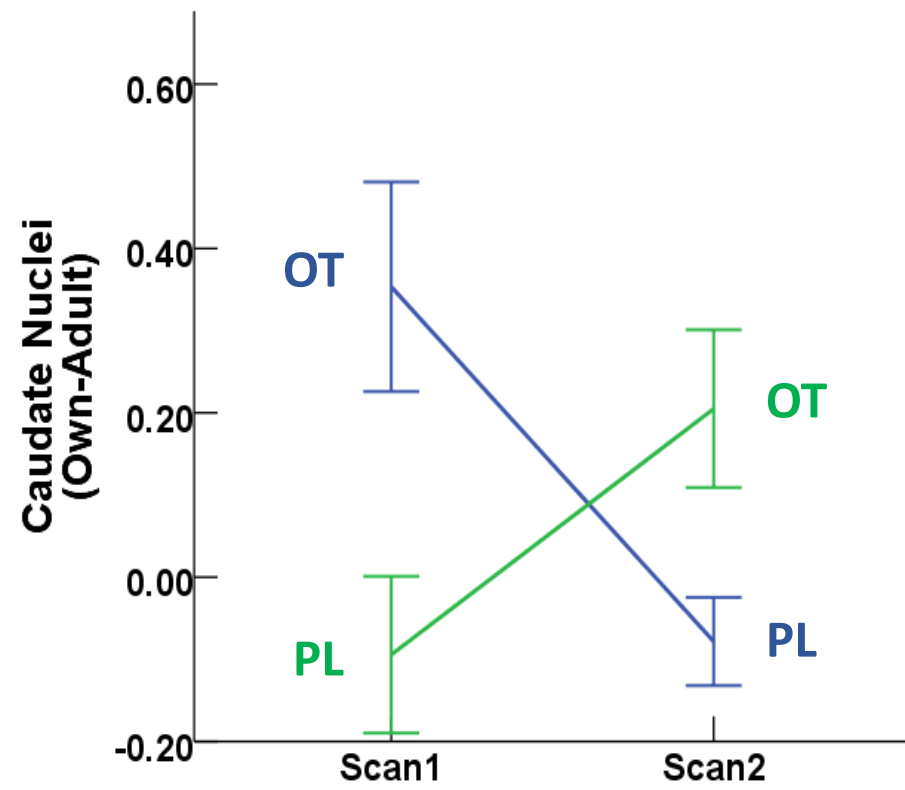


Fig. S10 Mean values of % signal change in brain activations within the three ROIs from Fig. 1 with ± 1 SE error bars.

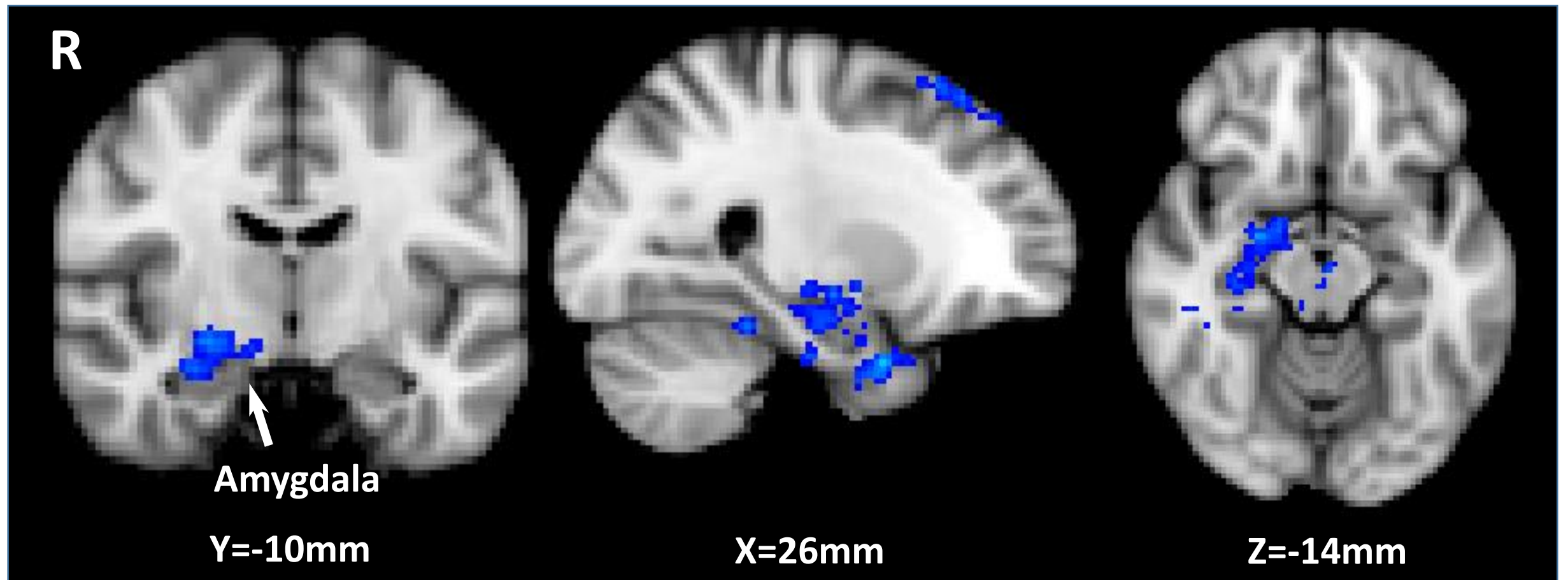


Fig. S11 OT effect on neural response to infant cry stimuli. Brain regions in which OT decreases activation at scan 1 for the contrast cry – tone control, thresholded at $p < 0.05$ corrected.

Supplementary Table 1 Activated brain regions for placebo treatment

Brain Regions	MNI Coordination of Local Maxima (mm)			Local Maxima Z	Cluster Size (voxel)
	x	y	z		
PICTURE STIMULI OWN-ADULT					
Positive Direction					
Thalamus extending into midbrain, visual cortex and cerebellum	4	-14	10	5.27	8120
L MPFC	2	62	16	4.53	936
Negative Direction					
R subgenual ACC	4	20	-10	3.73	169
PICTURE STIMULI OWN-UNKNOWN					
Positive Direction					
Thalamus extending to globus pallidus, midbrain, visual cortex and cerebellum	4	-32	6	5.4	4982
MPFC	2	62	16	5.09	1169
CRY STIMULI CRY-TCON					
Positive Direction					
R Auditory cortex	72	-20	0	5.27	1912
L Cerebellum	-20	-72	-32	4.09	335
Negative Direction					
Pre and post central gyri, lateral-parietal cortex (supramarginal gyrus and superior parietal lobule)	64	-26	34	4.54	6421
L insula	-42	0	14	4.59	2217
L visual cortex	-48	-78	16	4.58	1134
R lingual gyrus, fusiform gyrus	24	-38	-8	3.78	721
R insula	44	2	16	4.33	327
R visual cortex	18	-60	16	3.56	318
L visual cortex	-18	-98	26	3.76	298
R superior frontal gyrus	24	8	50	3.71	249
L visual cortex	-18	-66	-6	4.27	247

Supplementary Table 2 Activated brain regions for whole brain covariate analysis

Brain Regions	MNI Coordination of Local Maxima (mm)			Local Maxima Z	Cluster Size (voxel)
	x	y	z		
OXYTOCIN EFFECT PICTURE STIMULI					
Own-Adult vs. PBI Maternal Care - negative correlation					
R lateral occipital cortex extending into post central gyrus, precuneus and cuneal cortex	12	-64	62	4.96	2143
L precuneus cortex extending into cuneal cortex	-6	-76	38	4.89	536
R supramarginal gyrus	56	-34	42	4.64	448
L supramarginal gyrus	-62	-46	44	5.76	383
R posterior cingulate gyrus	12	-28	26	4.35	350
L posterior cingulate gyrus	-18	-26	32	4.86	277
R inferior frontal gyrus	52	22	4	4.35	259
L anterior cingulate gyrus	-4	10	40	4.98	228
R precentral gyrus	32	-10	40	5	178
L visual cortex	-44	-84	20	4.37	172
R lingual gyrus	22	-60	-2	4.47	159
R insula	30	8	14	5.05	125
L precentral gyrus	-38	-8	54	4.3	121
OXYTOCIN EFFECT CRY STIMULI					
Cry-TCon vs. PBI Maternal Care – negative correlation					
R TPJ	64	-48	36	4.89	891
OXYTOCIN EFFECT CRY STIMULI					
Cry-TCon vs. Maternal Love Withdrawal – positive correlation					
R cerebellum	16	-90	-16	4.29	502