Supplement 1

Supplementary Methods and Materials

Participants

Post-scanning exclusion criteria were met by 7 participants: non-completion of the experiment due to sleep or urge (n = 3), no effect of the sad mood induction (see main methods for criteria) (n = 3), skin sensitization over both runs (> 2 SD in the pain unpleasantness difference between the first half of both runs and the second half of both runs) (n = 1).

Experimental Design

Pain procedure

In order to be able to apply safely two series of ten tonic (21-second each) stimuli, heat perception was modified by the topical application of capsaicin. Capsaicin activates unmyelinated polymodal C-fiber afferents, allowing a non-noxious input to be perceived as painful (allodynia) or a small noxious input to be perceived as more painful (hyperalgesia; 1). The capsaicin cream was spread over a 1 x 1 cm area of the volar side of the left forearm, 30 min prior to the experiment, and the skin was covered with plastic film to avoid evaporation of the cream. Before beginning the experiment, it was wiped off.

An in-house built thermal resistor with fast rise time and internal self-calibration [such as in (2)] was applied to the pre-treated patch of skin. In each series, 10 heat stimuli were applied over 21 seconds (Figure 1): after a fast rise (30 ºC rise in 0.8 sec) from the skin temperature to the chosen painful temperature (mean temperature needed = 38.61 ± 1.61 ^{o}C), a very slow increasing ramp was initiated, at a rate of + 0.1 °C/sec. The painful stimulus was calibrated to an intensity rating of 6.5/10 (on a numerical rating scale from 0 = no pain, 1 = just painful, to 10 =

extremely painful) before the first run. The same temperatures were applied in both runs. This progressive increase was chosen, as pilot experiments had revealed that participants quickly habituate to a constant thermal stimulus, while the very small, progressive increase was perceived as a prolonged stable pain.

Ratings in the scanner (Figure 1)

State mood was assessed via ratings on Visual Analogue Scales (VAS) for sad and happy mood: the statement, “At this moment I feel sad ” was printed above a line, which was anchored on a scale of not at all to extremely (3). A composite depressed mood score was created on the basis of these separate VAS ratings [(10-happy) + sad)/2]. Mood ratings were taken at three time points. Each was preceded by instructions: “Please rate how you feel right now, at this moment in time”.

Ratings of pain unpleasantness were recorded after each stimulus on a VAS anchored from not at all to intensely unpleasant. Before the scanning session, during the calibration of the stimulus, the pain intensity was rated on a numerical rating scale (0-10).

After each pain unpleasantness VAS, participants rated how much they had experienced a specific negative pain related thought during the previous stimulus. We used 10 present-time catastrophizing thought statements such as “I worry about when the pain will end” (rated on a VAS with anchors: not at all - all the time). Six of these statements were the in-vivo catastrophizing statements developed by Edwards *et al.* (4). Four more were adapted from the original Pain Catastrophizing Scale (5) to be relevant to an experimental, present-time stimulus. Our in-vivo catastrophizing scale assesses the same three subscales (Magnification, Rumination, Helplessness) as the Pain Catastrophizing Scale’s items (5). The statements were presented in a

different order for each participant's depressed and neutral run, counterbalanced across participants.

fMRI Image Acquisition

Functional images were acquired with a bird–cage radio frequency coil for pulse transmission and a four-channel phased-array receiver coil. A whole brain gradient echo-planar imaging (EPI) sequence was used (repetition time (TR) = 3 sec, echo time (TE) = 30 msec, flip angle = 87°, field of view (FOV) = 224 x 224 mm, matrix 64 x 64, voxel size 3 x 3 x 3 mm^3, 42 x 3 mm-thick axial oblique slices allowed coverage of the whole brain). The sequences consisted of two series of 272 volumes, of which the first four volumes were discarded. A structural image was acquired for co-registration (T1 weighted structural scan, voxel size 1 x 1 x 1 mm^3, matrix 256 x 192, FOV = 256 x 192 mm^2, TR/TE = 13/5 msec, TI = 200 msec, flip angle = 8°).

Data Analysis

Imaging data

Preprocessing was conducted in FEAT on each participant's time series of fMRI volumes as follows: motion correction (6); non-brain removal using BET (Brain Extraction Tool), spatial smoothing using Gaussian kernel of full-width-half-maximum of 7 mm; mean-based intensity normalization of all volumes by the same factor; high-pass temporal filtering (cut-off 90 sec). Each functional image was first registered to the corresponding high-resolution structural image, then to a standard brain (MNI-template) using FLIRT (7).

All psychophysical and post-hoc analysis statistics were performed with SPSS v.16 for Mac (SPSS Inc., Chicago, IL).

Table S1. Strong versus no modulation of pain unpleasantness ratings due to mood induction. Results of the median split analysis dividing strong versus non-responders to the mood manipulation (effects on the perceived pain unpleasantness difference). This table is a complement to Figure 4C. Difference in pain unpleasantness ratings cut-off = 0.29 point difference.

	Strong modulation ***N* = 10** **M (SD)**	**No modulation** ***N* = 10** **M (SD)**	**Sig.**
Characteristics at baseline			
Beck Depression Inventory (BDI)	4.22 (4.97)	7.1 (5.8)	NS
Temperature used during experiment	39.1 (1.5)	38.1 (1.62)	NS
Pain Intensity during thresholding	6.35 (0.47)	6.45 (0.44)	NS
Neuroticism (EPQ-R)	4.7 (3.62)	4.3 (2.45)	NS
Gender: number of men / women	5/5	6/4	NS
Difference in negative mood ratings (depressed-neutral)	3.38 (2.17)	2.35 (1.61)	NS
% signal change in activity in the ROIs (all during pain in the depressed mood)			
Left IFG	0.29 (.198)	0.04 (.185)	< 0.001
Left Amygdala	0.21 (0.22)	-0.02 (0.15)	0.01
Right Amygdala	0.11 (0.12)	-0.02 (0.14)	0.04
Left dlPFC	-0.06 (0.21)	0.02 (0.12)	NS
Left OFC	1.15(0.22)	0.06 (0.28)	NS
Ratings of pain unpleasantness			
Neutral mood	5.30 (1.77)	5.27 (1.52)	NS
Depressed mood	6.85 (1.42)	5.10 (1.55)	0.02

Sig, significance; NS, not significant; EPQ-R, Eysenck Personality Questionnaire-Revised; ROI, region of interest; IFG, inferior frontal gyrus; dlPFC, dorsolateral prefrontal cortex; OFC, orbitofrontal cortex

NS defined as $P > 0.05$

Table S2. Activation peak coordinates for areas significantly less deactivated in the depressed mood than in the neutral mood in response to painful stimuli (Graphically represented in Figure S1).

Brain region	Laterality	Brodmann area	MNI coordinates			Cluster size (voxels)	Z score
			x	y	z		
Superior parietal lobule	L	7	-30	-58	48	2036	3.6
Precuneus/Post. Cing.	L	31	-6	-46	44		3.56
Occipital cortex	L	19	-32	-76	28	1637	3.3
Intraparietal sulcus	L	40	-38	-32	34		3.27
Middle temporal gyrus	L	37	-56	-56	-10	952	3.72
	L	21	-68	-36	-4		3.12
	L	20	-66	-42	-6		3.09
Intraparietal sulcus	R	40	36	-40	38	689	3.53
S I	R	3	52	-12	36		3.28
Precuneus	R	31	2	-48	44		2.89
S I	L	3	-56	-18	32		2.90

L, left; R, right; S I, primary somatosensory cortex; Post. Cing, posterior cingulate

Table S3. Activation peak coordinates for *t*-test pain [depressed mood > neutral mood] (as in Figure 4A).

Brain region	**Laterality**	**Brodmann area**	**MNI coordinates**			**Cluster size (voxels)**	**Z score**
			x	y	z		
Superior parietal lobule	L	7	-30	-58	48	13662	3.6
Precuneus	L	31	-6	-46	44		3.56
Supramarginal gyrus	R	40	36	-40	38		3.52
IFG	L	44	-56	14	6		3.48
Supramarginal/angular gyrus	L	40	-62	-44	30		3.46
S II	L	7	-20	-64	64		3.42
dlPFC	L	9	-24	22	44		3.14
Subgenual ACC	L	25	-2	6	-6		2.90
OFC	L	47	-45	40	-14		2.82
Middle temporal gyrus	L	37	-56	-56	-10	1455	3.72
Inferior temporal gyrus	L	37	-56	-62	-26		3.40
Posterior insular cortex	L	48	-36	-26	8	1171	3.18
Hippocampus	L	27	-20	-36	-2		3.02
Thalamus	L		-16	-12	8		2.97
Caudate	L		-12	10	6		2.83

L, left; R, right; IFG, inferior frontal gyrus; S II, secondary somatosensory cortex; dlPFC, dorsolateral prefrontal cortex; ACC, anterior cingulate cortex; OFC, orbitofrontal cortex

Table S4. Activation peak coordinates for *t*-test mood reinforcers [depressed mood > neutral mood] (as in Figure 4B).

Brain region	Laterality	Brodmann area	MNI coordinates			Cluster size (voxels)	Z score
			x	y	z		
mPFC	R	10	6	60	10	2968	3.53
OFC	L	11	-22	52	0		3.53
Perigenual ACC	R	25	10	38	-4		3.48
Perigenual ACC	L	25	-8	36	-2		3.45
Rostral ACC	L	24	-6	34	10		3.44
mPFC	L	10	-8	62	14		3.22
OFC	R	11	14	38	-8		3.13
Rostral ACC	R	24	2	36	8		3.10

L, left; R, right; mPFC, medial prefrontal cortex; OFC, orbitofrontal cortex; ACC, anterior cingulate cortex

Table S5. Activation peak coordinates for areas of increased activation during the mood reinforcer [neutral > depressed mood] (as in Figure S2).

Brain region	Laterality	Brodmann area	MNI coordinates			Cluster size (voxels)	Z score
			x	y	z		
Inferior temporal gyrus	L	37	-34	-38	-22	1810	5.17
	L	20	-32	-20	-26		3.43

L, left

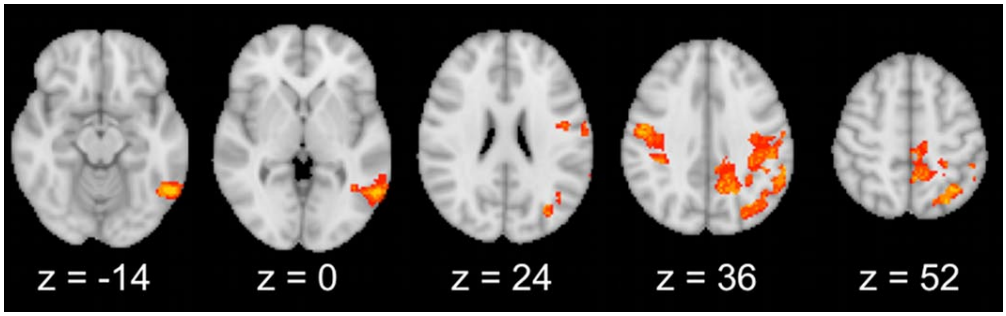

Figure S1. Areas significantly less deactivated in the depressed mood than in the neutral mood in response to painful stimuli.

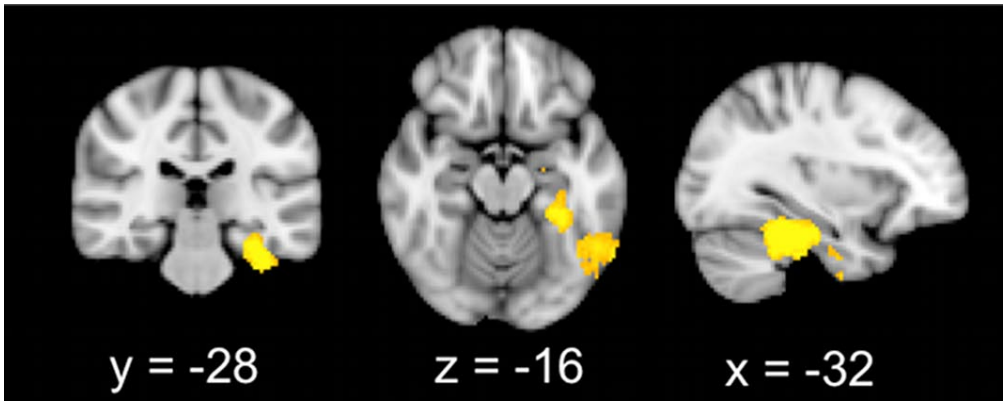

Figure S2. Areas of increased activation during the mood reinforcer [neutral > depressed mood].

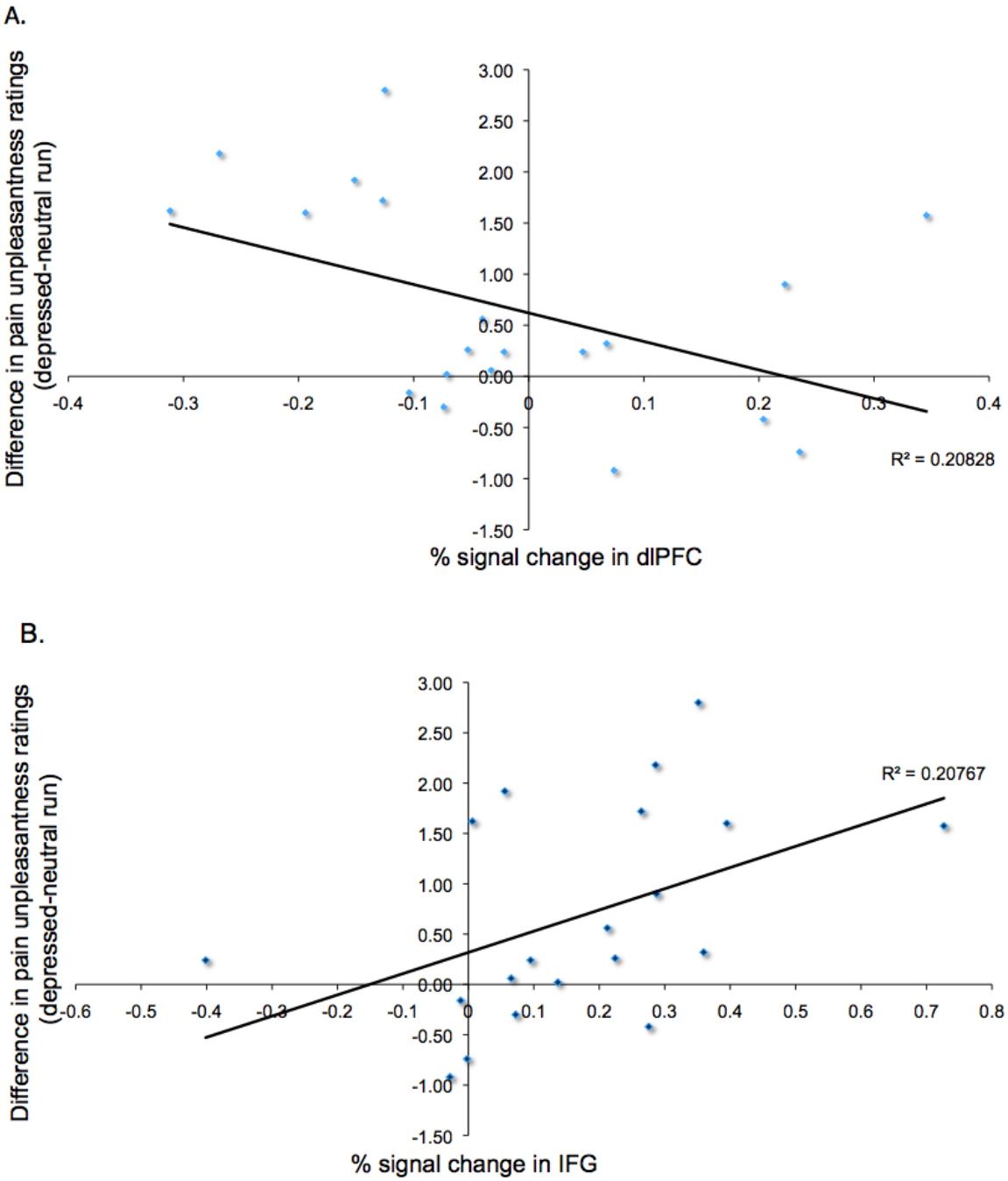

Figure S3. (A) Correlation between the activity in the left dorsolateral prefrontal cortex (dlPFC) and the difference in pain unpleasantness ratings between the depressed and neutral mood runs. **(**B) Correlation between the activity in the left inferior frontal gyrus (IFG) and the difference in pain unpleasantness ratings between the depressed and neutral mood runs.

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