SUPPLEMENTARY METHODS

Participant recruitment

Between March 2015 and April 2016, *N*=57 volunteers were recruited through the Netherlands Sleep Registry (NSR, www.slaapregister.nl), an online platform and database for extensive surveying of sleep, traits, life events and health history (Benjamins *et al.*, 2017). NSR volunteers are recruited through media, advertisements (e.g. Facebook and Twitter) and flyers distributed at healthcare institutions and conventions. Recruitment communications stress that, in order to make any progress in understanding insomnia, the NSR needs volunteers covering the whole range from good to bad sleepers. This has resulted in a uniform distribution of volunteers: overall about 38% do not have insomnia, 29% may have subthreshold insomnia, and 33% have clinical insomnia.

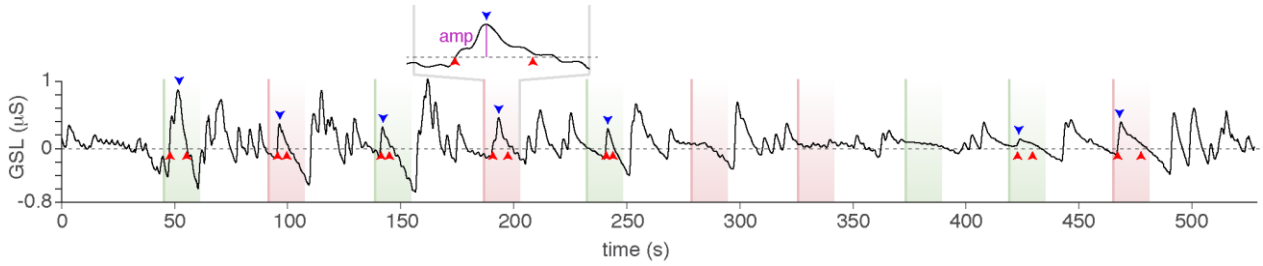
Data collection, processing and subject level fMRI analysis

Galvanic skin responses

To assess an index of autonomic activity during the task, MRI-compatible galvanic skin response sensors (GSR; Brain Products GmbH, Gilching, Germany) were placed on the intermediate phalanges of the left index and middle finger with conductive paste. Skin conductance was measured with a constant voltage of 0.5 V and recorded with an MRI-compatible amplifier at a sampling frequency of 5000 Hz.

Using EEGLAB (Delorme & Makeig, 2004), the fMRI-gradient artefact was removed with the FASTR plugin (Iannetti *et al.*, 2005; Niazy *et al.*, 2005; Niazy *et al.*, 2004), after which the skin conductance signal was bandpass-filtered between 0.05 and 2 Hz and downsampled to 256 Hz. The onset and offset of the first phasic GSR was identified within each stimulus presentation window (16 seconds; red arrows, supplementary figure S1) by the period where the

signal exceeded 0.01 μS, and was manually verified. We scored 281 GSRs in 1140 emotional stimuli (24.6%), and 232 GSRs in 1140 neutral stimuli (20.4%). 6 participants did not elicit a GSR in response to any stimulus. The amplitude of each response was calculated from the onset of the GSR to the maximal skin-conductance value (blue arrows, supplementary figure S1) between the onset and offset of the GSR (Hein *et al.*, 2011; Khalfa *et al.*, 2002), $\log_{10}$-transformed, and stored for data analysis.



Supplementary figure S1. Time course of skin-conductance recording and illustration of signal processing. Galvanic skin responses (GSRs) were identified within the intervals between onset and offset of the emotional stimuli (red shaded areas) and neutral stimuli (green shaded areas). GSRs outside these windows are related to the audio-visual 1-back task. Within each stimulus window, the onset and offset of the first GSR (red arrows) were identified by the period where the signal exceeded 0.01 μS, and manually verified. The amplitude of the GSR was calculated from the maximal skin-conductance value (blue arrow) relative to the value at the GSR onset (see insert).

MRI acquisition

To assess BOLD responses during the task, 212 Echo Planar Images (EPI; TR: 2.5 s) were acquired during each run of each task on a Philips Achieva 3T scanner with the following sequence-parameters: repetition time: 2500 ms, echo time: 28 ms, voxel-size: 2.5×2.5×2.5 mm, 43 slices, inter-slice gap: 10%, field-of-view: 240×240 mm, flip-angle: 77.2°, parallel imaging SENSE factor 2. A T1-weighted scan was used for anatomical registration; repetition time: 8.3 ms, echo time: 3.8 ms, voxel-size: 1 mm^3, 220 slices, field-of-view: 240 by 188 mm, flip-angle: 8°. And B0-fieldmaps were acquired in between each run of each task to correct the EPI images

for magnetic-field distortions; repetition time: 11 ms, echo time: 3 ms, voxel size: 2×2×2 mm, 128 slices, field-of-view: 256 by 208 mm, flip-angle: 8° (Jenkinson, 2004).

Single subject BOLD responses to novel and relived emotional experiences

General linear models were used to estimate the individual mean BOLD response to the emotional stimuli relative to the corresponding neutral stimuli, separately for novel and relived experiences (FSL FILM; Woolrich *et al.*, 2001). Stimuli were modelled with two box-car regressors, both convolved with a double-gamma haemodynamic response function (HRF). To adjust for variation in timing of the actual HRF and slice-acquisition, the first-order derivative of both regressors were added to the design-matrix. To adjust for motion artefacts, we added a nuisance-regressor for each time-sample where excessive motion was detected (FSL Motion Outliers, RMS intensity difference, 75^{th} percentile+1.5×IQR; (Jenkinson, 1999). Finally, the difference in BOLD response between emotional and corresponding neutral stimuli was quantified by contrasting the parameter estimates of the two regressors ($\beta_{emotional}$-$\beta_{neutral}$) at each voxel, hereafter denoted as the emotion-specific BOLD response.

Procedures for obtaining self-conscious emotional stimuli and their neutral counterparts

Karaoke task for novel self-conscious emotions.

To obtain recordings of the participant's own solo singing, participants were randomly assigned to perform a Karaoke sing-along of a Dutch version of either "Gloria in Excelsis Deo" or "Silent Night, Holy Night". The songs were selected because they are familiar to many, but moreover for their difficulty of maintaining vocal pitch, and for the number and duration of selectable fragments with an appropriate duration for a block-design fMRI implementation (±16 s). The recordings were made while the participant resided in a sound-proof room without any other person present (Audio-technica ATR1200 Cardioid microphone, and GarageBand software on a

MacBook Pro). During the recording, participants heard the instruments and the vocals of a sex-matched semi-professional singer, while their own voice was not included in the audio mix. Participants were not explicitly told what the purpose was of the recording, and received no feedback on their singing performance.

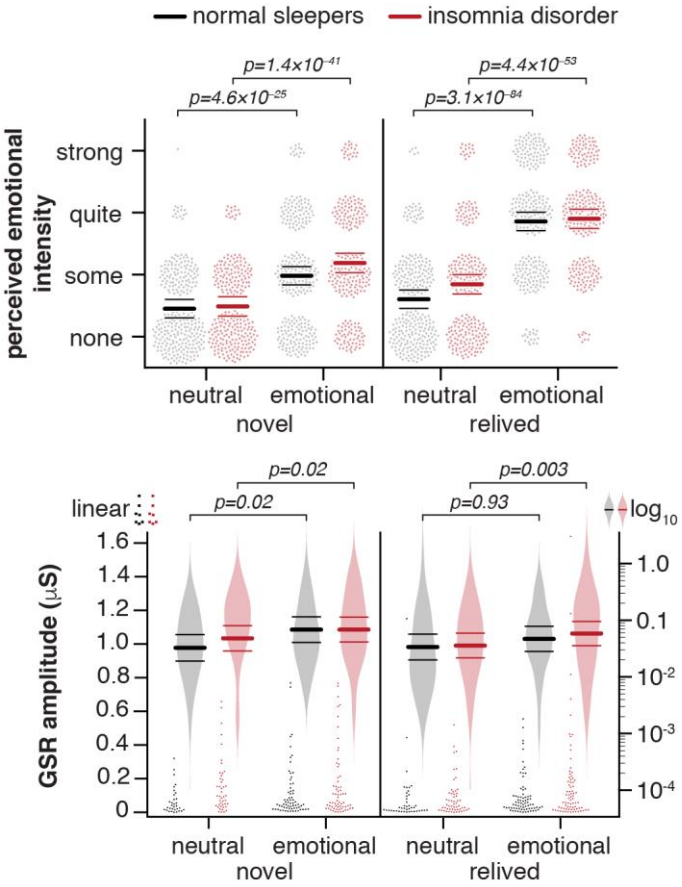
Ten 16-second fragments were extracted from the recordings to be used as emotional stimuli in the block-design fMRI task. For the neutral control condition, we used the sex-matched 16-second fragments of the same song, sung by a semi-professional singer (two colleagues who sing in choirs). Each fragment was compressed and normalised to -1 dB with the open source software Audacity 2.1.2 (www.audacityteam.org).

Self-conscious emotions induced by remembering one's own past shameful experiences.

In order to elicit self-conscious emotions related to past shameful experiences, participants were shown sets of keywords that triggered past shameful experiences (Wagner *et al.*, 2011). To obtain these sets of keywords, each participant was asked to recall at least five shameful autobiographical emotional experiences with the specific instruction: "*Think of at least five experiences that gave you the impression that you had put yourself in an unfavourable situation because it could damage your reputation or honour and you did not see the opportunity to change that negative impression. In short, experiences you felt ashamed of when it happened or even still feel ashamed of.*" With each of the memories, participants had to provide a combination of four keywords that by presentation would easily trigger recall of the shameful experience. This procedure ensured participants did not have to disclose the actual experience with the experimenter and thus allowed the participant to recall the most emotionally extreme experiences. In order to contrast *each* emotional memory, we asked to recall trivial, non-emotional experiences from the same period. Suggestions for neutral memories were memories of trips in the family car, characteristics of the house or the rooms in the house, the road to school or work,

or breakfast routines. In addition, participants indicated, to their best knowledge, how long ago the emotional experiences were in years, months, and days.

SUPPLEMENTARY RESULTS



Supplementary figure S2. Emotional responses to novel and relived experiences in terms of perceived emotional intensity ratings and galvanic skin responses. The horizontal axis shows the stimulus valence: neutral and emotional within both novel and relived stimulus types, for both normal sleepers (black) and insomnia disorder (red). Vertical axes: subjective emotional intensity on a scale of 1 to 4, with single-trial responses depicted with small dots (upper panel). *Galvanic skin response amplitudes are shown on a linear scale (left vertical axis) by small dots at the bottom of the graph, and on a logarithmic scale (right vertical axis) by violin-distributions in the mid part of the graph. Thick lines indicate the estimated mean and thin lines indicate the 95% confidence interval.*

Effects of age and sex on perceived intensity ratings and galvanic skin response amplitudes

We verified that sex did not affect the perceived intensity ratings to novel (β [SE]=0.25 [0.14], t(1118)=1.72, p=0.09) or relived experiences (β [SE]=0.16 [0.12], t(1103)=1.31, p=0.19). Nor did sex modulate the amplitude of GSRs to novel (β [SE]=0.13 [0.17], t(229)=0.75, p=0.45) or relived experiences (β [SE]=–0.03 [0.21], t(270)=–0.14, p=0.89).

Perceived emotional intensity ratings to novel experiences were not modulated by age (β [SE]=0.04 [0.07], $t(1118)=0.56$, $p=0.58$), whereas to relived experiences, intensity ratings increased with age (β [SE]=0.29 [0.06], $t(1103)=4.82$, $p=1.6\times10^{-6}$). Finally, GSR amplitudes decreased with age for both novel experiences (β [SE]=–0.21 [0.08], $t(229)=–2.65$, $p=0.009$), and for relived experiences (β [SE]=–0.28 [0.10], $t(270)=–2.59$, $p=0.01$).

Supplementary table S1. Rank-sorted emotional intensity ratings to 17 emotions indicate successful induction of self-conscious emotional experiences.

emotion	mean intensity	SD
shame	2.10	0.86
embarrassment	1.89	0.80
interest	1.71	0.76
sadness	1.67	0.85
humiliation	1.67	0.76
aversion	1.64	0.74
surprise	1.64	0.72
guilt	1.63	0.83
upset	1.62	0.78
excitement	1.60	0.71
anger	1.54	0.83
disgust	1.50	0.67
pleasure	1.49	0.72
fright	1.46	0.63
rage	1.41	0.73
pride	1.38	0.68
fear	1.30	0.58

Time of day effects on skin-conductance levels and response amplitude

We evaluated whether time of day affected mean skin-conductance levels (SCL) and galvanic skin response amplitudes (GSR). A mixed-effects general linear model evaluated whether SCLs and GSRs differed between morning and evening sessions, possibly differentially so in ID and NS. Results showed no significant time-of-day effect for SCL (β [se]=0.15 [1.39], $t(220)=0.11$,

p=0.92) and a trend for lower GSRs in the evening (β [se]=–0.02 [0.01], t(511)=–1.74, p=0.08). Time-of-day effects did not differ between ID and NS ($0.33 \leq p \leq 0.80$).

Main effects of stimulus type, group and confounders on emotion-specific BOLD responses

Differences between novel and relived experiences in the emotion-specific BOLD response

Emotion-specific BOLD responses to novel and relived experiences were significantly different in eleven significant clusters across brain regions involved in auditory processing and memory recall: novel experiences elicited stronger emotion-specific BOLD responses in nine clusters encompassing the bilateral posterior superior temporal gyrus (including the primary auditory cortices), right inferior frontal gyrus, supplementary motor area, bilateral precentral gyrus, left posterior parahippocampal gyrus, right supramarginal gyrus, and right pallidum. The relived experiences elicited stronger emotion-specific BOLD responses in the left temporal pole, and an area anterior and superior of the right caudate nucleus. For details see supplementary table S4.

Differences between ID and NS in the emotion-specific BOLD response

On average, participants with ID showed greater emotion-specific BOLD responses in one cluster in the left postcentral gyrus ($p_{cluster}$=0.01; Z_{max}=4.68 at MNI_{xyz}=[-62, -12, 41] mm; supplementary table S4).

Effects of age and sex on the emotion-specific BOLD response

Lastly, while there were no significant effects of sex or perceived emotional intensity ratings, emotion-specific BOLD responses were shown to decrease with age in three clusters (supplementary table S4); one cluster encompassing the right supplementary motor area and right superior frontal gyrus ($p_{cluster}$=0.0003); a second cluster in the dorsolateral prefrontal cortex

($p_{cluster}$=0.02); and a third cluster encompassing the inferior frontal gyrus and frontal operculum cortex ($p_{cluster}$=0.03).

Supplementary tables S5 to S8 show the brain regions encompassed by the identified clusters with a local maximally significant BOLD response to novel and relived experiences and within normal sleepers and insomnia patients. Brain regions identified with the Harvard-Oxford Structural Atlas.

Associations between galvanic skin responses, dorsal ACC activation, and stimulus intensity ratings while reliving emotional experiences

First, a general linear model evaluated whether the dorsal ACC response to relived experiences was associated with the amplitude of GSRs and whether this association was different between NS and ID (interaction term). We found no significant main association between the dorsal ACC response and GSR amplitudes (β [se] = –0.16 [0.28], p = 0.56), but a significant interaction effect indicated that the association between the dorsal ACC response and GSR amplitudes was greater in ID than in NS (β [se] = 0.74 [0.33], p = 0.03). Post-hoc within-group correlations indicated no association between GSR amplitudes and dorsal ACC responses in NS (r = –0.16, p = 0.54), but a significant positive association in ID (r = 0.60, p = 0.008).

Secondly, we used a similar general linear model to evaluate the association between the dorsal ACC response to relived experiences and perceived intensity ratings. We found no significant main association (β [se] = –0.16 [0.19], p = 0.41), and no significant interaction effect (β [se] = 0.36 [0.26], p = 0.17).

Thirdly, a final general linear model evaluated the association between the amplitude of GSRs to relived experiences and perceived intensity ratings. We found no significant main association between the GSR amplitudes and perceived intensity ratings (β [se] = –0.05 [0.20], p

= 0.80), but a significant interaction effect indicated that the association between GSR amplitudes and perceived intensity ratings was greater in ID than in NS (β [se] = 0.74 [0.29], p = 0.02). Post-hoc within-group correlations indicated no association between GSR amplitudes and dorsal ACC responses in NS (r = –0.07, p = 0.78), but a significant positive association in ID (r = 0.60, p = 0.009).

Supplementary table S2. Correlations between PSG variables and responses to relived experience. Pearson's correlation-coefficient (r) and false-discovery rate corrected p-values (α = 0.05) are shown for associations between polysomnographic sleep variables and three outcome measures of the response to relived experiences across all participants: the dorsal ACC BOLD response, GSR amplitudes, and perceived intensity ratings.

	dACC BOLD response				**GSR amplitude**				**Perceived Intensity Rating**			
	night before testing		*night after testing*		*night before testing*		*night after testing*		*night before testing*		*night after testing*	
	r	***p***	***r***	***p***	***r***	***p***	***r***	***p***	***r***	***p***	***r***	***p***
time in bed (min)	-0.02	0.98	0.04	0.98	0.22	0.98	0.42	0.40	0.09	0.98	0.27	0.93
sleep onset latency (min)	0.06	0.98	0.06	0.98	0.14	0.98	0.23	0.98	-0.16	0.98	0.10	0.98
wake after sleep onset (min)	0.11	0.98	0.00	1.00	-0.07	0.98	0.27	0.95	-0.19	0.98	-0.22	0.95
total sleep time (min)	-0.05	0.98	0.05	0.98	0.20	0.98	0.16	0.98	0.21	0.95	0.20	0.95
sleep efficiency (%)	-0.05	0.98	0.02	1.00	0.06	0.98	-0.18	0.98	0.21	0.95	0.02	0.98
Time spent ... (min)												
in N1	0.08	0.98	0.03	0.98	-0.15	0.98	0.00	1.00	-0.09	0.98	-0.17	0.98
in N2	-0.10	0.98	-0.01	1.00	0.15	0.98	0.26	0.95	0.07	0.98	0.34	0.40
in N3	-0.09	0.98	0.01	1.00	0.10	0.98	-0.08	0.98	0.27	0.93	-0.09	0.98
in REM	0.17	0.98	0.08	0.98	0.06	0.98	0.04	0.98	-0.07	0.98	0.04	0.98
Time spent ... (%)												
in N1	0.08	0.98	0.05	0.98	-0.15	0.98	-0.01	1.00	-0.10	0.98	-0.20	0.95
in N2	-0.09	0.98	-0.04	0.98	0.03	0.98	0.19	0.98	-0.10	0.98	0.23	0.95
in N3	-0.08	0.98	-0.02	0.98	0.01	1.00	-0.16	0.98	0.21	0.95	-0.16	0.98
in REM	0.21	0.95	0.08	0.98	0.00	1.00	-0.05	0.98	-0.16	0.98	-0.05	0.98
Arousal index ... (n/hr)												
in N1	-0.03	0.98	0.08	0.98	0.11	0.98	0.04	0.98	0.00	1.00	0.11	0.98
in N2	0.10	0.98	-0.09	0.98	-0.07	0.98	0.03	0.99	-0.09	0.98	0.03	0.98
in N3	0.02	1.00	-0.16	0.98	0.03	0.98	-0.17	0.98	-0.07	0.98	**-0.45**	**0.047**
in REM	0.02	0.98	0.01	1.00	-0.07	0.98	0.17	0.98	0.11	0.98	-0.11	0.98

Correlations between PSG variables and dorsal ACC activations, GSRs, and perceived intensity ratings to relived experiences

In order to investigate whether group differences in the emotion-specific response *to relived emotional experiences* related to current PSG variables, we evaluated correlations between interindividual differences in 17 PSG variables and the BOLD response of the dorsal ACC, GSR

amplitudes, and perceived intensity ratings to relived experiences across both groups (the BOLD response of the dorsal ACC was extracted from the conjunction analysis mask; see figure 3 in the main text).

Using a false discovery rate correction of $\alpha = 0.05$, no single correlation was close to significance, except one (supplementary table S2): individuals who perceived emotional relived stimuli as more intense relative to neutral stimuli, experienced less arousals per hour in stage-3 NREM sleep on the subsequent night ($r = –0.45$, $p = 0.047$).

Foremost, the findings indicate that case-control differences in ACC activation while reliving emotional experiences from the distant past cannot simply be attributed to current objective sleep variables. Furthermore, we found no evidence that features of sleep the night before our experimental probing of emotional circuits were associated with either the dorsal ACC BOLD response, the GSR amplitudes, or perceived intensity ratings (supplementary table S2). Given the very long time-scale of past emotional experiences in this study (on average about 15 years ago), and the large night-to-night variability of sleep in insomnia (Buysse *et al.*, 2010), we considered it unlikely that PSG variables derived from a single-night would reflect trait-like sleep characteristics across years of insomnia. Sleep features obtained during a single do not adequately represent the proposed more chronic process we hypothesized to underlie the failure to dissociate the dorsal ACC from the emotional memory trace.

Sensitivity analysis and specificity of dorsal ACC activation to relived emotional experiences

We evaluated whether group differences in dorsal ACC activation are specific to reliving of emotional experiences: if the activation would be nonspecific, group differences between ID and NS during reliving of emotions would no longer be significant after inclusion of a covariate representing an individual's dorsal ACC activation during novel emotions. We moreover

evaluated whether the group differences in dorsal ACC activation during reliving of emotional experiences could better be explained by hyperarousal. Hyperarousal was indexed in two ways. Trait-like generalized hyperarousal was assessed with the Hyperarousal Scale (Pavlova *et al.*, 2001). State-like hyperarousal during reliving was indexed by the mean difference in experienced intensity between the emotional and neutral trials. We thus added three variables to the general linear model. As presented in the main Results, we found a stronger dorsal ACC activation in ID than in NS (β=0.68 [0.28], $t(51)$=2.41, p=0.02), while none of the three added variables explained variance ($0.37 \leq p \leq 0.87$). In conclusion, this ancillary analysis does not support the alternative hypothesis that a more generalized hyperarousal would better explain our findings.

Supplementary table S3. Mean emotion-specific BOLD responses irrespective of stimulus-type or group. Each row depicts the name, hemisphere (H), MNI-coordinates (x, y, z; in mm), and *Z*-statistic of a local maximally significant BOLD response within each cluster, along with the cluster size and cluster *p*-value.

cluster	voxels	p	region	H	x	y	z	Z
Mean emotion-specific BOLD activations, irrespective of stimulus-type or group								
1	61950	0	Frontal Operculum Cortex	R	49	22	-4	7.03
			Posterior Superior Temporal Gyrus	R	56	-13	-3	6.69
			Posterior Superior Temporal Gyrus	R	51	-18	-6	7.12
			Parietal Operculum Cortex	R	54	-29	18	6.69
			Posterior Supramarginal Gyrus	R	58	-36	8	7.40
			Posterior Supramarginal Gyrus	R	62	-39	18	7.88
2	44360	6.60E-38	Central Opercular Cortex	L	-44	8	0	6.32
			Planum Polare	L	-42	-9	-9	5.70
			Posterior Supramarginal Gyrus	L	-63	-44	24	7.08
			Angular Gyrus	L	-62	-52	15	5.83
3	38268	2.72E-34	Anterior Cingulate Gyrus	R	2	23	32	7.25
			Paracingulate Gyrus	R	5	15	39	6.91
			Superior Frontal Gyrus	R	3	12	62	7.38
			Supplementary Motor Cortex	R	4	8	65	7.04
4	15903	8.19E-19	Caudate Nucleus	R	10	7	-2	5.10
			Cerebellum	L	-31	-61	-22	6.37
5	5042	2.09E-08	Middle Frontal Gyrus	R	55	6	48	5.62
			Precentral Gyrus	R	52	2	49	5.77
6	1641	0.00122	Precentral Gyrus	L	-54	-2	51	3.80
			Precentral Gyrus	L	-50	-4	50	4.32
7	1426	0.00294	Precuneous Cortex	L	-3	-51	52	4.20
8	931	0.027	Temporal Pole	R	49	10	-36	4.27
			Anterior Inferior Temporal Gyrus	R	42	0	-39	4.76
Mean emotion-specific BOLD deactivations, irrespective of stimulus-type or group								
1	22904	3.61E-24	Superior Lateral Occipital Cortex	R	33	-75	51	6.36
2	12456	6.87E-16	Superior Lateral Occipital Cortex	L	-33	-66	38	5.57
3	10753	2.40E-14	Middle Frontal Gyrus	R	52	31	30	5.96
4	5192	1.39E-08	Posterior Middle Temporal Gyrus	L	-63	-43	-11	6.28
			Posterior Inferior Temporal Gyrus	L	-52	-51	-9	5.60
			Inferior Lateral Occipital Cortex	L	-40	-72	-9	4.37
5	2942	1.12E-05	Superior Frontal Gyrus	L	-22	30	61	5.16
			Middle Frontal Gyrus	L	-37	18	59	5.11
6	2592	3.64E-05	Posterior Middle Temporal Gyrus	R	62	-39	-10	6.11
			Posterior Inferior Temporal Gyrus	R	60	-55	-14	4.42
7	2576	3.84E-05	Middle Frontal Gyrus	L	-49	28	38	4.78
8	1848	0.00054	Frontal Pole	L	-47	47	-8	4.79
9	1175	8.68E-03	Frontal Pole	R	45	55	-7	4.50
10	1078	0.013	Posterior Temporal Fusiform Cortex	L	-26	-40	-15	3.89
			Posterior Parahippocampal Gyrus	L	-27	-41	-13	3.90
			Temporal Occipital Fusiform Cortex	L	-30	-44	-17	4.15
11	1019	0.018	Posterior Temporal Fusiform Cortex	R	35	-24	-24	4.02
			Posterior Parahippocampal Gyrus	R	26	-30	-20	4.86
12	1012	0.018	Frontal Pole	R	31	62	14	4.50
13	911	0.029	Anterior Middle Temporal Gyrus	R	64	-2	-24	4.63
			Posterior Middle Temporal Gyrus	R	68	-7	-19	4.59

Supplementary table S4. Mean differences in brain responses to novel and relived experiences, and mean differences between participants with ID and normal sleepers. Each row depicts the name, hemisphere (H), MNI-coordinates (x, y, z; in mm), and *Z*-statistic of a local maximally significant BOLD response within each cluster, along with the cluster size and cluster *p*-value.

cluster	voxels	p	region	H	x	y	z	Z
Greater emotion-specific BOLD responses to novel than to relived experiences								
1	11175	9.78E-15	Frontal Operculum Cortex	R	43	23	-1	4.73
			Frontal Orbital Cortex	R	35	26	-1	5.12
			Frontal Pole	R	47	43	15	4.70
			Inferior Frontal Gyrus pars opercularis	R	52	15	20	5.42
2	11128	1.08E-14	Heschls Gyrus	L	-50	-22	5	5.56
			Planum Temporale	L	-61	-13	7	5.58
			Superior Temporal Gyrus anterior division	L	-60	-9	-1	4.29
			Superior Temporal Gyrus posterior division	L	-56	-37	8	4.79
3	6861	1.82E-10	Planum Temporale	R	59	-12	1	4.59
			Heschls Gyrus	R	49	-19	7	5.14
			Planum Temporale	R	51	-34	17	4.61
4	1697	0.00097	Supplementary Motor Area	R	0	9	63	4.03
			Superior Frontal Gyrus	R	4	16	62	4.71
5	1600	0.001	Precentral Gyrus	R	48	-6	41	5.16
6	1127	0.011	Parahippocampal Gyrus posterior division	L	-29	-37	-14	4.84
			Temporal Fusiform Cortex posterior division	L	-30	-34	-18	4.37
7	1012	0.018	Supramarginal Gyrus anterior division	R	59	-31	50	4.00
			Supramarginal Gyrus posterior division	R	58	-35	50	4.10
8	953	0.024	Precentral Gyrus	L	-55	-1	49	3.80
			Precentral Gyrus	L	-54	-5	50	4.80
9	848	0.04	Thalamus	R	14	-1	13	4.25
			Pallidum	R	16	3	-1	4.27
Greater emotion-specific BOLD responses to relived than to novel experiences								
1	1100	0.012	Anterior Middle Temporal Gyrus	L	-64	-1	-24	3.80
			Temporal Pole	L	-59	3	-27	4.87
2	830	0.044	Anterior and Superior of the Caudate Nucleus	R	19	20	19	4.47
Greater emotion-specific BOLD responses in ID than in NS								
1	1076	0.014	Postcentral Gyrus	L	-62	-12	41	4.68
Greater emotion-specific BOLD responses with increasing age								
1	1984	0.00032	Supplementary Motor Area	R	6	7	67	5.33
			Superior Frontal Gyrus	R	5	12	67	5.49
2	984	0.021	Dorsal Lateral Prefrontal Cortex	L	-40	42	29	4.86
3	906	0.03	Frontal Operculum Cortex	R	48	25	-1	4.31
			Inferior Frontal Gyrus (triangularis)	R	53	20	-4	4.30

Supplementary table S5. Brain responses to novel emotional stimuli as compared to neutral counterparts in normal sleepers. Each row depicts the name, hemisphere (H), MNI-coordinates (x, y, z; in mm), and *Z*-statistic of a local maximally significant BOLD response within each cluster, along with the cluster size and cluster *p*-value.

cluster	voxels	p	region	H	x	y	z	Z
Activations								
1	33339	3.18E-31	Inferior Frontal Gyrus (triangularis)	R	49	32	2	5.53
			Frontal Orbital Cortex	R	36	29	0	5.13
			Frontal Operculum Cortex	R	47	25	-3	5.51
			Inferior Frontal Gyrus (opercularis)	R	56	14	6	5.29
			Temporal Pole	R	54	14	-6	6.19
			Insular Cortex	R	39	10	3	4.32
			Planum Polare	R	58	4	0	3.69
			Anterior Superior Temporal Gyrus	R	59	-3	-5	4.51
			Heschls Gyrus	R	50	-15	6	5.10
			Posterior Superior Temporal Gyrus	R	67	-26	8	5.29
			Anterior Supramarginal Gyrus	R	62	-33	40	4.41
			Parietal Operculum Cortex	R	61	-33	24	4.85
			Planum Temporale	R	64	-34	18	6.29
			Posterior Supramarginal Gyrus	R	59	-39	18	6.55
2	19277	1.78E-21	Frontal Operculum Cortex	L	-47	13	1	4.27
			Inferior Frontal Gyrus (opercularis)	L	-54	9	1	4.79
			Insular Cortex	L	-40	7	-2	4.33
			Planum Polare	L	-57	0	-2	4.09
			Precentral Gyrus	L	-63	-2	20	4.30
			Anterior Superior Temporal Gyrus	L	-62	-9	1	5.41
			Central Opercular Cortex	L	-58	-11	9	5.36
			Heschls Gyrus	L	-50	-22	5	5.10
			Planum Temporale	L	-61	-29	9	5.53
			Posterior Superior Temporal Gyrus	L	-67	-36	14	4.87
			Parietal Operculum Cortex	L	-59	-37	25	4.06
			Anterior Supramarginal Gyrus	L	-66	-38	23	4.35
			Posterior Supramarginal Gyrus	L	-66	-43	12	4.96
			Posterior Middle Temporal Gyrus	L	-56	-50	9	4.59
			Angular Gyrus	L	-61	-51	14	5.34
3	6056	1.40E-09	Superior Frontal Gyrus	R	4	14	59	7.34
			Supplementary Motor Area	R	4	7	64	5.63
			Supplementary Motor Area	L	-1	5	58	4.80
4	3352	2.98E-06	Precentral Gyrus	R	52	-3	47	5.43
5	2900	1.29E-05	Anterior Cingulate Gyrus	R	1	17	34	5.37
			Paracingulate Gyrus	L	-2	17	38	4.48
			Paracingulate Gyrus	R	6	16	39	5.57
			Anterior Cingulate Gyrus	L	-1	14	37	4.31
6	1691	0.001	Cerebellum	R	25	-59	-25	5.10
7	1198	0.008	Cerebellum	L	-31	-61	-25	4.68
8	1032	0.017	Putamen	R	21	10	5	4.03
			Caudate nucleus	R	11	6	1	4.90
			Pallidum	R	14	2	-1	4.18

Supplementary table S5. Continued.

cluster	voxels	p	region	H	x	y	z	Z
Deactivations								
1	4148	2.38E-07	Superior Frontal Gyrus	L	-21	28	59	4.18
			Middle Frontal Gyrus	L	-37	19	59	4.65
2	3031	8.40E-06	Supramarginal Gyrus anterior division	L	-52	-37	49	3.73
			Angular Gyrus	L	-42	-55	26	3.88
			Superior Lateral Occipital Cortex	L	-36	-72	51	4.44
3	2402	7.05E-05	Posterior Middle Temporal Gyrus	L	-57	-39	-13	5.21
			Posterior Inferior Temporal Gyrus	L	-59	-44	-13	4.74
4	1995	0.00031	Anterior Middle Temporal Gyrus	R	64	-1	-23	5.29
			Posterior Middle Temporal Gyrus	R	64	-8	-19	5.48
5	1965	0.00035	Angular Gyrus	R	42	-54	34	4.32
			Superior Lateral Occipital Cortex	R	40	-60	31	3.86
6	1810	0.00063	Temporal Pole	L	-57	4	-26	3.83
			Anterior Middle Temporal Gyrus	L	-58	1	-30	4.22
			Posterior Middle Temporal Gyrus	L	-69	-16	-12	4.32
7	1576	0.0016	Superior Frontal Gyrus	R	26	33	51	3.92
			Middle Frontal Gyrus	R	35	26	52	4.50

Supplementary table S6. Brain responses to novel emotional stimuli as compared to neutral counterparts in insomnia disorder. Each row depicts the name, hemisphere (H), MNI-coordinates (x, y, z; in mm), and *Z*-statistic of a local maximally significant BOLD response within each cluster, along with the cluster size and cluster *p*-value.

cluster	voxels	p	region	H	x	y	z	Z
Activations								
1	48289	3.77E-40	Inferior Frontal Gyrus (triangularis)	R	49	26	4	4.66
			Frontal Orbital Cortex	R	44	23	-6	5.96
			Frontal Operculum Cortex	R	45	18	-4	5.60
			Insular Cortex	R	45	12	-4	6.39
			Nucleus Accumbens	R	6	12	-2	4.27
			Inferior Frontal Gyrus (opercularis)	R	51	11	3	4.83
			Temporal Pole	R	54	8	-16	5.29
			Pallidum	R	12	1	-4	4.41
			Planum Polare	R	61	-2	2	4.96
			Amygdala	R	24	-4	-12	4.26
			Thalamus	R	4	-4	8	4.60
			Thalamus	L	-6	-5	8	4.99
			Precentral Gyrus	R	47	-9	36	5.47
			Postcentral Gyrus	R	46	-14	38	5.37
			Central Opercular Cortex	R	59	-15	12	6.08
			Posterior Superior Temporal Gyrus	R	51	-19	-3	5.23
			Heschl's Gyrus	R	52	-20	12	5.57
			Parietal Operculum Cortex	R	55	-28	22	3.70
			Planum Temporale	R	50	-31	15	6.54
			Posterior Middle Temporal Gyrus	R	52	-37	2	4.38
			Posterior Supramarginal Gyrus	R	63	-39	18	6.41
			Angular Gyrus	R	47	-50	14	3.62

Supplementary table S6. Continued.

cluster	voxels	p	region	H	x	y	z	Z
Activations								
2	37857	4.85E-34	Temporal Pole	L	-34	23	-31	4.94
			Inferior Frontal Gyrus (triangularis)	L	-48	20	3	4.26
			Inferior Frontal Gyrus (opercularis)	L	-48	15	-1	4.41
			Frontal Operculum Cortex	L	-42	11	4	4.55
			Frontal Orbital Cortex	L	-29	11	-18	5.75
			Central Opercular Cortex	L	-47	7	-1	6.01
			Precentral Gyrus	L	-52	6	2	5.47
			Amygdala	L	-16	-3	-13	3.84
			Planum Polare	L	-42	-8	-9	4.98
			Posterior Middle Temporal Gyrus	L	-55	-14	-9	4.12
			Heschl's Gyrus	L	-55	-18	8	5.60
			Insular Cortex	L	-37	-21	2	4.77
			Postcentral Gyrus	L	-65	-21	19	4.40
			Planum Temporale	L	-44	-32	7	5.69
			Parietal Operculum Cortex	L	-53	-39	28	5.24
			Posterior Superior Temporal Gyrus	L	-60	-39	6	4.91
			Anterior Supramarginal Gyrus	L	-63	-40	29	4.66
			Posterior Supramarginal Gyrus	L	-60	-43	26	5.41
			Angular Gyrus	L	-59	-54	13	4.72
			Inferior Lateral Occipital Cortex	L	-61	-63	9	3.87
3	25392	6.20E-26	Medial Prefrontal Cortex	R	2	59	18	4.69
			Medial Prefrontal Cortex	L	-6	57	13	4.46
			Paracingulate Gyrus	R	1	22	38	6.73
			Paracingulate Gyrus	L	-4	21	38	6.42
			Anterior Cingulate Gyrus	R	3	20	30	5.59
			Anterior Cingulate Gyrus	L	-2	19	36	6.40
			Superior Frontal Gyrus	L	-2	15	61	5.34
			Superior Frontal Gyrus	R	8	8	69	5.53
			Supplementary Motor Area	R	6	2	67	6.23
			Supplementary Motor Area	L	-1	-4	66	5.59
			Posterior Cingulate Gyrus	R	0	-17	34	4.87
			Posterior Cingulate Gyrus	L	-3	-25	28	5.05
4	3483	1.97E-06	Precentral Gyrus	R	47	-9	36	5.47
			Postcentral Gyrus	R	46	-14	38	5.37
5	2566	3.98E-05	Precentral Gyrus	L	-53	-6	49	5.04
6	2280	0.00011	Cerebellum	L	-32	-61	-22	4.99
7	1161	0.0092	Dorsal Lateral Prefrontal Cortex	L	-30	54	30	4.23
8	982	0.021	Cerebellum	R	22	-66	-22	4.08
9	821	0.045	Cerebellum	R	41	-60	-25	4.23

Supplementary table S7. Brain responses to relived emotional experiences as compared to neutral counterparts in normal sleepers. Each row depicts the name, hemisphere (H), MNI-coordinates (x, y, z; in mm), and *Z*-statistic of a local maximally significant BOLD response within each cluster, along with the cluster size and cluster *p*-value.

cluster	voxels	p	region	H	x	y	z	Z
Activations								
1	850	0.04	Anterior and Superior of the Caudate Nucleus	R	22	16	17	4.71
2	808	0.049	Posterior Supramarginal Gyrus	L	-67	-47	26	3.99
Deactivations								
1	9579	3.10E-13	Anterior Supramarginal Gyrus	R	53	-33	49	3.95
			Posterior Supramarginal Gyrus	R	54	-36	44	4.07
			Angular Gyrus	R	43	-49	48	5.12
			Superior Parietal Lobule	R	34	-55	49	3.98
			Superior Lateral Occipital Cortex	R	23	-71	63	5.75
2	3002	9.24E-06	Retrosplenial Cortex	R	6	-43	7	3.66
			Precuneous Cortex	R	16	-50	6	4.83
			Precuneous Cortex	L	-11	-53	6	3.56
			Lingual Gyrus	R	9	-57	5	3.69
3	2165	0.00016	Ventral Lateral Prefrontal Cortex	R	43	39	14	4.99
			Inferior Frontal Gyrus (triangularis)	R	43	34	15	4.72
			Middle Frontal Gyrus	R	42	34	20	4.34
4	1366	0.0038	Posterior Parahippocampal Gyrus	L	-27	-26	-25	4.28
			Posterior Temporal Fusiform Cortex	L	-28	-37	-17	4.62
			Lingual Gyrus	L	-29	-41	-9	3.60
5	1335	0.0043	Posterior Inferior Temporal Gyrus	L	-52	-51	-9	4.25
			Inferior Lateral Occipital Cortex	L	-41	-64	-6	4.46

Supplementary table S8. Brain responses to relived emotional experiences as compared to neutral counterparts in insomnia disorder. Each row depicts the name, hemisphere (H), MNI-coordinates (x, y, z; in mm), and *Z*-statistic of a local maximally significant BOLD response within each cluster, along with the cluster size and cluster *p*-value.

cluster	voxels	p	region	H	x	y	z	Z
Activations								
1	4531	5.96E-08	Anterior Cingulate Gyrus	R	1	26	32	4.61
			Anterior Cingulate Gyrus	L	-4	24	31	4.70
			Paracingulate Gyrus	R	1	21	37	4.15
			Paracingulate Gyrus	L	-4	10	45	4.85
			Supplementary Motor Area	L	-4	5	47	4.24
			Supplementary Motor Area	R	1	2	47	4.29
2	4399	1.19E-07	Postcentral Gyrus	R	68	-17	26	4.00
			Anterior Supramarginal Gyrus	R	66	-25	26	4.13
			Planum Temporale	R	65	-25	12	3.55
			Parietal Operculum Cortex	R	54	-26	21	4.17
			Posterior Superior Temporal Gyrus	R	68	-28	20	4.35
			Posterior Supramarginal Gyrus	R	66	-35	21	4.32
			Angular Gyrus	R	64	-46	18	3.73
3	1171	0.0088	Posterior Supramarginal Gyrus	L	-59	-51	26	3.89
			Angular Gyrus	L	-59	-55	17	4.82
4	867	0.036	Superior Parietal Lobule	R	24	-47	65	4.53
5	836	0.042	Posterior Superior Temporal Gyrus	R	55	-13	-7	3.87
			Posterior Middle Temporal Gyrus	R	53	-20	-6	4.42
Deactivations								
1	5835	2.49E-09	Superior Parietal Lobule	L	-29	-56	42	3.58
			Superior Lateral Occipital Cortex	L	-29	-70	42	5.99
2	2516	4.73E-05	Superior Lateral Occipital Cortex	R	33	-74	52	4.45
3	1309	4.80E-03	Dorsal Ventral Prefrontal Cortex	R	52	36	21	4.42
			Middle Frontal Gyrus	R	50	30	30	3.85
4	1130	0.011	Superior Frontal Gyrus	R	27	25	58	3.84
			Middle Frontal Gyrus	R	38	16	60	4.62
5	826	0.044	Posterior Parahippocampal Gyrus	L	-30	-26	-21	3.23
			Posterior Temporal Fusiform Cortex	L	-29	-41	-13	4.63

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