Supplementary information

Exposure to negative socio-emotional events induces sustained alteration of resting-state brain networks in the elderly

Authors:

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Supplementary Table 1. Inclusion and exclusion criteria for Age-Well clinical trial (adapted from Poisnel et al., 2018)

Inclusion criteria	*Exclusion criteria*
- Age ≥65 years - Autonomous - Living at home - Educational level ≥7 years (from the Preparatory Course -1st grade- included) - Registered to the social security system - Motivated to effectively participate in the project and signing the informed consent form - Performance within the normal range on standardized cognitive tests according to agreed study-specific standards (age, sex and education level when available) - Native French speaker - Available to attend the intervention for the trial duration (24 months) - Retired for at least one year - No strong preference or aversion for an intervention group - No present or past regular or intensive practice of meditation or comparable practices; the practice is considered as regular and/or intensive if i) it occurs more than one day per week for more than six consecutive months over the last 10 years, and/or in case of more than five consecutive days of intensive practice (internship or retreat) over the past 10 years, and/or of more than 25 days of retreats (cumulatively) within the last 10 years - Not speaking fluent English	- Safety concerns in relation to MR scanning (claustrophobia, ferro- magnetic object) or PET scanning (blood sampling to check hepatic and renal functions are performed before the PET scans; known hypersensibility to Amyvid or Glucotep) - Presence of a major neurological or psychiatric disorder (including an addiction to alcohol or drugs) - History of cerebral disease (vascular, degenerative, physical malformation, tumor, or head trauma with loss of consciousness for more than an hour) - Presence of a chronic disease or acute unstable illness (respiratory, cardiovascular, digestive, renal, metabolic, hematologic, endocrine or infectious) - Current or recent medication that may interfere with cognitive functioning (psychotropic, antihistaminic with anticholinergic action, anti- Parkinson's, benzodiazepines, steroidal anti-inflammatory long-term treatment, antiepileptic or analgesic drugs), the interfering nature of the different treatments being at the discretion of the investigating doctor - Being under legal guardianship or incapacitation - Participation in another biomedical research protocol including the injection of radiopharmaceuticals - Physical or behavioral inability to perform the follow-up visits as planned in the study protocol

Supplementary Table 2. Categorization of the thought probes

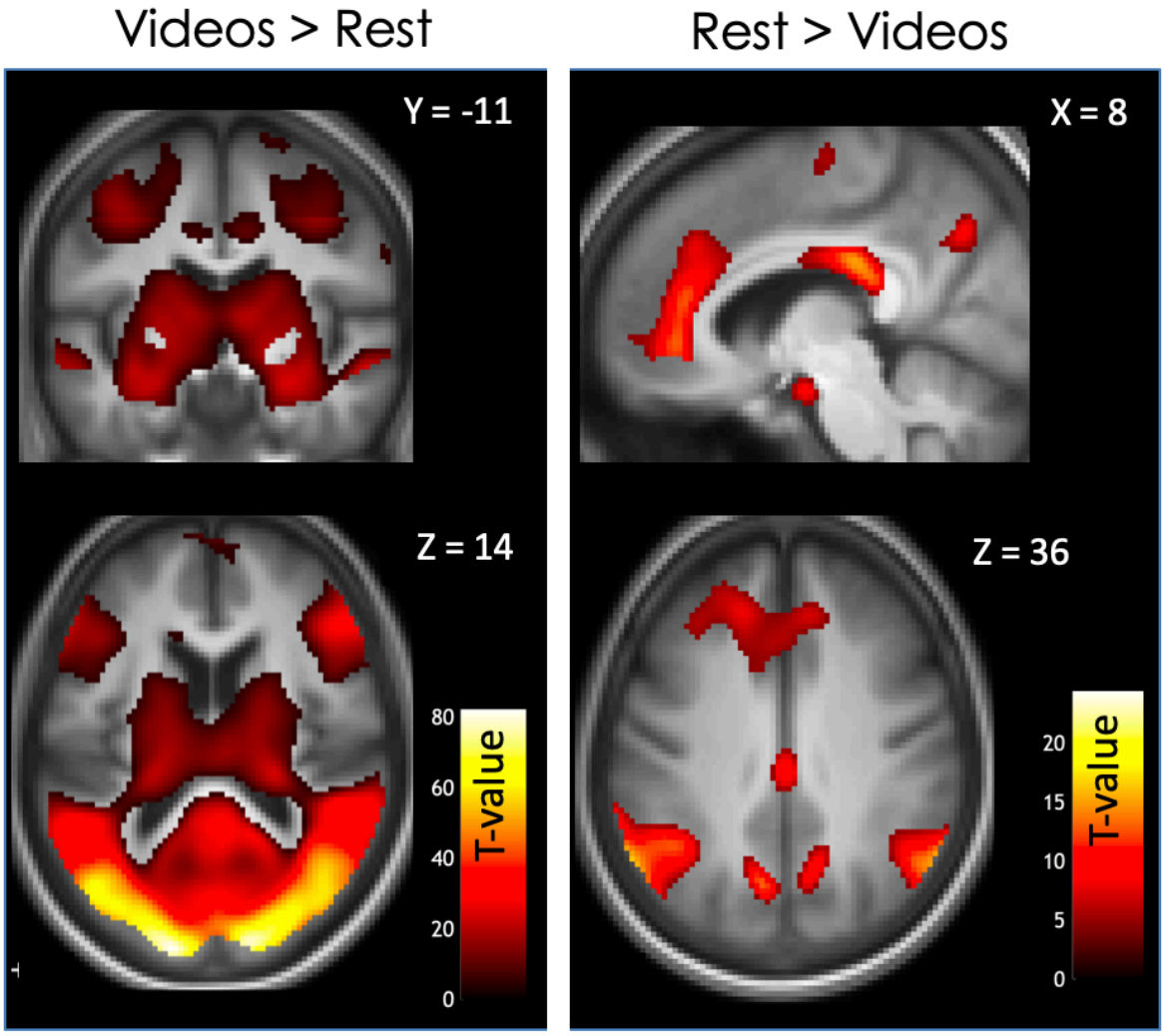
Categories	Labels	Criteria	Intra-group variability		Inter-rater reliability	
			LE % (n=110)	HE % (n=109)	LE (n=110)	HE (n=109)
Positive emotions	Present/ Absent	Presence or absence of items including: Affection, Enthusiasm, Happiness, Humor, Interest, Validation.	**Present = 40 Absent = 28.18 Undefined = 31.82**	**Present = 36.7 Absent = 24.77 Undefined = 38.53**	**Kappa = 0.39 p<0.001**	**Kappa = 0.28 p<0.001**
Negative emotions	Present/ Absent	Presence or absence of items including: Anger, Belligerence, Complaining, Criticism, Defensiveness, Disgust, Fear, Sadness, Stonewalling, Threats, Whining, Helplessness.	**Present = 37.27 Absent = 45.45 Undefined = 17.27**	**Present = 54.13 Absent = 27.52 Undefined = 18.35**	**Kappa = 0.66 p<0.001**	**Kappa = 0.61 p<0.001**
Positive social emotions	Present/ Absent	Presence or absence of items including: Compassion, Curiosity, Empathy, Goodwill, Love, Pride, Social conquest, Solidarity, Sympathy.	**Present = 50 Absent = 29.09 Undefined = 20.91**	**Present = 66.97 Absent = 16.51 Undefined = 16.51**	**Kappa = 0.57 p<0.001**	**Kappa = 0.57 p<0.001**
Negative social emotions	Present/ Absent	Presence or absence of items including: Embarrassment, Envy, Depreciation, Domineering, Disdain, Guilt, Jealousy, Self-criticism, Timidity.	Present = 1.82 Absent = 97.27 Undefined = 0.91	Present = 2.75 Absent = 94.50 Undefined = 2.75		
Emotion regulation (voluntary control of emotions)	Present/ Absent	Presence or absence of strategies willing to voluntarily repress or control the emotions felt.	Present = 2.73 Absent = 95.45 Undefined = 1.82	Present = 0.92 Absent = 97.25 Undefined = 1.83		
Temporality	Past or future / Present	Presence of elements referring to experiences from the past or the / No references to experiences from the past or the future.	Present = 90.91 Past or future = 1.82 Undefined = 7.27	Present = 91.74 Past or future = 3.67 Undefined = 4.59		
Directed attention to oneself	Present/ Absent	Expressed thoughts oriented towards itself or things concerning it.	**Present = 37.27 Absent = 44.55 Undefined = 18.18**	**Present = 26.61 Absent = 50.46 Undefined = 22.94**	**Kappa = 0.64 p<0.001**	**Kappa = 0.52 p<0.001**
Directed attention to others	Present/ Absent	Expressed thoughts oriented towards others.	**Present = 54.55 Absent = 28.18 Undefined = 17.27**	**Present = 59.63 Absent = 17.43 Undefined = 22.94**	**Kappa = 0.64 p<0.001**	**Kappa = 0.46 p<0.001**
Rumination	Present/ Absent	Presence or absence of recall and description of images.	Present = 10 Absent = 84.55 Undefined = 5.45	Present = 4.59 Absent = 88.99 Undefined = 6.42		

Categories based on Coan, J. A., & Gottman, J. M. (2007) and Lindahl and colleagues (2017). LE, Low emotion; HE, High emotion. Cohen's kappa index was calculated for categories with intra-group variablity higher than 15% (indicated in bold).

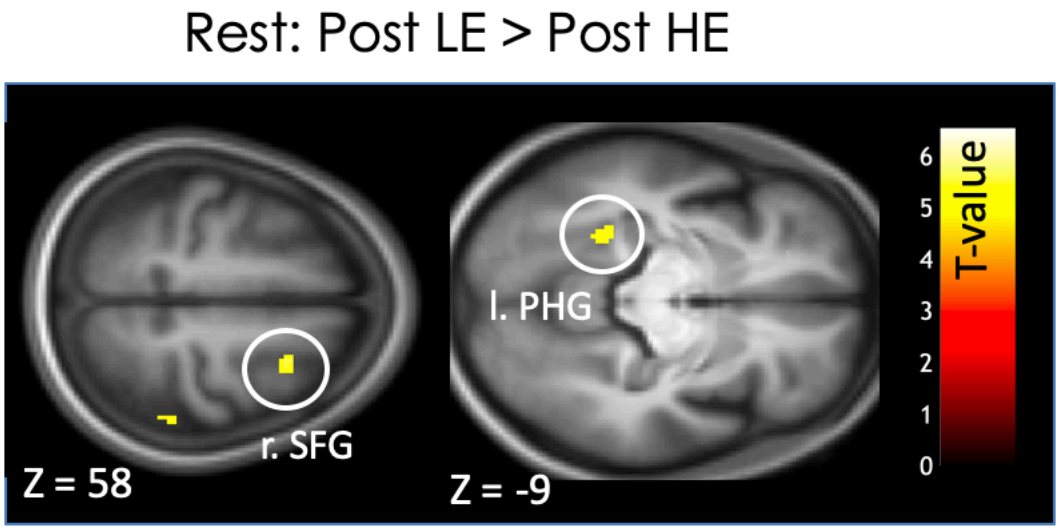
Supplementary Table 3. Regions significantly activated during the SoVT-Rest (videos and rest periods)

Region	Hemisphere	MNI peak coordinates			T-score	P(FWE-corr)	k
		x	*y*	*z*			
Rest > Videos							
Angular gyrus / IPL	R	52	-58	44	24.36	<0.0001	744
	L	-50	-58	46	21.66	<0.0001	1148
Supramarginal gyrus (SMG)	L	-58	-44	42	11.88	<0.0001	
Middle cingulate cortex (MCC)	R	4	-24	28	16.39	<0.0001	2689
Anterior cingulate cortex (ACC) / Medial prefrontal cortex (MPFC)	L	-10	38	8	14.57	<0.0001	6060
Precuneus / Posterior cingulate cc	L	-8	-68	38	12.96	<0.0001	231
	R	10	-64	38	10.22	<0.0001	192
Posterior insula (PI) / Central operculum	R	44	-16	14	9.43	<0.0001	1349
Central operculum	L	-54	-4	12	8.69	<0.0001	365
Posterior insula (PI)	L	-40	-18	18	6.80	<0.0001	86
Anterior insula (AI)	R	36	10	10	7.84	<0.0001	125
	L	-34	8	10	6.41	<0.0001	39
Supperior motor cortex		0	-12	64	6.37	<0.0001	201
Caudate	L	-16	20	0	6.27	<0.0001	49
Postcentral gyrus	R	42	-18	48	5.69	<0.0001	47
	L	-38	-22	48	5.49	<0.0001	24
Videos: HE > LE							
Inferior occipital gyrus (IFG)	R	48	-70	2	9.73	<0.0001	1185
Lingual gyrus	L	-6	-66	2	9.46	<0.0001	11161
Superior parietal lobule	R	30	-44	56	8.35	<0.0001	952
Anterior insula (AI)	L	-34	8	2	5.44	<0.0001	887
	R	38	10	4	5.75	<0.0001	1046
Caudate (Ventral striatum, VS)	R	10	2	2	6.15	<0.0001	
Anterior cingulate cortex (ACC)	L	-4	24	18	7.51	<0.0001	589
Superior frontal gyrus (SFG)	L	-18	52	26	6.51	<0.001	132
Tempor- parietal jonction (TPJ)	L	-50	-22	18	5.90	<0.001	119
Posterior cingulate cortex (PCC)		-2	-40	22	5.86	<0.0001	348
Middle cingulate cortex (MCC)		-6	-10	36	5.78	<0.001	140
Middle frontal gyrus (MFG)	R	36	4	58	5.55	<0.0001	349
Rest: Post HE > Post LE							
Precuneus	L	-8	-52	34	8.21	<0.0001	1089
Posterior cingulate cortex (PCC)		-12	-46	24	6.44		
Anterior cingulate cortex (ACC)		-8	40	18	7.43	<0.0001	1180
Superior frontal gyrus (SFG) / Medial prefrontal cortex (MPFC)		6	52	20	6.89	<0.0001	
Superior tempral gyrus (STG)	R	50	-32	-2	8.49	<0.0001	764
	L	-60	-22	0	6.10	<0.001	117
Supramarginal gyrus (SMG)	L	-52	-46	22	7.35	<0.0001	532
Anterior insula (AI)	R	30	20	-12	5.33	0.01	24
Putamen	L	-30	2	-12	5.12	0.002	64
Amygdala	R	22	-8	-12	4.67	0.03	3
Hippocampus	R	22	-12	-10	4.59	0.03	5
Rest: Post LE > Post HE							
Superior frontal gyrus (SFG)	L	-20	-4	74	5.81	0.01	21
Superior/middle frontal gyrus (SFC	R	28	12	58	5.56	0.002	54
Parahippocampal (PHG)/ Fusiforr	L	-30	-42	-8	5.28	0.006	36
Supramarginal / Sup parietal gyru	R	52	-38	56	5.08	0.02	12
Precental gyrus	R	6	-24	76	5.06	0.02	8

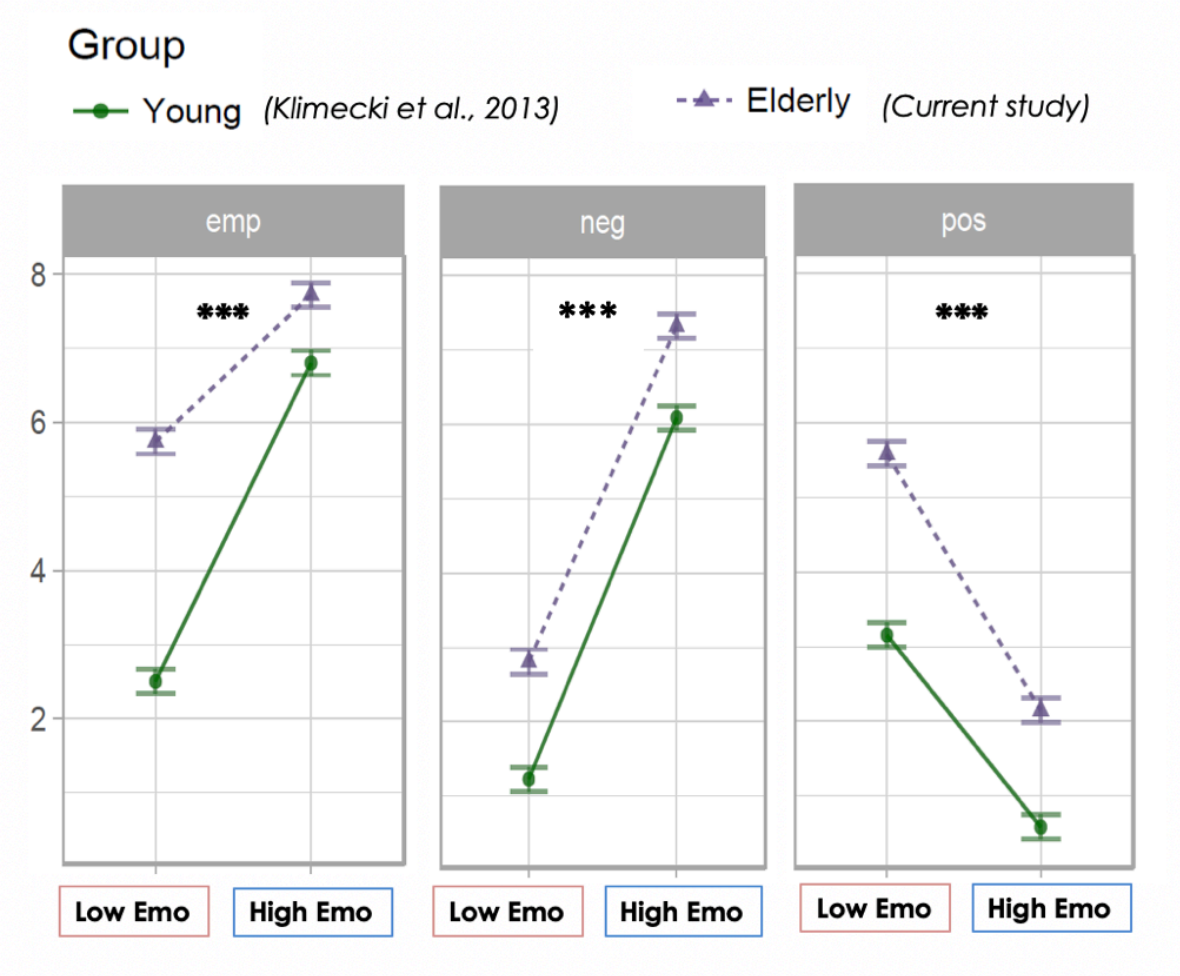
P(FWE-corr) indicates the p value resulting from a whole-brain family-wise error (FWE) correction at a voxel level. LE, Low emotion; HE, High emotion; MNI, Montreal Neurological Institute; k, Cluster size. Regions significantly activated during *Videos > Rest* are not reported in the present table due to the widespread activation of this contrast (see Supplementary Fig. 1).



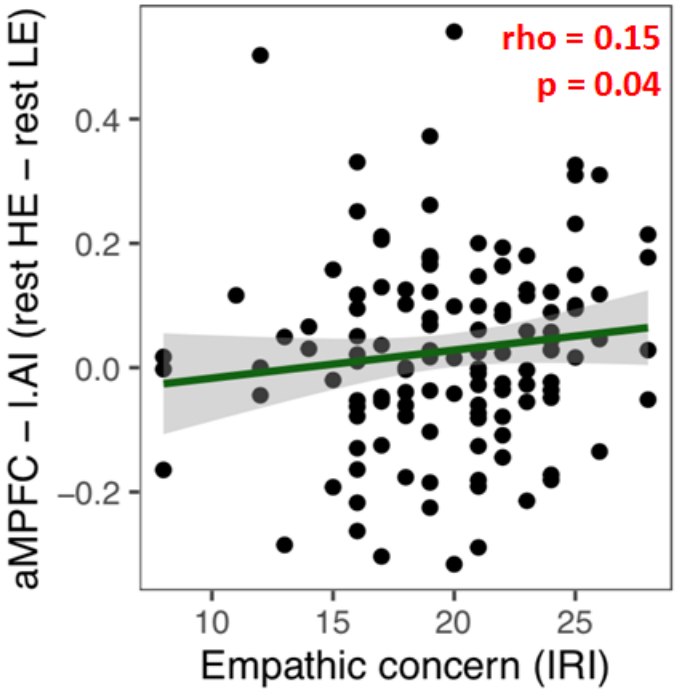
Supplementary Fig. 1. Significant brain activations during the SoVT-Rest task blocks (main effects). Results are reported at $p < 0.05$ FWE-corrected at the voxel level.



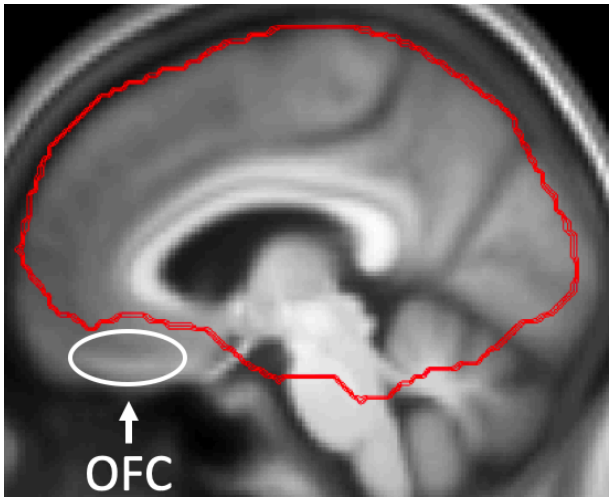
Supplementary Fig. 2. Brain regions with greater activation during rest periods after low emotional videos (rest post LE) in contrast to rest periods after high emotional videos (rest post HE). Results are reported at $p < 0.05$ FWE-corrected at the voxel level. For a full list, see Supplementary Table 2; r.SFG, righ superior frontal gyrus; l.PHG, left parahippocampal gyrus.



Supplementary Fig. 3. Age-related SoVT differences. The young group from Klimecki and colleagues (2013) is shown for comparison (consisting of *N* = 94 young females between 18 and 35 years of age), together with the elderly group from the present study (*N* = 127 older adults). ***= significant group differences $p < 0.001$; emp, empathy; neg, negative; pos, positive self-reports.



Supplementary Fig. 4. Spearman (*rho*) correlation shows that higher functional connectivity between anterior medial prefrontal cortex and left anterior insula during rest periods after HE > LE videos [amPFC-l.AI (rest HE-rest LE)] was positively related to the empathic concern subscale of the IRI. Note that this correlation was relatively weak (*rho* = 0.15, *p* = 0.04, one-tailed).



Supplementary Fig. 5 Group-based mask computed for the second-level GLM analysis. Red line delineates the brain volume ("mask") comprising all voxels included in the group-level analyses after the pre-processing pipeline applied to individual brain images. Voxels outside the red line were not included in the subsequent brain analyses of fMRI data. Note that this removed large parts of the orbitofrontal cortex (OFC) due to magnetic field inhomogeneity. The structural image was created by averaging all T1 images from our 127 participants.

Supplementary References

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