SUPPLEMENTARY INFORMATION

fMRI pre-processing

Preprocessing of fMRI data was performed using AFNI (v7.12; http://afni.nimh.nih.gov/afni). Anatomical images were spatially transformed to the AFNI standard Talairach space (TT\_N27\_SSW.nii.gz) using the @SSwarper function. Preprocessing of the three runs of task were analyzed together using afni\_proc.py.

Multi-echo data were combined using the tedana method (Kundu et al., 2012). The first two volumes of each voxel’s time course were excluded from analysis to allow the fMRI signal to reach steady state. We set motion limit at 0.3 and identifying volumes with more than 10% of outliers as defined with 3dToutcount tool in AFNI in a censor file to be used subsequently in the regression analysis. Motion correction and spatial transformation were implemented in a single image transformation. The EPI data were smoothed using a 4 mm full-width at half-maximum Gaussian kernel and using the in-mask option.

Maps for each condition and subject were created using the following script:

*preprocess\_taskFMRI\_02b\_TT27.sh*

*#!/usr/bin/bash*

*#preprocess\_taskFMRI\_02b\_TT27.sh*

*#interoception project, 07N0190*

*#uses afni\_proc.py to preprocess the task sequences (and SSwarper to prepare mprage for afni\_proc.py)*

*#this is an alternate version that uses the TT27 template instead of the MNI template*

*export OMP\_NUM\_THREADS=16*

*dataDir=/raids/newhmcsraid2/07N0190\_FMD/interoception/data*

*outDir=/raids/newhmcsraid2/07N0190\_FMD/interoception/data\_proc*

*scriptDir=/raids/newhmcsraid2/07N0190\_FMD/interoception/scripts*

*template=/usr/local/afni/TT\_N27\_SSW.nii.gz*

*echoes="14.5 32.3 50.1"*

*mkdir ${outDir}*

*#for sj in FMD0001 FMD0002 FMD0003 FMD0004 FMD0005 FMD0006 FMD0007 FMD0008 FMD0009 FMD0010 FMD0011 FMD0012 FMD0013 FMD0014 FMD0015 FMD0016 HV0002 HV0004 HV0007 HV0008 HV0009 HV0010 HV0011*

*for sj in HV0001 HV0014 HV0015*

*do*

 *mkdir ${outDir}/${sj}*

 *echo Sourcing data from ${dataDir}/${sj}*

 *echo Saving results to ${outDir}/${sj}*

 *if [ -f ${outDir}/${sj}/mprage\_TT27/anatQQ.mprage.nii ]; then*

 *echo "SSwarper already run"*

 *else*

 *mkdir ${outDir}/${sj}/mprage\_TT27*

 *echo Running SSwarper for ${sj}*

 */raids/hmcsraid3/parker/@SSwarper -input ${dataDir}/${sj}/mprage/mprage.nii -base ${template} -subid mprage -omp 16 -odir ${outDir}/${sj}/mprage\_TT27*

 *fi*

 *#preprocess all task runs together*

 *echo Running afni\_proc.py for ${sj} all task runs*

 *mkdir ${outDir}/${sj}/task\_TT27*

 *cd ${outDir}/${sj}/task\_TT27*

 *afni\_proc.py -subj\_id task\_TT27 \*

 *-blocks despike tshift align tlrc volreg mask combine blur scale regress \*

 *-copy\_anat ${outDir}/${sj}/mprage\_TT27/anatSS.mprage.nii \*

 *-anat\_has\_skull no \*

 *-dsets\_me\_run ${dataDir}/${sj}/taskA/e\*.nii \*

 *-dsets\_me\_run ${dataDir}/${sj}/taskB/e\*.nii \*

 *-dsets\_me\_run ${dataDir}/${sj}/taskC/e\*.nii \*

 *-echo\_times ${echoes} \*

 *-reg\_echo 2 \*

 *-tcat\_remove\_first\_trs 2 \*

 *-align\_opts\_aea -cost lpc+ZZ \*

 *-tlrc\_base ${template} \*

 *-tlrc\_NL\_warp \*

 *-tlrc\_NL\_warped\_dsets \*

 *${outDir}/${sj}/mprage\_TT27/anatQQ.mprage.nii \*

 *${outDir}/${sj}/mprage\_TT27/anatQQ.mprage.aff12.1D \*

 *${outDir}/${sj}/mprage\_TT27/anatQQ.mprage\_WARP.nii \*

 *-volreg\_align\_to MIN\_OUTLIER \*

 *-volreg\_align\_e2a \*

 *-volreg\_tlrc\_warp \*

 *-mask\_epi\_anat yes \*

 *-combine\_method tedana \*

 *-combine\_tedort\_reject\_midk no \*

 *-blur\_size 4 \*

 *-blur\_in\_mask yes \*

 *-regress\_motion\_per\_run \*

 *-regress\_censor\_motion 0.3 \*

 *-regress\_censor\_outliers 0.1 \*

 *-regress\_apply\_mot\_types demean deriv \*

 *-regress\_est\_blur\_epits \*

 *-regress\_basis 'BLOCK(10,1)' \*

 *-regress\_stim\_times \*

 *${dataDir}/${sj}/stim\_files/body\_stim\_times.txt \*

 *${dataDir}/${sj}/stim\_files/stomach\_stim\_times.txt \*

 *${dataDir}/${sj}/stim\_files/heart\_stim\_times.txt \*

 *${dataDir}/${sj}/stim\_files/target\_stim\_times.txt \*

 *-regress\_stim\_labels body stomach heart target \*

 *-regress\_stim\_times\_offset -5 \*

 *-html\_review\_style basic*

 *python ${scriptDir}/afni\_proc\_mod.py proc.task\_TT27*

 *tcsh -xef proc.task\_TT27\_mod |& tee output.proc.task\_TT27\_mod*

 *cd ${outDir}/${sj}/task\_TT27/task\_TT27.results*

 *python2.7 /usr/local/afni/apqc\_make\_tcsh.py -review\_style basic -subj\_dir . -uvar\_json out.ss\_review\_uvars.json*

 *tcsh @ss\_review\_html |& tee out.review\_html*

 *python2.7 /usr/local/afni/apqc\_make\_html.py -qc\_dir QC\_task\_TT27*

Each interoception condition (heart, stomach, body) was then contrasted against the exteroception (target) and the resulting aps enter for a group analysis using a multivariate model implemented with the AFNI function 3dMVM (Chen et al., 2014) as described in the script *MVM\_Target\_command.txt*.

Script:

*dMVM -prefix MVM\_results\_Target -jobs 24 \*

*-mask Mask3mm.nii \*

*-bsVars Group \*

*-wsVars Stim \*

*-num\_glt 12 \*

*-gltLabel 1 BvsT\_FMD -gltCode 1 'Group : 1\*FMD Stim : 1\*BvsT' \*

*-gltLabel 2 SvsT\_FMD -gltCode 2 'Group : 1\*FMD Stim : 1\*SvsT' \*

*-gltLabel 3 HvsT\_FMD -gltCode 3 'Group : 1\*FMD Stim : 1\*HvsT' \*

*-gltLabel 4 BvsOthers\_FMD -gltCode 4 'Group : 1\*FMD Stim : 1\*BvsT -0.5\*SvsT -0.5\*HvsT' \*

*-gltLabel 5 BvsT\_HV -gltCode 5 'Group : 1\*HV Stim : 1\*BvsT' \*

*-gltLabel 6 SvsT\_HV -gltCode 6 'Group : 1\*HV Stim : 1\*SvsT' \*

*-gltLabel 7 HvsT\_HV -gltCode 7 'Group : 1\*HV Stim : 1\*HvsT' \*

*-gltLabel 8 BvsOthers\_HV -gltCode 8 'Group : 1\*HV Stim : 1\*BvsT -1\*SvsT & 1\*BvsT -1\*HvsT' \*

*-gltLabel 9 BvsT\_FMDvsHV -gltCode 9 'Group : 1\*FMD -1\*HV Stim : 1\*BvsT' \*

*-gltLabel 10 SvsT\_FMDvsHV -gltCode 10 'Group : 1\*FMD -1\*HV Stim : 1\*SvsT' \*

*-gltLabel 11 HvsT\_FMDvsHV -gltCode 11 'Group : 1\*FMD -1\*HV Stim : 1\*HvsT' \*

*-gltLabel 12 BvsOthers\_FMDvsHV -gltCode 12 'Group : 1\*FMD -1\*HV Stim : 1\*BvsT -0.5\*SvsT -0.5\*HvsT' \*

*-num\_glf 2 \*

*-glfLabel 1 BvsT\_interact\_FMDvsHV -glfCode 1 'Group : 1\*FMD & 1\*HV Stim : 1\*BvsT ' \*

*-glfLabel 2 BvsOthers\_interact\_FMDvsHV -glfCode 2 'Group : 1\*FMD & 1\*HV Stim : 1\*BvsT -1\*SvsT & 1\*BvsT -1\*HvsT' \-dataTable \*

*Subj Group Stim InputFile \*

*FMD0001 FMD BvsT FMD0001B\_T\_Bmap.nii \*

*FMD0002 FMD BvsT FMD0002B\_T\_Bmap.nii \*

*FMD0004 FMD BvsT FMD0004B\_T\_Bmap.nii \*

*FMD0005 FMD BvsT FMD0005B\_T\_Bmap.nii \*

*FMD0006 FMD BvsT FMD0006B\_T\_Bmap.nii \*

*FMD0007 FMD BvsT FMD0007B\_T\_Bmap.nii \*

*FMD0008 FMD BvsT FMD0008B\_T\_Bmap.nii \*

*FMD0009 FMD BvsT FMD0009B\_T\_Bmap.nii \*

*FMD0010 FMD BvsT FMD0010B\_T\_Bmap.nii \*

*FMD0011 FMD BvsT FMD0011B\_T\_Bmap.nii \*

*FMD0013 FMD BvsT FMD0013B\_T\_Bmap.nii \*

*FMD0014 FMD BvsT FMD0014B\_T\_Bmap.nii \*

*FMD0016 FMD BvsT FMD0016B\_T\_Bmap.nii \*

*FMD0001 FMD SvsT FMD0001S\_T\_Bmap.nii \*

*FMD0002 FMD SvsT FMD0002S\_T\_Bmap.nii \*

*FMD0004 FMD SvsT FMD0004S\_T\_Bmap.nii \*

*FMD0005 FMD SvsT FMD0005S\_T\_Bmap.nii \*

*FMD0006 FMD SvsT FMD0006S\_T\_Bmap.nii \*

*FMD0007 FMD SvsT FMD0007S\_T\_Bmap.nii \*

*FMD0008 FMD SvsT FMD0008S\_T\_Bmap.nii \*

*FMD0009 FMD SvsT FMD0009S\_T\_Bmap.nii \*

*FMD0010 FMD SvsT FMD0010S\_T\_Bmap.nii \*

*FMD0011 FMD SvsT FMD0011S\_T\_Bmap.nii \*

*FMD0013 FMD SvsT FMD0013S\_T\_Bmap.nii \*

*FMD0014 FMD SvsT FMD0014S\_T\_Bmap.nii \*

*FMD0016 FMD SvsT FMD0016S\_T\_Bmap.nii \*

*FMD0001 FMD HvsT FMD0001H\_T\_Bmap.nii \*

*FMD0002 FMD HvsT FMD0002H\_T\_Bmap.nii \*

*FMD0004 FMD HvsT FMD0004H\_T\_Bmap.nii \*

*FMD0005 FMD HvsT FMD0005H\_T\_Bmap.nii \*

*FMD0006 FMD HvsT FMD0006H\_T\_Bmap.nii \*

*FMD0007 FMD HvsT FMD0007H\_T\_Bmap.nii \*

*FMD0008 FMD HvsT FMD0008H\_T\_Bmap.nii \*

*FMD0009 FMD HvsT FMD0009H\_T\_Bmap.nii \*

*FMD0010 FMD HvsT FMD0010H\_T\_Bmap.nii \*

*FMD0011 FMD HvsT FMD0011H\_T\_Bmap.nii \*

*FMD0013 FMD HvsT FMD0013H\_T\_Bmap.nii \*

*FMD0014 FMD HvsT FMD0014H\_T\_Bmap.nii \*

*FMD0016 FMD HvsT FMD0016H\_T\_Bmap.nii \*

*HV0001 HV BvsT HV0001B\_T\_Bmap.nii \*

*HV0002 HV BvsT HV0002B\_T\_Bmap.nii \*

*HV0004 HV BvsT HV0004B\_T\_Bmap.nii \*

*HV0005 HV BvsT HV0005B\_T\_Bmap.nii \*

*HV0006 HV BvsT HV0006B\_T\_Bmap.nii \*

*HV0007 HV BvsT HV0007B\_T\_Bmap.nii \*

*HV0008 HV BvsT HV0008B\_T\_Bmap.nii \*

*HV0009 HV BvsT HV0009B\_T\_Bmap.nii \*

*HV0010 HV BvsT HV0010B\_T\_Bmap.nii \*

*HV0011 HV BvsT HV0011B\_T\_Bmap.nii \*

*HV0013 HV BvsT HV0013B\_T\_Bmap.nii \*

*HV0014 HV BvsT HV0014B\_T\_Bmap.nii \*

*HV0016 HV BvsT HV0016B\_T\_Bmap.nii \*

*HV0001 HV SvsT HV0001S\_T\_Bmap.nii \*

*HV0002 HV SvsT HV0002S\_T\_Bmap.nii \*

*HV0004 HV SvsT HV0004S\_T\_Bmap.nii \*

*HV0005 HV SvsT HV0005S\_T\_Bmap.nii \*

*HV0006 HV SvsT HV0006S\_T\_Bmap.nii \*

*HV0007 HV SvsT HV0007S\_T\_Bmap.nii \*

*HV0008 HV SvsT HV0008S\_T\_Bmap.nii \*

*HV0009 HV SvsT HV0009S\_T\_Bmap.nii \*

*HV0010 HV SvsT HV0010S\_T\_Bmap.nii \*

*HV0011 HV SvsT HV0011S\_T\_Bmap.nii \*

*HV0013 HV SvsT HV0013S\_T\_Bmap.nii \*

*HV0014 HV SvsT HV0014S\_T\_Bmap.nii \*

*HV0016 HV SvsT HV0016S\_T\_Bmap.nii \*

*HV0001 HV HvsT HV0001H\_T\_Bmap.nii \*

*HV0002 HV HvsT HV0002H\_T\_Bmap.nii \*

*HV0004 HV HvsT HV0004H\_T\_Bmap.nii \*

*HV0005 HV HvsT HV0005H\_T\_Bmap.nii \*

*HV0006 HV HvsT HV0006H\_T\_Bmap.nii \*

*HV0007 HV HvsT HV0007H\_T\_Bmap.nii \*

*HV0008 HV HvsT HV0008H\_T\_Bmap.nii \*

*HV0009 HV HvsT HV0009H\_T\_Bmap.nii \*

*HV0010 HV HvsT HV0010H\_T\_Bmap.nii \*

*HV0011 HV HvsT HV0011H\_T\_Bmap.nii \*

*HV0013 HV HvsT HV0013H\_T\_Bmap.nii \*

*HV0014 HV HvsT HV0014H\_T\_Bmap.nii \*

*HV0016 HV HvsT HV0016H\_T\_Bmap.nii*

**Supplementary Table 1.** Group-differences in the Multidimensional Scale of Interoceptive Awareness (MAIA) subscale scores between patients with FMD and healthy controls

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AttnRegulation= attention regulation; EMAwareness = emotional awareness

**References**

Kundu, P., Inati, S. J., Evans, J. W., Luh, W.-M., & Bandettini, P. A. (2012). Differentiating BOLD and non-BOLD signals in fMRI time series using multi-echo EPI. Neuroimage, 60(3), 1759–1770. https://doi.org/10.1016/j.neuroimage.2011.12.028

Chen G, Adleman NE, Saad ZS, Leibenluft E, Cox RW. Applications of multivariate modeling to neuroimaging group analysis: a comprehensive alternative to univariate general linear model. Neuroimage. 2014 Oct 1;99:571-88. doi: 10.1016/j.neuroimage.2014.06.027