Online Supplemental Materials
Narcissists' social pain seen only in the brain
Christopher N. Cascio, Sara Konrath, & Emily B. Falk

Methods
fMRI data analysis
Functional data were pre-processed and analyzed using Statistical Parametric Mapping (SPM8, Wellcome Department of Cognitive Neurology, Institute of Neurology, London, UK). To allow for the stabilization of the BOLD signal, the first four volumes (eight seconds) of each run were discarded prior to analysis. Functional images were despiked using the 3dDespike program as implemented in the AFNI toolbox. Next, data were corrected for differences in the time of slice acquisition using sinc interpolation; the first slice served as the reference slice. Data were then spatially realigned to the first functional image. We then co-registered the functional and structural images using a two-stage procedure. First, in-plane T1 images were registered to the mean functional image. Next, high-resolution T1 images were registered to the in-plane image. After coregistration, high-resolution structural images were skull-stripped using the VBM8 toolbox for SPM (http://dbm.neuro.uni-jena.de/vbm), and then normalized to the skull-stripped MNI template provided by FSL ("MNI152_T1_1mm_brain.nii"). Finally, functional images were smoothed using a Gaussian kernel (8 mm FWHM).

Data were modeled using the general linear model as implemented in SPM8. Three phases of cyberball (inclusion, exclusion, visual tracking) were modeled as blocks and convolved with the synthetic hemodynamic response as provided by SPM8. The six rigid-body translation and rotation parameters derived from spatial realignment were also included as nuisance regressors. Data were high-pass filtered with a cutoff of 128 s. Volumes were weighted according to the inverse of their noise variance using the robust weighted least squares toolbox (Diedrichsen, Hashambhoy, Rane, & Shadmehr, 2005).

Regions of Interest (ROIs)
Anatomical regions of interest (ROIs) were constructed in Wake Forest University Pickatlas toolbox within SPM (Maldjian, Laurienti, Kraft, & Burdette, 2003), combining gross definitions from the Automated Anatomical Labeling Atlas (AAL; (Tzourio-Mazoyer et al., 2002), Brodmann areas, and manual tracing, intersected with x,y,z bounds as noted below to restrict sub-regions.

Social pain network: The hypothesized social pain network was constructed to include bilateral anterior insula, the subgenual cingulate cortex, and the dorsal anterior cingulate cortex.

Anterior insula: The anterior insula ROI was defined as all voxels within the left and right insula masks provided by PickAtlas that were anterior to the y=0 plane.

Dorsal ACC: The dACC ROI was defined as the union of Brodmann areas 24 and 32 (dilated to 2mm), as well as the anterior, middle, and posterior cingulate masks from the AAL atlas. We then subtracted Brodmann areas 8 and 9 from this mask. Finally, we restricted this ROI to the voxels bounded by (x=-16 to 16, y=0 to 33, and z=6 to 52).

Subgenual ACC: The subgenual ACC ROI was manually traced to include regions of the cingulate and paracingulate cortices ventral to the body of the corpus callosum and posterior to the genu.

Results
Whole brain analyses

Whole brain analysis of exclusion experience during Cyberball (exclusion > inclusion) regressed onto narcissistic personality inventory scores. Results were thresholded at $p=.005$, $K=36$, corresponding to $p<.05$, corrected, based on a Monte Carlo Simulation implemented using AlphaSim in the software package AFNI (Ward, 2000).

Region	*x*	*y*	*z*	*K*	*t*
dACC	1	43	19	50	3.14
Insula Cortex (right)	35	-22	-5	39	3.55
subACC/MPFC	-6	50	-14	113	3.78
Inferior Frontal Gyrus (right)	35	29	1	48	3.22
Temporoparital Junction (right)	39	-50	25	163	3.72
SMA (right)	8	22	52	1193	4.12
Fusiform (right)	42	-57	-23	48	3.82

Whole brain analysis of neural regions associated with the main effect of exclusion > inclusion during Cyberball, thresholded at $p<.005$, $K=36$ (Falk, Cascio, O'Donnell, Carp, Tinney, Bingham, Shope, Ouimet, Pradhan, Simons-Morton, in press).

Region	*x*	*y*	*z*	*K*	*t*
Anterior Insula (Right)	25	19	-11	971	4.92
Anterior Insula (Left)	-23	19	-11	-	4.89
SubACC	1	26	-2	-	4.79
DMPFC	-2	67	28	-	4.07
Cuneus (Right)	15	-98	25	48	3.92
MTG (Left)	-57	-30	-8	342	5.2

Outlier analysis

When examining the correlation between NPI scores and social pain network activation, we noticed a potential outlier. Therefore, results were reanalyzed with the participant in question removed. The additional analysis yielded consistent findings after the potential outlier was removed, with the correlation examining the relationship between the social pain NOI (AI, dACC, and subACC) and NPI scores remaining of a similar magnitude ($r=.34$, $p=.037$, $CI=[.04$, .54]). Thus, the results remained consistent with previous findings, such that participants who reported higher levels of narcissism also had higher activation in the social pain network during social exclusion compared to baseline inclusion activations. In addition, further investigation established that the NOI estimates for the individual in question were driven by the dACC sub-region. Therefore, results for the dACC sub-region were reanalyzed with the participant in

question removed. The additional analysis revealed that findings within the dACC sub-region remained significant when this individual was excluded (r=.33, p=.044). Results from the whole brain analysis further suggest that sub clusters within each hypothesized social pain ROI are robustly associated with NPI scores.