Supporting Information

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SI Methods

Inclusion Criteria. All participants met the following inclusion criteria: (*i*) fluent in English: (*ii*) free of any serious mental or physical health problems; (*iii*) not taking any prescription mental health-related or pain medications; (iv) right-handed; (*v*) had no conditions that prevented scanning (e.g., a pacemaker, claustrophobia); (vi) had been in a committed, romantic relationship with a boyfriend/husband for at least 6 mo; and (*vii*) rated their partner as a significant source of social support, with a score of at least 7 on a scale from 1 (not a source of support) to 10 (a tremendous source of social support).

Determining Pain Thresholds. Pain thresholds were determined by a female experimenter who delivered the 6-s heat stimulations (to two different locations on the volar surface of the participant's left forearm) via a 9-cm^2 computer-controlled Peltier-type thermode (TSA-II; Medoc Inc.). Pain thresholds were computed using a double random staircase algorithm (DRS) (1). The DRS procedure selects each stimulus temperature based on a participant's previous responses; if the previous response is above the chosen threshold, the next stimulus for that staircase is lowered, and if the rating is below the threshold, the next stimulus is increased. Stimuli from two staircases (with starting temperatures of 37 °C and 40 °C) were presented pseudorandomly to mask the rating–stimulus intensity relationship within a staircase. Stimulus temperatures on subsequent trials within a staircase were increased or decreased by increments between 1.6 °C and 0.2 °C, with smaller changes when the staircase crossed the threshold or reversed direction. Stimuli were delivered until the staircases converged on a temperature that evoked a "10" rating.

In addition, the experimenter explained to the participant that "there are two different aspects of discomfort that people usually feel in response to the heat stimulations—one is how intense or strong the heat stimulation feels, and the other is how unpleasant or disturbing it is." Participants were told that the present study was concerned with this second aspect of discomfort and that they should make their ratings based on how distressing or unpleasant they found the heat stimulations to be.

Functional MRI Scanning Parameters. Data were acquired on a 1.5-T Sonata MRI scanner (Siemens). A standard radiofrequency head coil was used in all scans. Head movements were restrained with foam padding and surgical tape placed across the participant's forehead. An initial three-plane localization scan was conducted to ensure proper placement in the magnet. Then brief shimming and sagittal scans were taken to aid in slice alignment and selection for the coplanar T2-weighted image with 1.5-mm in-plane resolution. This T2 anatomical scan was conducted using a set of high-resolution echo-planar image (EPI) localizers (TR/TE 5,000/33 ms, 32 slices (3 mm with a 1-mm gap), 128 × 128 matrix, and 200-mm field of view) in the same plane (aligned anterior commissure–posterior commissure) used for the functional scans. The high-resolution scans had readout bandwidth along the phase-encoding direction identical to the functional runs, such that the B0-related distortions were identical. The slices used for the functional runs were identical to those of the T2-weighted anatomical image. The functional run used an EPI sequence acquiring thirty-two 3-mm slices using a TR/TE of 2,000 ms/25 ms, and a flip angle of 90°. Stimuli were presented via an MRI-compatible miniature liquid crystal display-based goggles system (Resonance Technology).

Functional MRI Task Design. During the scanning session, participants received heat stimulations while viewing pictures of (*i*) their partner, (*ii*) a male stranger (roughly matched to the partner's age, height, and weight), or (*iii*) an object (a picture of a chair). In addition, participants received heat stimulations while viewing a fixation crosshair; results from these trials are not included here. Participants completed three functional runs with counterbalanced orders of these conditions. Each run lasted 6 min and 54 s and contained four 80-s blocks; one of the study conditions was presented continuously for the 80-s block, and each condition was presented once per run. The presentation of the study conditions consisted of the four photographs appearing for 2 s at a time. The pain-rating scale remained on the screen during each of these blocks. Each run also contained 18 s of fixation following each block and an initial 22 s of fixation at the beginning of each functional run.

Region of Interest Analyses. Structural regions of interest (ROIs) of the dorsal anterior cingulate cortex (dACC) and bilateral anterior insula were created using the automated anatomical atlas (2). The dACC ROI used a rostral boundary of $y = +32$ and a caudal boundary of $y = 0$ based on summary data indicating that the majority of physical pain-study activations fall between these two demarcations (3). The anterior insula used a caudal boundary of $y = +8$, corresponding to the agranular insula (4).

1. Gracely RH, Lota L, Walter DJ, Dubner R (1988) A multiple random staircase method of psychophysical pain assessment. *Pain* 32:55–63.
2. Tzourio-Mazoyer N, et al. (2002) Automated anatomical labeling of activations in SPM using a macroscopic anatomical parcellation of the MNI MRI single-subject brain. *Neuroimage* 15:273–289.
3. Vogt BA, Berger GR, Derbyshire SWG (2003) Structural and functional dichotomy of human midcingulate cortex. *Eur J Neurosci* 18:3134–3144.
4. Ongür D, Ferry AT, Price JL (2003) Architectonic subdivision of the human orbital and medial prefrontal cortex. *J Comp Neurol* 460:425–449.x