Supplemental Information

Methods and Materials

Behavioral and Self-Report Measures of Cognitive Control

Go/No-Go Task

Participants completed a standard Go/No-Go task on the computer (1) using Direct RT software (Empirisoft, New York, NY, USA). Participants' task was to press the space bar to the "go" signal (green circle) and withhold response to the "no-go" signal (red octagon). There were more "go" than "no-go" trials (73% vs. 27%) and context of the "no-go" signal was manipulated such that each "no-go" trial was preceded by 1, 3, or 5 "go" trials. As the number of preceding "go" trials increases, more cognitive control is needed to inhibit response to the "no-go" signal. Each trial started with a fixation cross (2000 ms), then the go/no-go signal (i.e., the green circle or red octagon) was presented for 350 ms with an additional 25 ms of response window. Each trial was preceded by an inter-stimulus interval of 1000 ms (total trial length = 1350 ms or 1375 if no response was made). Instructions emphasized both speed and accuracy. Participants received a message ("Wrong") if they erroneously pressed the space bar in response to a "no-go" trial or failed to respond to a "go" trial. Failure to press the space bar to a "go" signal resulted in a message "Please try to respond faster." Both messages remained on the screen for 1500 ms. Participant's behavioral inhibition score was calculated as the percent of accurate inhibition to the 20 difficult "no-go" trials, defined as "no-go" trials that were preceded by 3 or 5 "go" trials. The average accuracy for our sample was 89% (11) with a range of 50 – 100%.

Barratt Impulsivity Scale

The Barratt Impulsivity Scale version 11 (BIS-11) is a 30 item self-report measure of impulsivity (2). Participants rate the extent to which items accurately describe them on a 4 point scale (1 = rarely/never to 4 = almost always/always). Higher scores indicate more impulsive behavior. Typical items include: "I act on impulse;" "I say things without thinking;" "I am self-controlled" (reverse scored); and "I plan trips carefully" (reverse scored). The average sum score for our sample was 64.2 (7.8) with a range of 52 – 82. These scores are similar to those previously found for healthy adults (2, 3).

Attentional Control

Participants completed a 12-item short version (4) of the Attentional Control Scale (5). This scale assesses the ability to voluntarily focus and switch attention on a 4 point scale (1 = rarely/never to 4 = almost always/always). Typical items include: "I can quickly switch from one task to another;" "When trying to focus my attention on something, I have difficulty blocking out distracting thoughts" (reverse coded); "When I need to concentrate and solve a problem, I have trouble focusing my attention" (reverse coded); and "It's very hard for me to concentrate on a difficult task when there are noises around" (reverse coded). We computed each participant's average rating out of 12 items. The mean for our sample was 2.8 (.32) with a range of 2.2 – 3.6.

Measures of Relationship Quality

Relationship Closeness

Closeness was assessed by a one-item graphical measure that captures the extent of perceived overlap of self with the partner represented as spatially overlapping circles on a 7-point scale (6) [X = 5.66, SD = 1.11].

Relationship Commitment

Commitment was assessed by a one-item question where participants indicated their responses on a 7-point scale (1: not committed to 7: very committed) on the following item: "How committed are you to the relationship?"[X = 6.59, SD = .78].

fMRI Data Acquisition

Images were acquired on a 4T Varian INOVA MR scanner (Palo Alto, CA, USA). E-Prime software (PST, Pittsburgh, PA, USA) displayed the stimuli and recorded responses. Acquisition parameters optimized the signal in regions susceptible to drop-out due to magnetic field inhomogeneity; each volume included 40, 3.5 mm thick coronal slices, .5 mm inter-slice gap, with superior – inferior phase encode direction. Blood-oxygenation dependent (BOLD) signal was acquired with a one-shot T2* weighted echo-planar image (EPI) sequence [TR = 2000 ms, TE = 28 ms, FOV = 22.4 cm^2, matrix size = 64 x 64] with voxel size 3.5 x 3.5 x 4 mm. A high-resolution 3D T1-weighted structural scan (MPFLASH) and an in-plane low resolution T2-weighted structural scan (GEMS) were acquired for anatomical localization.

fMRI Data Processing and Analysis

fMRI data was processed and analyzed using SPM2 software. All participants moved less than 3 mm peak-to-peak within a run. Each EPI volume was realigned to the first scan, re-sliced to the axial plane, and smoothed 8 mm (FWHM). The general linear model (GLM) was built and estimated. Contrast images of the difference between neural activity for each comparison were co-registered to the individual subject's co-planar (GEMS) and high resolution (MPFLASH) anatomical images, resliced to 2 x 2 x 2 mm

isotropic voxels, and normalized to the Montreal Neurological Institute (MNI) atlas space.

The hemodynamic response was modeled with a boxcar function from the onset of the condition block (24 second duration) and convolved with the canonical hemodynamic response function. Brain activity was high-pass filtered at 200 s, scaled by the global mean, and corrected for serial autocorrelation. Contrast images were created by computing the difference in neural activity between two trial types (e.g., Partner Negative vs. Partner Neutral). These contrast images were submitted to a one sample *t*-test across subjects in order to identify regions that were significant at the group level. This whole-brain, random-effects analysis was thresholded at $t(26) = 3.4$, $p < .001$ (uncorrected). Significant activation was corrected for multiple comparisons within the anatomically defined LPFC region (see Figure 1) using the Small Volume Correction tool. Individual participant's level of neural activity from each significant LPFC cluster was extracted with MarsBaR toolbox. This individual measure of neural activity was used as a predictor in the hierarchical linear modeling analysis with the daily-diary data.

Detailed Methods for Daily-Diary Analyses

The diary data involved a hierarchical structure where participants were nested within couples, and days of assessment were nested within participants. For each couple, this structure represented a two-level model and required the simultaneous analysis of within-person and between-person levels that are hierarchically organized. Therefore, the analyses were conducted using the mixed procedure in the SAS statistical package (SAS Institute, Cary, NC, USA), which is based on a hierarchical linear modeling (HLM) approach, and permits the simultaneous analysis of within- and between-person variation

(7).

For each member of a couple, the lower level *within-person* analysis was used to generate independent estimates of a person's average level of a dependent variable over the diary period (e.g., average level of mood across 21-days) and estimates of the relationship among daily constructs for each person (e.g., the relationship between occurrence of conflict and mood at the daily level). The higher-level *between-person* analyses were then used to examine whether these within-person processes were a function of between subjects variables, such as differences in LPFC activation. Thus, for example, we were able to examine whether the relationship between variables measured at the daily level (i.e., relation between having a conflict and mood) differed as a function of individual differences in LPFC activation. Additionally, to make use of the longitudinal nature of the data and more directly explore causal direction of effects with respect to this question, we focused on associations with a 1-day lag (e.g., today's mood following yesterday's conflict). We assessed whether the effect of the *previous* day's conflict on *change* in the level of mood from the previous day was contingent on the between-subject predictor, LPFC activity, by including the lagged value of mood in the model and therefore controlling for any effect of previous day's mood on today's mood. In addition, centered scores of trait neuroticism were entered as a covariate in all analyses in order to control for individual differences in heightened sensitivity to negative affect (8).

These analyses assumed an error structure allowing for contemporaneous (same-day) dependence between the errors within a couple and a first order autoregressive structure within a person in a couple. In addition, variances were allowed to differ

between males and females. In preliminary analyses we found no differences in the pattern of the results with gender, therefore, this variable will not be discussed further. For all analyses reported, continuous variables were centered on their group means and simple slopes for high and low groups were tested at 1 SD above and below each centered mean (9).

Correlation Between Neural Activity and Affect Ratings During the fMRI task

After extracting the contrast values from each contrast of interest, we investigated the relationship between LPFC activity in each contrast and affect ratings (1 = very negative to 4 = very positive) of those stimuli in the scanner. Difference scores of the affect ratings for each contrast of interest (e.g., affect ratings for Partner Negative – Partner Neutral pictures) were computed. We then investigated whether there was a correlation between the difference in affect rating and LPFC activity for each contrast. Results were not consistent and only one significant correlation emerged: affect ratings for Partner Positive – Partner Neutral pictures were negatively correlated with left VLPFC activity for Partner Positive versus Partner Neutral pictures [$r(25) = -.44$, $p<.05$], such that less positive feelings toward positive pictures was related to more left VLPFC activity.

Additional Analyses on the Relationship Between LPFC Activity and Daily Mood and Behavior in the Diary

As described in the main text, we investigated whether LPFC activity from each contrast significantly interacted with conflict occurrence to predict change in negative mood and behavior. When the interaction term was significant, follow-up analyses were conducted to examine the slope of VLPFC activation in predicting mood and behavior

(i.e., the association between VLPFC activity and each outcome variable) separately for days following the ***occurrence*** and ***absence*** of conflicts (as described in the main text). To supplement these findings, we ran additional follow-up analyses to examine the slope of conflict in predicting mood and behavior (i.e., the association between occurrence of conflicts and mood and behavior) separately for participants with ***low*** and ***high*** VLPFC activity. (Low and high VLPFC activity is defined as 1 SD below or above the group mean). The results from these analyses are shown in Tables S2 and S3. The analysis of VLPFC activity to Partner Negative vs. Partner Neutral expressions revealed two main findings. First, for individuals with high VLPFC activity, conflict occurrence was associated with a significant *reduction* in overall negative mood and rumination the next day. However, for individuals with low VLPFC activity, conflict ocurrence was unrelated to change in overall negative mood and rumination the next day (See Table S2). In other words, although all participants showed an increase in overall negative mood and rumination on the day of conflict (see Results in main text), individuals with high VLPFC activity significantly *reduced* these elevated levels by the next day, whereas individuals with low VLPFC continued to have elevated levels of overall negative mood and rumination. Second, for those with low VLPFC activity, conflict occurrence was associated with a significant *increase* in substance-use the next day, whereas for those with high VLPFC, conflict occurrence was unrelated to change in substance-use. Finally, the analysis of VLPFC to Partner Positive vs. Partner Neutral expressions revealed one key finding: For those with high VLPFC activity, ocurrence of a conflict was associated with an increase in positive mood the next day; however, for individuals with low

VLPFC activity, conflict occurrence was unrelated to the change in positive mood (see Table S3).

In addition, although DLPFC was not significantly active in the group analysis, we conducted an anatomical region of interest (ROI) analysis to investigate whether individual level of DLPFC activity during our primary contrast of interest [Partner Negative vs. Partner Neutral] interacted with conflict to predict change in mood and behavior. The DLPFC ROI is shown in dark blue in Figure 1. Individual contrast values from the group analysis of Partner Negative vs. Partner Neutral expressions were extracted from the left and right DLPFC. The results are shown in Table S4. Briefly, there was one significant finding: The right DLPFC interacted with conflict to predict change in substance-use, such that lower DLPFC activity was related to higher substance-use the day after conflict. These results indicate that the VLPFC is a more consistent and robust predictor of self-regulation after conflict.

To further verify that the results observed regarding the change in mood and behavior after conflict were not due to individual differences in emotional reactivity, we performed an anatomical ROI analysis on the left and right amygdala. Contrast values for Partner Negative vs. Partner Neutral were extracted from the left and right amygdala. These values were entered as between subject predictors in the HLM. Amygdala activity did not interact with conflict to predict change in mood and behavior (Table S4). These findings provide additional evidence that emotional reactivity (as measured here by amygdala response to negative facial expressions) does not explain the individual differences in mood and behavior after conflict.

Validation of Photo Stimuli for the fMRI Task

After the scan, participants ($N = 25$) returned to the lab on a separate day to rate the "realism" of the stimuli used in the fMRI task. Because the photo-shoot was not a naturalistic environment and participants may have differing ability to pose emotions, the post-scan evaluation was used to verify that the emotional facial expressions viewed in the fMRI task appeared realistic. Each photograph was rated on a scale from 1 to 5 according to how "realistic" the expression was [1 = unrealistic; 5 =extremely realistic]. The results verified that participants perceived the partner and stranger facial expressions as moderately to extremely realistic [Partner Negative mean realism = 3.0 (.9); Partner Positive = 3.6 (.97); Partner Neutral = 4.0 (1.0); Stranger Negative = 2.6 (.8); Stranger Neutral = 3.6 (1.2); Stranger Positive = 2.7 (.63)].

Table S1. Brain regions that showed significant activity for each contrast of interest

Brain Region	**R/L**	**BA**	**Volume Voxels^3**	**MNI Coordinates x, y, z**	**T value**
Partner Negative > Partner Neutral					
Cerebellum	R	N/A	617	40, -54, -28	5.57
Cerebellum	L	N/A	290	-30, -66, -20	4.2
Lateral Orbital Gyrus (LOFC)	L	47	62	-48, 22, -6	4.2
Inferior Frontal Gyrus (VLPFC)*	L	45	12	-44, 28, 16	3.81
Superior Parietal Gyrus	L	7	50	-28, -62, 54	3.82
Dorsal Anterior Cingulate Gyrus (dACC)	L	24	10	-4, 16, 48	3.65
Partner Negative > Stranger Negative					
Inferior Frontal Gyrus (VLPFC)*	R	45	11	44, 38, 4	3.84
Inferior Frontal Gyrus –Operculum	R	44	12	52, 16, 16	3.72
Precentral Gyrus	R	6	6	54, 10, 40	3.68
Stranger Negative > Stranger Neutral					
Cerebellum	R	N/A	1366+	38, -44, -26	8.22
Calcarine	L	18	2439+	-2, -74, 18	7.19
Superior Parietal Lobe	L	40	303+	-40, -46, 54	5.37
Thalamus - Pulvinar	L	N/A	512	-8, -34, 2	5.51
Thalamus – Pulvinar	R	N/A	(512)	2, -30, 4	5.18
Superior Frontal Gyrus	L	6	211	-28, 0, 62	5.24
Lateral Orbital Gyrus (LOFC)	L	47	17	-44, 18, -8	3.91
Cerebellum	L	N/A	19	-34, -44, -32	3.76
Thalamus	L	N/A	24	-16, -18, 2	3.75
Inferior Frontal Gyrus (VLPFC) *	L	45	3	-44, 28, 26	3.54
Parahippocampal Gyrus	L	30	4	-24, -22, -22	3.53
Partner Positive > Partner Neutral					
Inferior Frontal Gyrus (VLPFC)*	L	45	847	-40, 30, 2	5.37
Temporal Pole	L	38	(847)	-56, 16, -16	5.15
Lateral Orbital Gyrus (LOFC)	L	47	(847)	-42, 22, -8	4.8
Inferior Parietal Gyrus	L	40	929	-34, -50, 58	5.29
Cerebellum	R	N/A	1156	38, -52, -26	5.27
Inferior Frontal Gyrus (VLPFC)*	R	45	77	54, 36, 2	4.63
Thalamus – Pulvinar	L	N/A	108	-8, -30, 2	4.58
Thalamus – Pulvinar	R	N/A	(108)	8, -26, 0	4.12
Superior Frontal Gyrus	L	6	239	-28, -6, 66	4.36
Temporal Pole	L	38	15	-36, 24, -30	4.29
Cerebellum	L	N/A	50	-38, -54, -22	4.2
Inferior Occipital Lobe	L	19	11	46, -84, -10	4.15
Superior Parietal Lobe	L	7	181	-12, -66, 58	4.15
Temporal Pole at STG	R	38	77	52, 14, -18	3.89
Anterior Cingulate Cortex	L	24	3	-2, 20, 28	3.65
Supplemental Motor Area	L	6	3	-4, 4, 60	3.54
Medial Superior Frontal Gyrus	L	10	19	-2, 66, 22	3.97

Thalamus	L	N/A	1	-10, -20, 10	3.47
Partner Positive > Stranger Positive					
Temporal Pole	L	21	385	-52, 2, -18	5.92
Temporal Pole	R	21	202	48, 4, -8	4.64
Middle Cingulate Gyrus	L	23	157	-6, -8, 42	4.51
Supplemental Motor Area	R	6	214	8, -12, 76	4.45
Cerebellum	R	N/A	50	32, -52, -42	4.44
Medial Orbital Frontal Cortex	L	11	18	-24, 52, -4	4.16
Precentral Gyrus	R	4	32	46, -18, 46	3.98
Superior Frontal Gyrus	L	6	9	-10, 8, 62	3.74
Inferior Frontal Gyrus (VLPFC)*	L	45	8	-44, 32, 0	3.73
Stranger Positive > Stranger Neutral					
Bilateral Cerebellum		N/A	10288	26, -74, -20	13.4
Superior Parietal Gyrus	L	7	961	-28, -60, 50	5.99
Pulvinar	R	N/A	1066	6, -32,0	5.95
Pulvinar	L	N/A	(1066)	-4,-40, 2	5.46
Inferior Parietal Lobe	L	2/40	138	-48, -34, 46	4.76
Anterior Thalamus	R	N/A	34	14, -4, 12	4.43
Inferior Frontal Gyrus (VLPFC)*	L	45	56	-42, 24, 22	4.22
Middle Occipital Area	L	18	12	-34, -92, 10	3.88
Precentral Gyrus	L	6	24	-26, -14, 76	3.82
Inferior Frontal Gyrus (VLPFC-Anterior/Superior)*	R	45	14	54, 26, 24	3.8
Superior Frontal Gyrus	L	6	20	-28, -2, 64	3.78
Superior Temporal Pole	L	38	15	-48, 18, -28	3.73
Inferior Frontal Gyrus (VLPFC)*	R	45/44	5	44, 22, 26	3.6
Lateral Orbital Gyrus (LOFC)	L	47	2	-42, 22, -2	3.53
Precentral Gyrus	L	44	3	-44, 4, 32	3.51
Supplemental Motor Area	L	32	3	-6, 20, 46	3.46
Partner Neutral> Stranger Neutral					
Fusiform Gyrus	R	37	301	42, -58, -22	5.18
Middle Occipital Gyrus	L	18	245	-20, -88, 2	4.57
Precuneus	L	19/7	200	-14, -64, 34	4.54
Brain Stem		N/A	50	6, -28, -16	4.36
Middle Occipital Gyrus	L	19	51	-42, -80, 0	4.25
Precuneus	R	23	89	20, -60, 30	4.15
Fusiform Gyrus	L	19	58	-44, -62, -16	4.07
Cerebellum	R	N/A	21	20, -78, -16	3.99
Putamen	L	N/A	3	-20, 8, 8	3.51
Lingual Gyrus	R	19	12	42, -80, -18	3.71
Calcarine	R	18	2	20, -92, 4	3.46

R/L: right or left hemisphere; N/A, not applicable; BA, Brodmann's area; STG, superior temporal gyrus.
Voxel size is 2x2x2 mm
* Individual values were extracted from this cluster.
(volume) = The volume of this cluster is combined with the volume of the cluster listed directly above it.
+ Volume is recorded at higher threshold (p<.0001) in order to separate cluster.

Table S2. Results showing the interaction between VLPFC activity in response to Partner Negative vs. Partner Neutral expressions and occurrence of conflicts for daily mood and behavior.

	VLPFC x conflict interaction			Simple slope of activation following no conflict			Simple slope of activation following conflict			Simple slope of conflict for low activation group			Simple slope of conflict for high activation group		
	F	*p*	*b*	*t*	*p*	*b*	*t*	*p*	*b*	*t*	*p*	*b*	*t*	*p*	*b*
Overall Negative Mood	6.31	.02	-.12	-.88	.39	-.02	-2.66	.02	-.12	1.13	.28	.09	-2.27	.04	-.22
Rumination	6.54	.02	-.25	-.34	.74	-.01	-2.72	.02	-.22	1.30	.21	.27	-2.10	.05	-.45
Substance-use	8.45	.01	-.16	-.09	.93	-.00	-2.92	.01	-.16	3.02	.01	.38	-.09	.93	-.00
Negative Mood Only	5.00	.04	-.14	-.41	.69	-.01	-2.08	.05	-.12	1.37	.19	.25	-.90	.38	-.17
Positive Mood Only	6.08	.03	.17	.45	.66	.01	2.61	.02	.19	-1.20	.25	-.18	2.04	.06	.33

Note that the simple slopes of activation on days following the occurrence and absence of conflict are reported in the main text and repeated here for convenience. The simple slopes of conflict for low and high activation groups are reported only in the Supplemental Tables.

Table S3. Results showing the interaction between VLPFC activity in response to Partner Positive vs. Partner Neutral expressions and occurrence of conflicts for daily mood and behavior

	VLPFC x conflict interaction			Simple slope of activation following no conflict			Simple slope of activation following conflict			Simple slope of conflict for low activation group			Simple slope of conflict for high activation group		
	F	*p*	*b*	*t*	*p*	*b*	*t*	*p*	*b*	*t*	*p*	*b*	*t*	*p*	*b*
Overall Negative Mood	5.02	.04	-.10	-.16	.87	-.00	-2.40	.03	-.10	2.01	.06	.17	-1.12	.28	-.12
Rumination	2.39	.14	-.13												
Substance-use	3.54	.08	-.13												
Negative Mood Only	.25	.62	-.03												
Positive Mood Only	6.50	.02	.14	-.23	.82	-.01	1.84	.09	.12	-1.21	.24	-.12	2.14	.05	.31

Note that the simple slopes of activation on days following the occurrence and absence of conflict are reported in the main text and repeated here for convenience. The simple slopes of conflict for low and high activation groups are reported only in the Supplemental Tables.

Table S4. Results showing the interaction between DLPFC and amygdala activity and occurrence of conflicts for daily mood and behavior

	Neural Activity x Conflict Interaction		
	F	*p*	*b*
	Left DLPFC		
Overall Negative Mood	.36	.56	-.03
Rumination	.47	.50	.07
Substance-use	.23	.64	-.04
	Right DLPFC		
Overall Negative Mood	3.16	.10	-.01
Rumination	.37	.55	-.04
Substance-use	5.14	.04	-.01
	Left Amygdala		
Overall Negative Mood	.25	.62	.02
Rumination	.66	.43	.06
Substance-use	.02	.88	.01
	Right Amygdala		
Overall Negative Mood	.30	.59	.01
Rumination	.11	.75	.02
Substance-use	.00	.95	.00

1. Durston S, Thomas KM, Worden MS, Yang Y, Casey BJ (2002): The effect of preceding context on inhibition: an event-related fMRI study. *Neuroimage* 16: 449-53.
2. Patton JH, Stanford MS, Barratt ES (1995): Factor structure of the Barratt impulsiveness scale. *J Clin Psychol* 51: 768-74.
3. Cools R, Sheridan M, Jacobs E, D'Esposito M (2007): Impulsive personality predicts dopamine-dependent changes in frontostriatal activity during component processes of working memory. *J Neurosci* 27: 5506-14.
4. Ayduk O, Zayas V, Downey G, Cole AB, Shoda Y, Mischel W (2008): Rejection sensitivity and executive control: joint predictors of borderline personality features. *J Res Pers* 42: 151-168.
5. Derryberry D, Reed MA (2002): Anxiety-related attentional biases and their regulation by attentional control. *J Abnorm Psychol* 111: 225-36.
6. Aron A, Aron EN, Smollan D (1992): Inclusion of other in the self scale and the structure of interpersonal closeness. *J Pers Soc Psychol* 63: 596-612.
7. Kenny DA, Kashy DA, Cook WL (2006): *Dyadic data analysis*. New York: Guilford Press.
8. Costa PT Jr, McCrae RR (1980): Influence of extraversion and neuroticism on subjective well-being: happy and unhappy people. *J Pers Soc Psychol* 38: 668-78.
9. Aiken LS, West SG (1991): *Multiple regression: Testing and interpreting interactions*. Thousand Oaks, CA: Sage Publications, Inc.