Neural Reactivity to Emotional Stimuli Prospectively Predicts the Impact of a Natural Disaster on Psychiatric Symptoms in Children

Supplemental Information

Supplemental Methods

Emotional Interrupt Task

The following pictures from the International Affective Picture System (IAPS; 1) were used in the emotional interrupt task completed at age 9: pleasant images (1463, 1710, 1750, 1811, 2070, 2091, 2092, 2224, 2340, 2345, 2347, 7325, 7330, 7400, 8031, 8200, 8370, 8461, 8496, 8497); neutral images (2514, 2580, 5390,5395, 5500, 5731, 5740, 5900, 7000, 7002, 7009, 7010, 7026, 7038, 7039, 7090, 7100, 7130, 7175, 7190); unpleasant images (1050, 1052, 1200, 1205, 1300, 1304, 1930, 2458, 2691, 2703, 2800, 2811, 2900, 3022, 6190, 6213, 6231, 6510, 6571, 9600).

Supplemental Results

Child Behavior Checklist (CBCL) Subscale Analyses

Exploratory analyses examined the LPP and stress as predictors of each of the eight syndrome scale scores from the post-hurricane CBCL controlling for the same subscale at baseline. The interaction between stress and unpleasant LPP was significant for Rule-Breaking Behavior, b = .02, $t_{(259)}$ = 2.14, p = .03, and Aggressive Behavior, b = .03, $t_{(259)}$ = 2.32, p = .02, such that unpleasant LPP was positively related to symptoms at higher levels of stress. In addition, the interaction between stress and pleasant LPP was significant for Rule-Breaking Behavior, b = -.01, $t_{(259)}$ = -1.95, p = .05, and Aggressive Behavior, b = -.04, $t_{(259)}$ = -2.78, p < .01, and approaching significance for Withdrawn/Depressed, b = -.01, $t_{(259)}$ = -1.92, p = .06, such that pleasant LPP was negatively related to symptoms at higher levels of stress. The main effect of

unpleasant LPP was significant for the Withdrawn/Depressed, b = .02, $t_{(259)}$ = -2.06, p = .04, Social Problems, b = .03, $t_{(259)}$ = 2.06, p = .04, Attention Problems, b = .06, $t_{(259)}$ = 2.55, p = .01, and Thought Problems, b = .04, $t_{(259)}$ = 2.27, p = .02 subscales, with an enhanced unpleasant LPP predicting greater symptoms after the hurricane.

Sex Differences

In order to evaluate whether child sex moderated effects of stress and the LPP on symptoms, we also examined interactions between sex, LPP, and stress. We first computed internalizing and externalizing symptom prediction models with the addition of the 2-way (sex X stress, sex X pleasant LPP, sex X unpleasant LPP) interactions with sex. None of the 2-way interactions reached significance (ps > .08).

Next, we tested the 3-way interactions (sex X stress X pleasant LPP; sex X stress X unpleasant LPP) on internalizing and externalizing disorders, controlling for all 2-way interactions between variables. Only the sex X stress X pleasant LPP interaction on externalizing symptoms reached significance, b = -.06, $t_{(259)}$ = -2.11, p = .04, such that the stress X pleasant LPP was a significant predictor of externalizing symptoms for males, b = -.07, $t_{(140)}$ = -3.30, p < .01, but did not reach significance for females (p = .75), though the main effect of pleasant LPP was a significant predictor for females, b = -.10, $t_{(118)}$ = -2.32, p = .02.

Adjusting for Socioeconomic Status

To account for socioeconomic status, we also examined effects of parent-reported family income from the initial assessment (income data were unavailable for 13 participants). Family income was significantly correlated with internalizing, $r_{(245)}$ = -.18, p < .01, and externalizing symptoms, $r_{(245)}$ = -.18, p < .01, at the initial assessment and following the hurricane, $r_{(245)}$ = -.14, p < .05, and, $r_{(245)}$ = -.19, p < .01, respectively, but was not significantly related to level of hurricane-

related stress (p = .79). When included in overall models with LPP and stress predicting post-hurricane internalizing and externalizing symptoms, income no longer reached significance in predicting internalizing or externalizing symptoms (ps > .13). The stress X unpleasant LPP, b = .04, $t_{(246)}$ = 2.49, p = .01, and stress X pleasant LPP, b = -.05, $t_{(246)}$ = -3.36, p < .001, interactions remained significant predictors of externalizing symptoms even when controlling for income, as did the main effect of unpleasant LPP on internalizing symptoms, b = .10, $t_{(246)}$ = 2.10, p = .04. Results were similar when parental education was included in the model, rather than family income.

Time Between Age 9 Assessment and Hurricane Sandy

Given individual variability in the time between the electroencephalogram assessment at age 9 and Hurricane Sandy, we also computed the models controlling for weeks between the assessments. The stress X unpleasant LPP, b = .04, $t_{(259)}$ = 2.72, p < .001, and stress X pleasant LPP, b = -.05, $t_{(259)}$ = -2.85, p < .01, interactions remained significant predictors of externalizing symptoms even when controlling for income, as did the main effect of unpleasant LPP on internalizing symptoms, b = .09, $t_{(259)}$ = 2.26, p = .03.

LPP at Occipital vs. Parietal Sites

Given evidence of developmental changes in the scalp distribution of the LPP (2), we also evaluated the LPP prediction models separately for the LPP at parietal (P3, P4, and Pz) and occipital (O1, O2, and Oz) sites. The stress X unpleasant LPP at parietal, b = .03, $t_{(259)}$ = 2.48, p = .01, and occipital sites, b = .04, $t_{(259)}$ = 2.72, p < .001, as well as the stress X pleasant LPP at parietal, b = -.05, $t_{(259)}$ = -2.96, p < .01, and occipital sites, b = .03, $t_{(259)}$ = 1.98, p < .05, were significant predictors of externalizing symptoms. For internalizing symptoms, the main effect of unpleasant LPP remained significant at parietal sites, b = .08, $t_{(259)}$ = 1.95, p = .05, and the

unpleasant LPP X stress interaction reached significance at occipital sites, $b = .04$, $t_{(259)} = 2.03$, $p = .04$.

LPP to Neural Images

We also evaluated whether the LPP to neutral images predicted post-hurricane symptoms. None of the effects of neutral LPP were significant alone or in interaction with stress (*p*s > .17), indicating that the LPP to neutral images did not drive significant effects of unpleasant and pleasant LPP on symptoms.

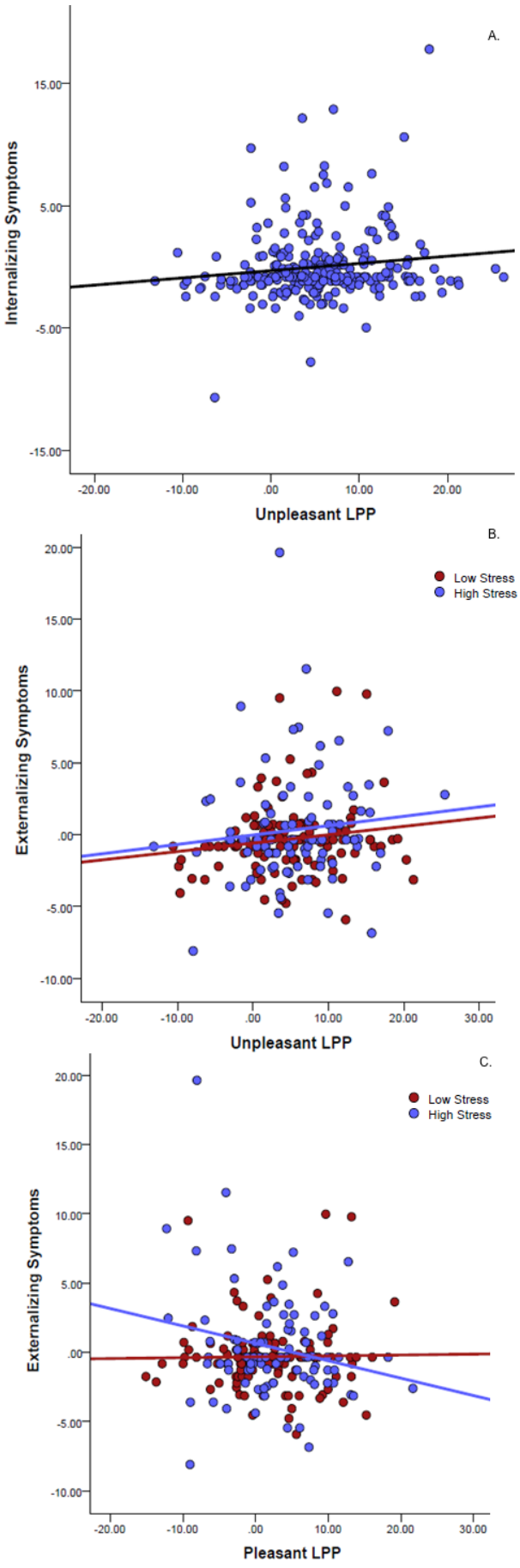

Figure S1. Scatter plots depicting: (**A**) the main effect of unpleasant LPP on internalizing symptoms after the hurricane (unstandardized residuals controlling for symptoms prior to the hurricane), (**B**) effect of unpleasant LPP on externalizing symptoms (unstandardized residuals) for children high (above median) and low (below median) in hurricane-related stress exposure, and (**C**) effect of pleasant LPP on externalizing symptoms (unstandardized residuals) for children high (above median) and low (below median) in hurricane-related stress exposure.

Supplemental References

1. Lang PJ, Bradley MM, Cuthbert BN (2008): *International Affective Picture System (IAPS): Affective ratings of pictures and instructional manual. Technical Report A-8*. University of Florida, Gainesville, FL.

2. Kujawa A, Klein DN, Proudfit GH (2013): Two-year stability of the late positive potential across middle childhood and adolescence. *Biol Psychol*. 94: 290–296.