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BRIEF REPORTS

# Predisaster Trait Anxiety and Negative Affect Predict Posttraumatic Stress in Youths After Hurricane Katrina

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On the basis of theory and previous research, it was hypothesized that predisaster child trait anxiety would predict disaster-related posttraumatic stress symptoms and generalized anxiety disorder symptoms, even after controlling for the number of hurricane exposure events. Results support this hypothesis and further indicate that predisaster negative affect predicted disaster-related posttraumatic stress symptoms and generalized anxiety disorder symptoms. Also, Katrina-related posttraumatic stress disorder symptoms were predicted by the number of hurricane exposure events and sex (being female). Predisaster generalized anxiety disorder symptoms predicted postdisaster generalized anxiety disorder symptoms, and predisaster trait anxiety predicted postdisaster depressive symptoms. Findings are discussed in terms of their relevance for developing interventions to mitigate the impact of disasters in youths.

*Keywords:* posttraumatic stress, trait anxiety, negative affect, disasters

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Hurricane Katrina was a physically and emotionally devastating event, and it has been estimated that it will be the most costly natural disaster in U.S. history (Bacon, 2005). As Katrina made headlines across the United States and abroad, it became apparent that the traumatic stress wrought by the storm would have a substantial effect on the mental health of many survivors. The effect of the devastation on youths' mental health and developmental trajectories over time has been a major concern for researchers and policymakers (Gard & Ruzek, 2006). Research indicates, however, that whereas some youths are severely impaired by exposure to a disaster, others cope much more effectively (La Greca & Silverman, 2006). It is thus important to identify predictors of youths' psychosocial functioning in response to trauma. The present study draws on past research and a unique opportunity to test the viability of predisaster variables for predicting posttraumatic stress (PTS) reactions in youth survivors of Hurricane Katrina.

Research suggests that exposure to natural disasters, such as Hurricane Katrina, is associated with PTS symptoms in youths (e.g., La Greca, Silverman, Vernberg, & Prinstein, 1996; Lonigan, Shannon, Taylor, Finch, & Sallee, 1994; Vernberg, La Greca, Silverman, & Prinstein, 1996). The most commonly investigated symptoms are those associated with the diagnosis of posttraumatic stress disorder (PTSD) and include negative reexperiencing, avoidance, emotional numbing, and hyperarousal (American Psychiatric Association, 1994). In addition to PTSD symptoms, other PTS reactions are common; in particular, symptoms of anxiety (e.g., Lonigan et al., 1994; Yule et al., 2000) as well as symptoms of depression are thought to be common among youths following natural disasters (e.g., Bolton, O'Ryan, Udwin, Boyle, & Yule, 2000; McDermott & Palmer, 2002; Nolen-Hoeksema & Morrow, 1991). Unfortunately, evidence suggests that for many youths these reactions may not be transitory (Yule et al., 2000) and that a substantial number will meet diagnostic criteria for anxiety or depressive disorders over time (see La Greca & Silverman, 2006).

Given the potential negative impact of natural disasters on youths, it is important to identify factors associated with negative outcomes, as such information has the potential to inform prevention efforts. For instance, research suggests that the level of PTS symptoms a child experiences is related to the number of hurricane exposure events the youth experiences (La Greca, Silverman, & Wasserstein, 1998; Silverman & La Greca, 2002). Consequently, those experiencing more frequent and more intense hurricane-related events are more likely to have more severe PTS reactions. However, in addition to the extent of exposure, a number of studies indicate that preexisting propensities for anxiety and other negative affect states also are significant risk factors for postdisaster PTS symptoms (Asarnow et al., 1999; Earls, Smith, Reich, & Jung, 1988; La Greca et al., 1998; Lonigan et al., 1994; Nolen-

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Hoeksema & Morrow, 1991). For example, Lonigan et al. (1994) found that trait anxiety was the strongest predictor of PTS reactions in a large ($N$ = 5,687) sample of youths assessed following Hurricane Hugo. In this study, however, PTS and trait anxiety data were both collected after the storm, and this limits conclusions about predisaster functioning.

The unpredictable nature of most natural disasters makes prospective studies examining predisaster and postdisaster data rare and difficult to conduct. In essence, researchers have to rely on serendipity. For example, a few studies have been able to report on pretrauma psychological functioning because of the chance collection of data before an unexpected disaster. For instance, using a sample of 66 youths (ages 9–19 years) from Los Angeles, Asarnow et al. (1999) found that preexisting anxiety disorders predicted earthquake-related PTS reactions 1 year following the disaster. Earls et al. (1988) found that preexisting anxiety disorders predicted flood-related PTS reactions in their sample of 32 youths from Missouri (ages 6–17 years). Research by Nolen-Hoeksema and Morrow (1991) suggests that predisaster levels of depression, stress symptoms, and ruminations also predict disaster reactions. Taken together, the research points to anxiety and negative affect states as potential predictors of PTS reactions.

Turning specifically to research on youth hurricane survivors, we note that La Greca et al. (1998) represents the only child study that used predisaster data. La Greca and colleagues examined stress reactions in a sample of children (in fourth to sixth grade) assessed 3 ($n$ = 92) and 7 months ($n$ = 74) postdisaster (pretrauma data were collected 15 months prior to Hurricane Andrew's landfall in South Florida) and found that trait anxiety was the strongest and most consistent predictor of youths' PTS reactions (e.g., trait anxiety predicted PTS symptoms even when controlling for level of exposure and demographic characteristics). Theoretically, preexisting trait anxiety is thought to impact the way children are able cope with and process the traumatic event (La Greca et al., 1996; Vernberg et al., 1996). Those with elevated trait anxiety are theorized to be less able to positively cope and are more likely to have elevated PTS symptoms even with relatively low exposure experiences (La Greca et al., 1998).

Drawing on the theoretical perspective developed by La Greca and colleagues (e.g., La Greca et al., 1996, 1998; Vernberg et al., 1996), we sought to increment knowledge on the role of preexisting trait anxiety on youths' reactions to trauma. We predicted that predisaster (pre-Katrina) child trait anxiety would be predictive of PTSD symptoms following the disaster, even after controlling for the number of hurricane exposure events. In this study we also sought to extend previous research by examining the role of predisaster PTS symptoms. For example, it is reasonable to argue that the reason trait anxiety has been found to be related to PTS symptoms may be due to previous exposure to trauma and predisaster PTS symptoms (i.e., that trait anxiety is simply a marker for existing PTSD symptoms). In this study, our sample also was screened for PTS symptoms pre-Katrina, and thus this is the first study, to our knowledge, to be able to control for preexisting PTS symptoms in testing La Greca and colleagues' model. In addition, research from disasters other than hurricanes indicates that factors that tap negative affect may also be predictive of reactions to trauma (Nolen-Hoeksema & Morrow, 1991); therefore, we hypothesized that negative affect pre-Katrina would predict post-Katrina PTS symptoms. Finally, in addition to PTS symptoms as the outcome variable, we examined the prediction of major depression symptoms post-Katrina, because research has shown these to be a possible reaction to disaster. We also examined the prediction of generalized anxiety disorder symptoms post-Katrina, because previous research has provided limited information on the more cognitive (i.e., worry) aspects of anxiety disorder symptoms that may develop in the wake of disaster.

## Method

### *Participants*

The sample was composed of 52 youths (mean age = 11.35 years, $SD$ = 3.6): 30 boys (58%) and 22 girls (42%). Sixty-four percent were European American ($n$ = 33), 29% were African American ($n$ = 15), and 7% reported "other" ($n$ = 4) as their ethnic background. In terms of income, 24% ($n$ = 13) of youths came from families with annual incomes of less than $21,000, for 31% ($n$ = 16) incomes ranged from $21,000 to $51,000, and for 45% ($n$ = 23) incomes were above $51,000. All 52 youths had participated in a series of studies at the University of New Orleans (e.g., Weems & Costa, 2005; Weems, Zakem, Costa, Cannon, & Watts, 2005) on average 17 months before the storm, and all were residing in the greater New Orleans area at the time of the storm. Data also were collected on 173 youths before the hurricane, but because of the extensive devastation caused by the natural disaster it was impossible to recontact these participants for the immediate post-Katrina assessment (6 to 7 months after the disaster). Comparison of the 52 youths who completed the pre- and post-Katrina assessment versus the 173 youths who completed the pre-Katrina assessment revealed no statistically significant differences on most pre-Katrina variables. Only significant differences in terms of family income were found between the two groups. Specifically, this study's sample ($N$ = 52) had higher family income.

### *Measures*

The Child Posttraumatic Stress Disorder Checklist (PTSD checklist; Amaya-Jackson, McCarthy, Newman, & Cherney, 1995) was used to assess pre- and post-Katrina PTSD symptoms. The PTSD checklist consists of 28 items that inquire about symptoms corresponding to each of the major PTSD symptoms (reexperiencing, avoidance, emotional numbing, and hyperarousal) specified in the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM–IV*; American Psychiatric Association, 1994). Previous research has reported alpha reliability coefficients ranging from .91 to .72. In the present study, alpha reliabilities for the Time 1 and Time 2 administrations were .95 (95% confidence interval [CI] = .93, .96) and .87 (95% CI = .82, .92).

The State–Trait Anxiety Inventory for Children—Trait version (STAIC–T; Spielberger, 1973) was used to assess trait anxiety pre-Katrina. The Trait version of the STAIC is a 20-item self-report instrument designed to measure relatively stable individual differences in the tendency to experience anxiety states. Spielberger reported retest reliabilities ranging from .65 to .71. Alpha reliability for the STAIC–T was .81 (95% CI = .73, .88).

The Revised Child Anxiety and Depression Scale (RCADS; Chorpita, Yim, Moffitt, Umemoto, & Francis, 2000) was used to assess pre- and post-Katrina symptoms of generalized anxiety

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disorder and depression. The RCADS Generalized Anxiety Disorder scale (GAD) has 6 items, and the Major Depression scale (MD) has 10 items. The GAD and MD scales were chosen as a focus of this study to reduce item overlap with other scales used in this study. Chorpita et al. reported alpha reliabilities of .80 for the GAD scale and .76 for the MD scale. Alpha reliability for the Time 1 and Time 2 administrations of the GAD scale were .70 (95% CI = .54, .81) and .78 (95% CI = .66, .85) and for the MD scale were .78 (95% CI = .67, .86) and .83 (95% CI = .75, .89), respectively.

The Positive and Negative Affect Schedule—Child version (PANAS–C; Laurent et al., 1999) was used to assess negative affect (NA) pre-Katrina. The PANAS–C consists of positive affects (e.g., interested, excited, strong, enthusiastic, proud, alert) and negative affects (e.g., distressed, upset, guilty, hostile, nervous, jittery, and afraid). NA is assessed via 15 items. Laurent et al. reported an alpha reliability of .94. Alpha reliability estimate for the PANAS–C NA in the present study was .92 (95% CI = .88, .95).

### *Procedure*

Informed consent was obtained from the parent and assent from the child before the pre-Katrina assessment. Consent (assent for child) was obtained for both data collections (i.e., pre- and post-Katrina). Written consent (assent for child) was obtained at Time 1 and included a clause to recontact participants and conduct follow-ups. At Time 2, parents were contacted and verbal consent (assent for child) was obtained over the phone prior to the administration of the follow-up assessment. The predisaster assessment battery included the PTSD checklist, STAIC–T, RCADS, and PANAS–C. Youths were assisted, as necessary, by a trained research assistant who either read aloud the questions to younger children or monitored completion of the assessment battery. After the disaster, trained research assistants attempted to recontact all families who completed the pre-Katrina assessment, and 52 were located. Each of the 52 youths and their families recontacted and located after the disaster then participated in a post-Katrina telephone interview. Procedures for conducting the phone interviews were similar to those described by Asarnow et al. (1999). Phone interviews lasted approximately 30 min with each child and included a survey of exposure to hurricanes and their aftermath. This survey was similar to the one used by La Greca et al. (1998), and sample items included "During the storm did you see windows and doors breaking?" and "During the storm did you hear about tornados in your area?" Respondents indicated "yes" or "no" with respect to whether they were exposed to each event. For the present study, the number of hurricane-related events was computed by adding the number of "yes" responses. The telephone interview also included administration of the PTSD checklist and RCADS.

## Results

Means and standard deviations for each of the pre- and post-Katrina measures are presented in Table 1. Examination of the scores' ranges and skew indicated acceptable levels for the planned analyses.[1] As shown in Table 1, participants were exposed to a wide range and large number of potentially stressful hurricane-related events. Results of paired-samples *t* tests on the number of PTSD symptoms, RCADS–GAD symptoms, and RCADS–MD symptoms indicated no significant differences in mean scores from pre- to post-Katrina (PTSD 95% CI for the mean difference = –7.0, 2.9, Cohen's $d = 0.16$; GAD 95% CI for the mean difference = –0.9, 1.2, Cohen's $d = 0.04$; and MD 95% CI for the mean difference = –1.1, 2.6, Cohen's $d = 0.16$). Intercorrelations between the study's focal variables are presented in Table 1, and as shown in the table, the number of hurricane-related events was significantly related to the number of post-Katrina PTSD symptoms. In addition, pre-Katrina STAIC–T and PANAS–C scores were significantly related to post-Katrina PTSD, GAD, and MD symptoms.

Before selecting demographics for inclusion in the regression models, we examined age, gender, ethnicity, and income levels as predictors of the outcomes (post-Katrina PTSD checklist, GAD, and MD symptoms); however, only gender was associated with these variables. Because, age, ethnicity, and income levels were not associated with outcome, as suggested by Tabachnick and Fidell (2001) in an effort to preserve degrees of freedom given the relatively small sample size, age, ethnicity, and income were not included in the regression analyses.

Next, a series of hierarchical regression analyses were conducted to determine if pre-Katrina trait anxiety and negative affect predicted post-Katrina PTSD, GAD, and MD symptoms. In the first model, post-Katrina PTSD symptoms were entered as the criterion variable, and pre-Katrina PTSD symptoms were added in the first step.[2] Next, the number of hurricane-related events was entered in Step 2, followed by sex in Step 3, and pre-Katrina STAIC–T scores in Step 4. Results are summarized in Table 2 and indicated that sex (being female), number of hurricane-related events, and STAIC–T scores predicted elevated post-Katrina PTSD symptoms, with STAIC–T scores accounting for 7% additional variance.[3] A similar regression was conducted using pre-Katrina PANAS–C NA scores in Step 4, and results indicated that the step was significant (11% additional variance). In both regressions, the overall model was significant ($p < .01$).

In the second model predicting post-Katrina GAD symptoms, pre-Katrina GAD symptoms were entered in Step 1, and the number of hurricane-related events was entered in Step 2, followed by sex in Step 3, and pre-Katrina STAIC–T scores in Step 4. Results are summarized in Table 2 and indicated that GAD symptoms, sex (being female), and STAIC–T scores predicted post-Katrina GAD symptoms, with STAIC–T scores accounting for 11% additional variance. A similar regression was run using pre-

[1] PTSD checklist symptoms before Katrina were skewed (expectedly) because many youths had not experienced a traumatic event. Consequently, we checked our results regarding this variable using nonparametric tests (e.g., Spearman's rho correlations), and these provided identical conclusions. The most common traumatic events reported by youths before Katrina were motor vehicle accidents and community crime and violence.

[2] Because of their correlation, STAIC–T and PANAS–C scores were run in separate models to reduce the effects of multicollinearity in interpreting the results (Tabachnick & Fidell, 2001). When entered together in Step 4, the step produced a significant change in $R^2$, but neither variable was individually significant in each of the three models and tolerance was low.

[3] The order of steps was chosen by drawing on the study of La Greca et al. (1998) to provide consistency across studies.

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Table 1
*Means, Standard Deviations, and Zero-Order Correlations for Measures Pre- and Post-Hurricane Katrina (N = 52) and Percentage of Participants Experiencing Various Hurricane-Related Events*

| Variable | *M* | *SD* | % | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Number of hurricane-related experiences | 6.56 | 2.9 | | — | | | | | | | | |
| 2. PTSD checklist–pre | 15.49 | 16.5 | | .09 | — | | | | | | | |
| 3. STAIC–T–pre | 35.30 | 6.4 | | .01 | .46** | — | | | | | | |
| 4. PANAS–C NA–pre | 29.14 | 12.0 | | .02 | .40** | .58** | — | | | | | |
| 5. RCADS–GAD–pre | 11.40 | 3.5 | | .07 | .52** | .39** | .38** | — | | | | |
| 6. RCADS–MD–pre | 17.37 | 5.0 | | −.07 | .40** | .45** | .55** | .44** | — | | | |
| 7. PTSD checklist–post | 13.58 | 5.7 | | .44** | .09 | .37** | .35* | .30* | .04 | — | | |
| 8. RCADS–GAD–post | 11.21 | 3.2 | | .18 | .24 | .46** | .47** | .40** | .18 | .69** | — | |
| 9. RCADS–MD–post | 16.48 | 4.7 | | .26 | .09 | .44** | .32* | .18 | .10 | .62** | .54** | — |
| Type of hurricane-related experiences | | | | | | | | | | | | |
| Lost contact with friends | | | 60 | | | | | | | | | |
| Relocated to another city | | | 58 | | | | | | | | | |
| Saw trees being damaged | | | 44 | | | | | | | | | |
| Home damaged or destroyed | | | 35 | | | | | | | | | |
| Witnessed others sick, hurt, or die | | | 19 | | | | | | | | | |
| Friend or family member died | | | 10 | | | | | | | | | |

*Note.* PTSD checklist = Child Posttraumatic Stress Disorder Checklist; STAIC–T = State–Trait Anxiety Inventory for Children—Trait version; PANAS–C NA = Positive and Negative Affect Schedule—Child version, Negative Affect; RCADS = Revised Child Anxiety and Depression Scale; GAD = generalized anxiety disorder symptoms; MD = major depression symptoms.
* $p < .05$. ** $p < .01$.

Katrina PANAS–C NA scores in Step 3, and results indicated that the step was significant, accounting for 10% additional variance. In both regressions, the overall model was significant ($p < .01$).

In the third model predicting post-Katrina MD symptoms, pre-Katrina MD symptoms were entered in Step 1, and the number of hurricane-related events was entered in Step 2, followed by sex in Step 3, and pre-Katrina STAIC–T scores in Step 4. Results are summarized in Table 2 and indicated that sex (being female) and STAIC–T scores predicted post-Katrina MD symptoms with STAIC–T score accounting for 10% additional variance. A similar regression was run using pre-Katrina PANAS–C NA scores in Step 3, and results indicated that the step did not reach statistical significance (5% additional variance, $p = .089$ for the step). In both regressions, however, the overall model was significant ($p \leq .05$).

## Discussion

Results indicated that trait anxiety was a predictor of negative stress responses in the wake of Hurricane Katrina, and these findings were highly consistent with the theorizing and conclusions of La Greca et al. (1998). Findings extend the previous research by controlling for preexisting PTSD symptoms. This study's findings also showed that youths with elevated negative affect are at risk for the development of PTSD symptoms after a disaster; however, this may be due to shared variance. Prevention trials designed to mitigate the impact of disasters on youths might benefit from specifically considering elevated trait anxiety or negative affect as part of the efficacy evaluation. This may be important because it would show whether this segment of youths seems to benefit from PTS inoculation efforts. The clinical importance of identifying targets for prevention is highlighted by the growing realization that response to trauma is not one-dimensional and that some interventions not only are ineffective but may be detrimental (McNally, Bryant, & Ehlers, 2003). Trait anxiety may thus be an important target for posttrauma interventions, as anxiety reduction strategies have not been shown to have iatrogenic effects.

The present study also sought to examine the prediction of worry or GAD symptoms as well as the prediction of depressive symptoms. Worry symptoms assessed after the disaster were predicted by both predisaster trait anxiety and negative affect but were not predicted by the number of disaster-related events experienced. One reason may be that GAD symptoms are more stable or less reactive to disaster exposure. PTSD, GAD, and depressive symptoms did not show statistically significant increases nor decreases (i.e., the mean scores in the sample pre- to post-Katrina were roughly the same). These findings are highly consistent with previous research findings; for example, La Greca et al. (1998) found little change in mean scores pre- to post-Hurricane Andrew. One reason for this may be found in research suggesting that, in general, anxiety symptoms decline over time and in older age groups in youths (Weems & Costa, 2005). What may be happening in youths exposed to disasters is that the normative reductions in levels over time do not occur. However, the differences across regression models may also be due in part to the low power (i.e., small sample size) in this study.

Depression symptoms were predicted by trait anxiety and not hurricane events or negative affect. The finding also may be due to this study's limited sample size, as the obtained significance levels were marginal ($p$s $< .09$). Another plausible explanation is that depression emerges after initial anxious–hyperarousal reactions because hyperarousal symptoms give way to features of depression such as emotional numbing in youths exposed to trauma (see Weems, Saltzman, Reiss, & Carrion, 2003). As such, depression may be a secondary disorder arising from such factors as bereavement and unresolved PTS (Vernberg & Varela, 2001). Prospective studies assessing children at multiple time points and examining the likely multiple and varied developmental trajectories of symptoms postdisaster in larger samples are needed.

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Table 2
*Summary of Hierarchical Regression Analyses for Variables Predicting Post-Hurricane Katrina Symptoms*

| Step | Model $R^2$ | Change in $R^2$ | β | *t* | *p* |
|---|---|---|---|---|---|
| Model 1: Predicting PSTD symptoms post-Katrina | | | | | |
| 1 PTSD checklist–pre | .01 | .01 | .09 | 0.6 | .529 |
| 2 Hurricane events | .17** | .16** | .40 | 2.8 | .007 |
| 3 Sex | .25** | .11* | −.34 | −2.5 | .018 |
| 4 STAIC–T | .32** | .07* | .33 | 2.1 | .040 |
| 4 PANAS–C | .36** | .11* | .37 | 2.6 | .012 |
| Model 2: Predicting generalized anxiety post-Katrina | | | | | |
| 1 GAD–pre | .14** | .14** | .37 | 2.7 | .009 |
| 2 Hurricane events | .16* | .02 | .16 | 1.2 | .245 |
| 3 Sex | .24** | .08* | −.28 | −2.1 | .043 |
| 4 STAIC–T | .35** | .11* | .41 | 2.7 | .009 |
| 4 PANAS–C | .34** | .10* | .35 | 2.6 | .013 |
| Model 3: Predicting depression post-Katrina | | | | | |
| 1 MD–pre | .01 | .01 | .09 | 0.6 | .526 |
| 2 Hurricane events | .08 | .07 | .27 | 1.9 | .061 |
| 3 Sex | .19* | .11* | −.33 | −2.5 | .017 |
| 4 STAIC–T | .30** | .11* | .42 | 2.6 | .013 |
| 4 PANAS–C | .24* | .05 | .28 | 1.7 | .089 |

*Note.* All full models were significant at $p \leq .05$. PTSD checklist = Child Posttraumatic Stress Disorder Checklist; STAIC–T = State-Trait Anxiety Inventory for Children—Trait version; PANAS–C = Positive and Negative Affect Schedule—Child version; GAD = generalized anxiety disorder symptoms; MD = major depression symptoms.
* $p < .05$. ** $p < .01$.

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Last, our models predicting postdisaster PTSD, GAD, and depressive symptoms showed girls were at greater risk for developing these maladaptive PTS reactions than boys. In the child trauma literature, child gender has been an inconsistent predictor (La Greca & Silverman, 2006). In community samples, girls have generally been found to report more anxiety, worry, and fear than boys (see Vasey & Dadds, 2001, for reviews), but few explanations have been empirically tested, making it difficult to draw any firm conclusions concerning gender differences. Overall, the sample was composed of an ethnically diverse group of youths; however, caution should be made in drawing too wide a generalization from the findings, as the sample was biased toward upper income families.

The present study is limited by its sample size. Because the power to detect significant effects was low in this study, results of no significant findings should be interpreted with caution. In addition, the small sample size precluded conducting more complex analyses (e.g., structural equation modeling) to tease out the relative contribution of the predictors to the various outcome variables. In addition, the study relied on youths' self-reports. It might be the case that reports from other sources (such as parents) would result in additional information about the prediction of PTS reactions in youths. However, youths have been consistently found to be valid reporters of their own internalizing distress (see, e.g., Weems et al., 2005). Another limitation of the present study concerns the clinical severity of youths' symptoms, which could have been ascertained by using a *DSM–IV* Axis V domain measure. Unfortunately, most studies in the child trauma literature do not report these data and rely on PTS symptom counts, as does the present study. An additional limitation of this study is that we had little control over the postdisaster time frames examined. The extent of devastation made reassessment of youths immediately following Hurricane Katrina impossible. Data collected in various time frames following the storm could have helped clarify the temporal associations of youths' symptom reactions.

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