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ORIGINAL PAPER

# Longitudinal Impact of Attachment-Related Risk and Exposure to Trauma Among Young Children After Hurricane Katrina

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**Abstract**
*Background* Research suggests that young childhood is a dynamic developmental phase during which risks to attachment figures as well as traumatic events may be particularly important. The loss and disruption associated with Hurricane Katrina highlighted the vulnerabilities and special needs of young children exposed to natural disaster.
*Objective* The current study explored ways in which multiple stressors associated with Hurricane Katrina contributed to adverse outcomes. We hypothesize overall decreases in trauma symptoms over time. We further hypothesize that increased attachment and hurricane related risk factors will negatively influence longitudinal symptom patterns.
*Methods* Data was collected from families of preschool-aged children (ages 3–5) during the school year following Hurricane Katrina (2005–2006) and each subsequent school year (2006–2007, 2007–2008, and 2008–2009). Latent growth curve modeling was used to assess trauma symptoms overtime and the effect of risk indices on these trauma symptoms.
*Results* Results suggest an overall decrease in trauma distress symptoms over time and further indicate that attachment and trauma related risks of caregiver disruption, other non-human losses, trauma prior to and subsequent to the storm, as well as Katrina exposure are significant predictors of symptoms over time.
*Conclusions* Given the rapid physical, cognitive, and emotional development that occurs in early childhood, these findings support the importance of providing intervention with preschool age children post-disaster. Further, the findings also suggest that a relationship based treatment including both caregiver and child is most likely to be effective.

**Keywords** Young children · Pre-school · Attachment · Trauma symptoms · Longitudinal · Natural disaster

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## Introduction

Hurricane Katrina made landfall on August 29, 2005 resulting in significant damage and destruction. In the New Orleans metropolitan area, Hurricane Katrina's winds and heavy rains combined with the breaching of the levees resulted in flooding of 80 % of New Orleans (Knabb et al. 2006) and flood-related damage or destruction to all of the 26,000 homes in St. Bernard Parish Government (2008). With over 1,500 deaths in Louisiana attributed to Hurricane Katrina (Knabb et al. 2006), the degree of loss and disruption associated with this unprecedented natural disaster effectively changed the face of mental health needs for young children and their families in the Gulf Coast region.

Hurricane Katrina highlighted the lack of knowledge and attention to the vulnerabilities and special needs of young children exposed to a natural disaster. Within 1 week after the disaster, the National Center for Missing & Exploited Children received calls regarding 4,909 children who were missing or dislocated from their families (Broughton et al. 2006). In addition to separation from family, many child survivors of Hurricane Katrina lost their homes, their toys, their schools, and, the overall stability that is so important for children's healthy emotional development (Osofsky et al. 2007; Osofsky 2011b). Young children who lack the cognitive and emotional capacity and skills to understand and cope with the traumatic experience and uncertainties can be profoundly impacted. For these reasons, the separations and losses experienced by young children following Hurricane Katrina may have been particularly traumatic because of the importance of secure attachments and stability in the early years (Bowlby 1969, 1973; Masten and Osofsky 2010; Osofsky and Osofsky 2010). The current study seeks to explore the ways in which multiple stressors experienced by children contributed to adverse longitudinal outcomes following Hurricane Katrina.

### Early Exposure to Trauma

Given the rapid physical, cognitive, and emotional development that occurs during the preschool period, early exposure to trauma may have a profound impact. Previous research demonstrates that disaster affects young children's mental health outcomes, specifically predicting posttraumatic stress symptomatology; however, few studies have used a longitudinal approach to studying this problem. Although exposure to disasters is negative for all children and families, it is important to recognize that with protection and support, most children will be resilient (Masten and Osofsky 2010; Masten and Narayan 2012). Studies show that disasters and the resulting losses and ongoing stressors negatively impact young children's psychological outcomes (Osofsky 2011a; Devoe et al. 2011). While children's symptoms of posttraumatic stress generally decrease over time, level of exposure, loss, and ongoing stress affects the severity and longevity of children's symptoms (McLaughlin et al. 2009). As demonstrated in a study by Swenson et al. (1996), while the majority of two to six-year-old children's hurricane-related distress decreased over time, children who had lost their homes as a result of the hurricane or who experienced ongoing life stressors such as a marriage or a death in the family were more likely to have increased levels of posttraumatic stress 14 months after the hurricane. Proctor et al. (2007) assessed four and five-year-old children who experienced an earthquake and found that children's level of posttraumatic stress was related to earthquake exposure, as defined by physical injury, damage to the home, displacement from home or school, loss of possessions, and financial stressors and was moderated by caregiving relationships, specifically, caregivers' positive and negative behaviors with their children during play and caregivers' level of stress.

## Young Children and Hurricane Katrina

Following Hurricane Katrina, Scheeringa and Zeanah (2008) found that 43.5 % of preschoolers who evacuated for Hurricane Katrina and 62.5 % of children who stayed in the city during the hurricane met criteria for PTSD. They were more likely to exhibit symptoms of PTSD, depression, oppositionality, and anxiety if their caregiver also developed symptoms of PTSD following the storm (Scheeringa and Zeanah 2008). These findings on the negative impact of direct exposure and proximity to the disaster, as well as the moderating influence of caregiving relationships on the impact of a disaster have been replicated by other researchers (McLaughlin et al. 2009). In another study, Scaramella et al. (2008) described two-year-old children's outcomes following Hurricane Katrina in the context of family stress. They demonstrated that hurricane-associated stressors such as financial strain increased the likelihood of maternal depression which, in turn, was associated with mothers' experiencing a decrease in parenting effectiveness and children showing increased internalizing and externalizing problems. Based on these findings, it is clear that children may be impacted by many aspects of disasters, including primary exposure to the disaster as well as secondary stressors such as separations from and losses of significant people, objects, and places which provide familiarity and security. Further inquiry is needed to better understand the interactions among these different types of trauma and the ways in which they predict longitudinal patterns of symptom progression in young children.

## Attachment and Hurricane Related Risk Factors

In assessing young children, it is important to evaluate risk factors and outcomes from a developmental perspective given the cognitive capacity and special needs of children in their early years (Masten and Osofsky 2010; Osofsky and Osofsky 2010; Osofsky 2011b). Regarding outcomes, several studies have described the specific posttraumatic stress symptoms of preschool-aged children following a natural disaster. For example, studies of preschool- and kindergarten-aged children who were impacted by hurricanes found that children exhibited distress through re-experiencing, as evidenced by play re-enactment, intrusive thoughts, and repeatedly talking about the hurricane (Saylor et al. 1992; Sprung 2008; Sprung and Harris 2010; Swenson et al. 1996). Another study following a flood in Bangladesh focused on the impact of natural disaster on children's regressive behavior and found that 5 months after the flood, 34 % of two to nine-year-old children developed enuresis (Durkin et al. 1993).

Clinginess to caregivers is another symptom commonly observed in young children following trauma (Devoe et al. 2011). Given that attachment behaviors are activated by stressful experiences, it is expected that young children would experience an increase in proximity seeking towards their caregivers following a disaster (Lieberman and Amaya-Jackson 2005). Research by Junn and Wright Guerin (1992) supported an increased incidence of attachment behaviors 2–6 weeks following the 1989 Loma Prieta earthquake; they found that over 50 % of parents of two to three-year-old children reported that their children demonstrated increased clinginess and separation anxiety.

Further, the preschool period represents a critical developmental stage in the context of the attachment relationship (Ainsworth 1985; Delius et al. 2008; Greenberg et al. 1993; Stafford and Zeanah 2006). In describing the ages at which children are most vulnerable to negative outcomes following a separation from a caregiver, Bowlby (1952) states that "all children under three and a very large proportion between three and five suffer through

deprivation" (p. 28). Greenberg et al. (1993) have described the purpose and primacy of the attachment during the preschool period as follows:

> the protection of children from danger while they develop the skills to protect themselves—continues to play a paramount role during the preschool and early school-age years…Preschoolers are certainly not yet able to protect themselves from most sources of danger (p. 7).

When children are securely attached, they feel comfortable exploring their world through play and interaction with peers because they have a stable and reliable caregiver to whom they can turn especially in times of stress (VanderVen 2008). However, stress and trauma associated with natural disasters, war, or interpersonal trauma can negatively impact the parent–child relationship, thus affecting attachment and the achievement of social and cognitive developmental milestones during the preschool period (Hinshaw-Fuselier et al. 2004; Lieberman and Van Horn 2008; O'Connor and McCartney 2007; Osofsky 2011b; Rydell et al. 2005).

Experiences of war and terrorism prompted early research on the importance of the early child-caregiver relationship during times of stress. This early research included Burlingham and Freud's (1942) observations of children being cared for at a residential nursery during the London Blitz. They described children who were separated from their caregivers as regressed, aggressive, depressed, and withdrawn. Contemporary researchers have continued this line of research on children impacted by terrorism; for example, following the terrorist attacks on September 11th, maternal psychopathology (depression and PTSD) were associated with preschool-aged children's increased levels of emotional reactivity and aggression (Chemtob et al. 2010). Although these children were not separated from their parents as were the children in Burlingham and Freud's (1942) traditional research, the findings further the original research by demonstrating that not only separation, but also alterations in the relationship, impact children's outcomes following a traumatic event. For many young child survivors of Hurricane Katrina, parent separation, relationship changes, and environmental disruptions were unavoidable (Osofsky 2011a).

Research suggests that young childhood is a dynamic developmental phase during which risks to attachment figures as well as traumatic events may be particularly important. The limited available research highlights that young children experience trauma distress related to exposure and loss and that caregiving relationships have an impact on how children respond to disasters (Devoe et al. 2011; Masten and Osofsky 2010; Osofsky 2011b; Proctor et al. 2007; Scaramella et al. 2008; Scheeringa and Zeanah 2008). The severity and chronicity of the trauma that children experienced as a result of Hurricane Katrina represents a unique intersection of trauma such that children had the potential to be exposed to multiple attachment-related risks (e.g. disruption in the caregiver-child relationship, separations from pets, familiar toys, peers, and, schools) in addition to multiple risks related to primary exposure (e.g. witnessing the devastation and destruction and sustaining injuries). The purpose of this study is to improve understanding of how attachment and hurricane related risk factors contribute to longitudinal patterns of symptom progression in young children following Hurricane Katrina. Consistent with literature on older children, we hypothesize decreases in trauma symptoms over time. Based on attachment literature specific to young children we further hypothesize that increased attachment and hurricane related risk factors in the areas of caregiver disruption, other non-human losses, and primary exposure to the storm will negatively influence longitudinal symptom patterns.

## Methods

The current study includes data collected from families of preschool-aged children (ages 3–5 years old) during the school year following Hurricane Katrina (2005–2006) and each subsequent school year (2006–2007, 2007–2008, and 2008–2009).

### Procedures

Data collection was conducted as part of a school initiated screening and intervention project. Screeners were sent home for the parents to complete and was then returned to the school. As a school initiated screening, the content was deemed necessary toward the post disaster educational environment and parents and guardians provide annual consent for assessments. Notification was also sent home regarding the voluntary nature, option to refuse participation on all or parts of the screener at their discretion, and the option to contact a school mental health professional if wanted. Reports, including compilations of students' responses, were given to the schools to provide them with more information about students' concerns in an effort to improve services and enhance the school environment. The screeners were administered confidentially, but not anonymously, so that it was possible to provide further evaluation for students with greater mental health symptoms or contact parents that requested services. This study was submitted and received approval by the IRB at Louisiana State University Health Sciences Center.

### Participants

The current study included 914 children who were between the ages of 3 and 5 at the time of the hurricane. Each child's current primary caregiver provided data included in the current study. The sample is comprised of 437 boys (48 %) and 465 girls (51 %); the genders of 12 children (1 %) were unknown. Children in this sample were, on average, 4 years old at the time of the storm. Forty-six percent of the sample were Caucasian ($n = 418$); 44 % were African American ($n = 399$); 5 % were mixed race ($n = 44$); 2 % were Hispanic ($n = 15$); 1 % were Asian ($n = 10$); 1 % were American Indian/Alaskan Native ($n = 10$), and 1 % were Middle Eastern ($n = 6$). Less than 1 % identified as "other" ($n = 4$). The racial/ethnic backgrounds of 1 % ($n = 8$) of the total current sample were unknown. For household income—based on participant reports of zip code prior to the storm and Census estimates of median household income—the minimum median income was $7,448 and the maximum was $52,375 ($M = \$33{,}171.23$, $SD = 9{,}098.32$). See Table 1 for sample demographic characteristics.

### Trauma Distress Symptoms

The outcome study variable is a subscale of posttraumatic stress symptomatology drawn from the National Child Traumatic Stress Network (NCTSN) Hurricane Assessment and Referral Tool for Children and Adolescents (NCTSN 2005). The NCTSN assessment scale of posttraumatic symptoms was based on the validated UCLA PTSD Index (Steinberg et al. 2004). Items are scored on a Likert scale, ranging from 1 to 4. A subscale of items targeting young children was included in the current study; reliability was acceptable in the current sample ($\alpha = .79$). These items were used to better understand trauma related distress among young child and included: (1) "Child is clingy or worried about separation"; (2)

**Table 1** Sample demographic characteristics (N = 914)

| Demographic characteristic | % | *n* |
|---|---|---|
| Median household income | | |
| $0–$15,000 | 3 | 24 |
| $15,001–$30,000 | 23 | 211 |
| $30,001–$45,000 | 43 | 395 |
| $45,0001–$55,000 | 16 | 148 |
| Unknown | 15 | 136 |
| Child ethnicity | | |
| African-American | 46 | 418 |
| Mixed race | 44 | 399 |
| Hispanic | 5 | 44 |
| Asian-American | 2 | 15 |
| American Indian/Alaskan Native | 1 | 10 |
| Caucasian | 1 | 10 |
| Middle Eastern | 1 | 6 |
| Other | <1 | 4 |
| Unknown | 1 | 8 |
| Child gender | | |
| Boys | 48 | 437 |
| Girls | 51 | 465 |
| Unknown | 1 | 12 |
| Child age at time of Katrina | | |
| 3 years old | 24 | 217 |
| 4 years old | 50 | 456 |
| 5 years old | 26 | 241 |

Median household income is of the area in which a given participant lives

"Child is quiet/withdrawn since the hurricane"; (3) "Child talks repeatedly about hurricane"; (4) "Child's play about hurricane"; (5) "There have been changes in child's development since the hurricane"; (6) "The child has demonstrated behavior problems since the hurricane"; and (7) "I have other concerns about my child." Descriptive statistics for trauma distress symptoms are presented in Table 2.

**Table 2** Descriptive statistics for trauma distress and risk indices (N = 914)

| Variable | Minimum | Maximum | *M* | *SD* |
|---|---|---|---|---|
| Trauma distress symptoms | | | | |
| Time point 1 | 6.77 | 24.63 | 11.18 | 2.59 |
| Time point 2 | 6.95 | 21.00 | 10.13 | 2.42 |
| Time point 3 | 6.82 | 22.00 | 9.08 | 2.23 |
| Time point 4 | 7.00 | 26.00 | 9.27 | 2.49 |
| Risk indices | | | | |
| Caregiver disruption | 0 | 2.18 | 0.33 | 0.48 |
| Other non-human losses | 0 | 5.00 | 3.26 | 0.90 |
| Direct exposure | 0 | 4.02 | 1.09 | 0.36 |

## Risk Indices

In the current study, we conceptualize risk via indices of the accumulation of various risk factors. Indices were created by summing endorsed (*yes* = 1) responses for each index. Research has demonstrated that the accumulation of risk may be a better predictor of outcomes than any single indicator (Puma et al. 2008; Sameroff et al. 1987; Sameroff 2000). Risk indices provide important advantages over other statistical approaches. Data reduction is based on theoretical criteria as opposed to statistical information and no assumptions are made about the distribution of risk factors (Burchinal et al. 2000). This is useful in the current study as all sample children had the opportunity to be exposed to multiple kinds of risk. Although developmental research most frequently presents associations between single-indicator risk and children's outcomes, Burchinal et al. (2000) suggest that a risk index approach may be superior in certain scenarios, particularly when modeling developmental patterns over time, as is the case in the current study. Thus the analytic strategy adopted herein represents a novel and dynamic approach to analyzing longitudinal data when hypotheses consider symptom progression/change and when children are exposed to multiple types of risk that are accounted for in a single model.

### *Caregiver Disruption Risk Index*

Binary-coded, attachment-related indicators of separation and loss from primary caregivers were summed into a risk index. These indicators suggest a disruption with the primary caregiver and included: family member was killed, child was separated from caregiver at the time of the storm, child was separated from caregiver after the storm, and child was isolated during evacuation.

### *Other Non-human Losses Risk Index*

Similarly, binary-coded indicators of separation and loss from objects, place and environment were summed into a risk index. These indicators suggest a disruption or loss from non-human attachment forming items and included: child was separated from a pet, child was separated from toys, child was displaced, child transferred schools, and child's home was destroyed.

### *Primary Exposure to Trauma Index*

Finally, binary-coded indicators of children's direct experiences with storm-related trauma were summed into a risk index. These indicators included: child was injured, child witnessed injury to another person, child was exposed to violence/looting, and child had to evacuate. Descriptive statistics for attachment and hurricane related risk indices are presented in Table 2.

Preliminary analyses were conducted to assess bivariate correlations among the outcome variables (trauma distress at four time periods), hurricane related risk indices (caregiver disruption, other non-human losses, and direct exposure), major trauma prior to the storm, and major trauma since the storm (see Table 3). Results of the point biserial correlations revealed weak associations among male children and increased trauma disruption at time 1; and for those that experienced a major trauma since the storm and increased caregiver disruption. Results of the Pearson correlations revealed significant

**Table 3** Correlation matrix of key study variables

| | Trauma prior to the storm | Trauma since the storm | Caregiver disruption index | Non-human loss index | Exposure to the storm index | Trauma distress 1 | Trauma distress 2 | Trauma distress 3 | Trauma distress 4 |
|---|---|---|---|---|---|---|---|---|---|
| Child gender | −.00 | −.00 | −.03 | .00 | .00 | −.09** | −.06 | −.06 | −.06 |
| Trauma before the storm | – | .13 | .04 | .06 | .03 | .16** | .13** | .16** | .15** |
| Trauma after the storm | – | – | .19** | .06 | .03 | .19** | .20** | .23** | .26** |
| Caregiver disruption index | – | – | – | .13** | .06 | .19** | .21** | .21** | .17** |
| Non-human loss index | – | – | – | – | .20** | .20** | .21** | .22** | .12** |
| Exposure to the storm index | – | – | – | – | – | .25** | .27** | .28** | .16** |
| Trauma distress 1 | – | – | – | – | – | – | .85** | .74** | .62** |
| Trauma distress 2 | – | – | – | – | – | – | – | .87** | .59** |
| Trauma distress 3 | – | – | – | – | – | – | – | – | .70** |

** $p < .01$

positive associations among trauma distress (time 1–time 4); the risk indices (caregiver disruption, other non-human losses, and direct exposure).

## Covariates

Several sets of analyses were run to determine the impact of demographic covariates on the outcome measure used in the current study at all four time points. Household income, ethnicity, and variation in child age did not significantly predict outcome scores at any of the time points. However, child gender did significantly predict outcomes such that boys generally fared worse on trauma distress symptoms at time 1 ($t = 2.86$, $p < .01$) and time 4 ($t = 1.93$, $p < .05$). Additionally, we explored the impact of trauma experienced before the storm as well as after the storm and the impact of each of these on outcome scores. Parents were asked at each time point if their children experienced trauma prior and/or subsequent to the storm (a single question per variable). Both trauma before the storm and trauma experienced after the storm significantly predicted outcome scores at each time point; therefore, we included this information in the final model.

## Missing Data

All participants included in the current study ($N = 914$) had complete data at a minimum of one time point to inform imputation. We were largely able to recover data on child characteristics (gender, age, and ethnicity) and risks because data collection for these variables were repeated at each time point. Of note: we utilized the information provided about traumas experienced at the first time point it was available for each participant. When this information was provided at multiple times by a single participant, and if it differed across time, we utilized the answer first provided. However, there was a greater amount of missing data within the outcome scores (trauma distress symptoms) in the current study, particularly at the first wave of data collection (79 % missingness at this wave compared to 73 % missingness at wave 2, 52 % missingness at wave 3, and 58 % missingness at wave 4; 26 % of sample participants provided data on trauma symptoms at least 2 waves or more of data collection). Scholars suggest 50–75 % missingness as an acceptable upper limit (Newman 2003). We hypothesize that missingness in our study is tied to the chaotic nature of the post-disaster community, particularly at wave 1 which occurred in the months following the storm, and is not directly related to participants' outcome scores; therefore, we hypothesized that data were missing at random (MAR). Repeated measures for a given participant are likely to be correlated, and therefore, these procedures allow us to partially recover data from earlier and/or later waves of assessment (Schafer and Graham 2002).

To test our missingness hypothesis, we ran extensive wave nonresponse analyses to determine if the mechanism of nonresponse was associated with a participant's true status on variables in the current study. Participants were categorized based on pattern of missingness, and 14 subgroups emerged, describing the various permutations of wave response for participants. One-way ANOVA analyses demonstrated that there were no significant differences ($p > .10$) in the variables utilized in the current study based on patterns of wave nonresponse. These analyses were completed across groups as well as by collapsing groups into different sets of like patterns. Missing data were imputed using the Expectation Maximization algorithm (Dempster et al. 1977), a maximum likelihood (ML) approach, in SPSS 17.0. EM methodology is a two-step algorithm, imputing missing values with two steps in each iteration, an Expectation-step and a Maximization-step. ML

approaches are considered ideal for preparing data for latent variable models when data is assumed to be MAR (Musil et al. 2002; Schafer and Graham 2002). Predictor variables were imputed separately from outcome variables, and data were used from respondents' scores at other time points and on related measures to inform imputation. Another potential approach to impute missing data would be to use Full Information Maximum Likelihood (FIML) procedures concurrent with SEM analyses. However, scholars agree that FIML and EM should yield similar results and have largely trivial differences in bias and efficiency (Enders 2006; Schafer and Graham 2002).

## Results

The main analyses in the current study utilize latent growth curve modeling via structural equation modeling to test the hypotheses in LISREL 8.80. Latent growth curve modeling (LGCM) is a statistical approach that supports the assumption of nested data and allows researchers to model error (Burchinal et al. 2006; Duncan et al. 1998). Furthermore, LGCM will provide information about predictors of sample-level change over time, and preliminary review of mean scores, as well as study hypotheses, suggest that trauma related distress symptoms generally decreased over time in the current sample. Based on these characteristics, this approach will best support testing model fit in the current study.

Unconditional models were compared to test for the shape of symptom progression among sample participants. We compared a linear growth curve, including two growth factors, with slope loadings constrained to 3, 2, 1, 0; with that of a quadratic model, adding a third growth factor in which the slope loadings are constrained to be the square of the linear factor (9, 4, 1, 0); and a no-growth model, including only the intercept factor. The no-growth model ($\chi^2 = 70.63$, $df = 3$, $p = .00$; RMSEA = .16; GFI = .96; SRMR = .10) demonstrated a poor fit with the data. The linear model ($\chi^2 = 8.63$, $df = 2$, $p = .01$; RMSEA = .06; GFI = 1.00; SRMR = .04) demonstrated a good fit with the data and significantly improved upon the no-growth model based on the Chi square distribution for 1 degree of freedom. The quadratic model ($\chi^2 = 61.07$, $df = 1$, $p = .00$; RMSEA = .26; GFI = .97; SRMR = .11) demonstrated a poor fit with the data and did not improve upon the linear model. Therefore, we retained the linear model of the trauma related distress data for the current study. These findings demonstrate a general linear growth pattern in symptomatology supporting our hypothesis that, overall, children's level of trauma related distress would decrease over time. Slope loadings were constrained to demonstrate normative improvement in symptomatology over time. Heterogeneity in growth is measured by the variances of the intercept and slope in the measurement model. The basic equation of the linear growth curve is: $v_i = b_0 + b_1 t_i + e_i$, where $b_0$ represents the intercept, $b_1$ is the slope, $t_i$ is the $i$th value of time, $e_i$ is the time-specific error of prediction, and $i$ is the value of time (Duncan and Duncan 2004).

The complete conditional model included six time invariant predictors of the growth curve factors: child gender, the presence of major trauma prior to the storm (binary coded), the presence of major trauma subsequent to the storm (binary coded), the caregiver disruption index, the other losses index, and the primary exposure index. All observed predictor variables were centered for analyses. The alpha vector, or the latent variable means of the intercept and slope, was constrained to zero as a result of preliminarily noted sample trends showing that, while some children improved in symptomatology over time, other children may have shown no change or worsened over time, and these subgroups inhibited

the estimation of accurate latent variable means in the current study. Standardized coefficients are presented in Fig. 2.

SEM statistics will be reported based on Raykov et al. (1991): Chi square index, degrees of freedom, and corresponding $p$ value; the goodness-of-fit index (GFI) if using LISREL; and the standardized root mean square residual (SRMR). This set of indices is reported and considered together, therefore, based on these guidelines. Furthermore, the root mean square error of approximation (RMSEA) is a useful index of fit because it is independent of sample size (Bollen 1989), and this statistic will be presented as well. Hu and Bentler (1999) indicate, as *rules of thumb,* that the GFI should be .90 or above, the SRMR should be .08 or below, and the RMSEA should be .06 or below.

The growth curve was centered at the final time point for the current set of analyses so that we could examine the relationship between the predictor variables and trauma distress symptoms 4 years after the storm. We were most interested in this final time point as the center of the growth curve so as to improve interpretation regarding the predictive power of risk on the final value of symptoms in the context of symptom decrease over time. The complete model (see Fig. 1) fit the sample data well. Furthermore, this model explains a very high amount of variance in the outcome scores; the observed variable $R^2$ for this model were .87, .84, .93, and .55 for years 1–4 respectively. There was a significant amount of variance among sample participants in trauma distress scores ($\Sigma = 2.95$, $p = .00$), and a significant covariance between the intercept and slope factors as well

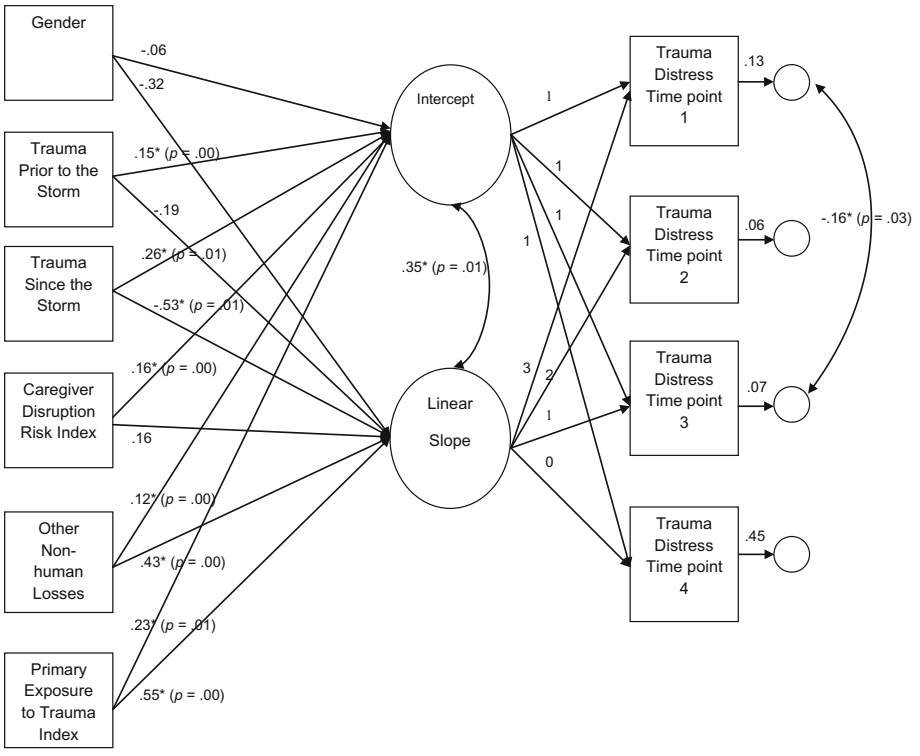


**Fig. 1** Associations between risk exposure and growth over time in Trauma distress symptomatology. *Note* $\chi^2 = 86.63$, $df = 36$, $p = .00$; RMSEA = .04; GFI = .98; SRMR = .04

($\beta = .35$, $p = .01$), suggesting that children who had higher scores (suggesting more symptoms) at the final time point also demonstrated a faster rate of improvement in scores over time. This finding likely indicates that children who had particular high symptomatology in general also normatively had more room to improve over the study period.

All three risk indices significantly positively predicted the intercept factor variance, suggesting that greater risk overall was a significant predictor of symptomatology at the final time point (caregiver attachment risk: $\beta = .16$, $p = .00$); attachment-related stress: $\beta = .12$, $p = .00$; primary exposure: $\beta = .23$, $p = .01$), supporting hypothesis 2 that the attachment and hurricane related risk typologies, specifically caregiver disruption, non-human losses, and primary exposure to the storm would significantly predict individual-level trauma distress growth curves. In addition primary exposure risk ($\beta = .55$, $p = .00$) as well as other non-human losses ($\beta = .43$, $p = .00$) predicted variance in the rate of change in symptomatology such that greater number of risks in these areas predicted a significantly faster rate of improvement in symptoms, mirroring the sample trend described above regarding the positive covariance between the variances of the intercept and slope factors. The caregiver attachment index did not significantly predict variance in the rate of change in symptomatology and therefore did not similarly reflect the sample trend. Figure 2 illustrates the unconditional sample-level relationships between the risk indices and trauma related distress symptomatology over time.

Both trauma experienced prior to the storm ($\beta = .15$, $p = .00$) as well as trauma experienced subsequent to the storm ($\beta = .26$, $p = .01$) were significant predictors of variance in trauma related distress at the final time point. Only trauma experienced subsequent to the storm predicted variance in the rate of change in symptomatology ($\beta = -.53$, $p = .01$), such that children whose parents endorsed this item demonstrated a slower rate of improvement in scores over time. In the context of the complete model, child gender was not a significant predictor of variance in either latent change factor.

Taken together, these findings indicate that sample children generally improved in trauma related distress symptoms over time, though individual children demonstrated differential patterns. Ipsative analyses demonstrate that all three risk indices were significant predictors of higher rates of trauma symptoms at the final time point, with small to moderate effect sizes, indicating that greater risk in any area contributed to greater rates of symptomatology. The risk indices related to primary exposure and non-human related stressors also predicted variance in the rate of linear change across time in trauma symptoms, such that children with a greater number of risks in these areas actually may adapt more quickly over time; however, children with multiple risks on the attachment related caregiver disruption index did not reflect this pattern, suggesting a differential finding. Overall, this model is a robust predictor of the outcomes, demonstrating a high amount of variance explained by the full model, as evidenced by the square multiple correlation coefficients ($R^2$), and a low amount of unexplained variance, evidenced by the low standardized root mean square residual (SRMR).

## Discussion

The purpose of this study was to examine multiple risk factors associated with natural disasters, including attachment-related risks resulting from exposure to a major hurricane. The current study focused on a group of children who were 3–5 years of age at the time Hurricane Katrina struck the Gulf Coast. This age range was chosen because much less research and data is available for preschool children for whom traumatic disruptions may

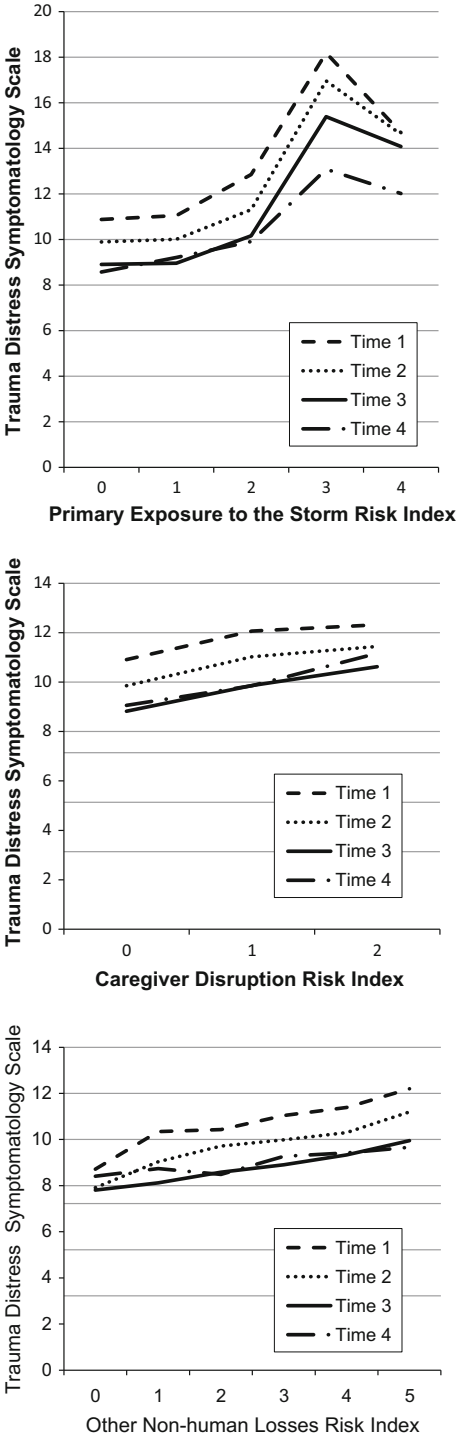


**Fig. 2** *Plots* illustrating relationships between risk indices and trauma distress symptomatology over time

be particularly salient given their dependence on relationships with a primary caregiver and other caretaking adults. Preschool-aged children, while dependent on primary caregivers, also strive to form peer relationships and learn that they can control their behavior and have an impact on their environments (Erikson 1956). Thus, exposure to a natural disaster which may stress the parent–child relationship, disrupt the child's environment, and leave the child with a feeling of powerlessness as a result of the disaster's direct impact may both disrupt the child's ability to achieve developmental milestones and lead to negative behavioral health outcomes.

The first hypothesis—children who were impacted by Hurricane Katrina would have symptomatology that would decrease over time—was supported. Children in this study generally improved in a linear pattern of growth and their trauma symptoms decreased over time. The overall decrease in symptoms over time is an important finding that supports much of the literature on disaster outcomes with older children (Bonanno et al. 2010). Not only does this speak to the ability of younger children to rebound following disaster, but it can also help to inform parents that initial trauma symptoms may be present, that they are normal, and are likely to decrease over time. The negative covariance between the intercept (level) and slope (rate of change over time) of trauma distress may simply reflect the law of initial values such that children with the highest scores had the most room to grow. However, it may also suggest that, in a period of time when community resources were stretched, the children with the highest risk were more likely to receive necessary supports.

Based on support of the second hypotheses, factors and risks beyond the primary attachment system can contribute to symptomatology. This is especially relevant for preschool-aged children who are at a developmental stage in which their social world expands; peers and other adults become more salient, and they have the emerging cognitive capacity to more fully understand the world around them. The second hypothesis, hurricane and attachment related risks—caregiver disruption, non-human losses, and primary exposure to the storm—would impact children's long-term post-hurricane psychological outcome was also supported. Results revealed that children who experienced high levels of direct exposure to the hurricane, multiple disruptions related to their relationship with their primary caregivers, or other non-human losses including evacuation (e.g. displacement from school, separation from pet, or loss of toys) had worse outcomes 4 years after the storm than children who experienced few to no stressors in each category.

Children whose caregivers reported experiencing additional traumatic experiences prior to or since the storm also reported worse outcomes. These results are in line with related research in this area, showing that children demonstrate increased negative symptoms as a result of cumulative stressors (e.g. Durkin et al. 1993; Saylor et al. 1992; Scheeringa and Zeanah 2008; Sprung 2008; Sprung and Harris 2010; Swenson et al. 1996). The current study builds on this research, and concludes that these outcomes persist over time, that multiple kinds of stressors are significant after controlling for other types of trauma, and that cumulative risk is significant in predicting adverse outcomes.

Of note is the differential impact that the risk factors had on children's post-hurricane recovery. Children who were directly impacted by the storm (e.g. children who were injured, witnessed injury to another person, were exposed to violence/looting, or who had to evacuate, and children who were impacted by non-human losses (e.g. children who were separated from a pet or from toys, who were displaced, who transferred schools, or whose homes were destroyed) exhibited decreased trauma distress symptoms over time. Specifically children who experienced high levels of these types of stressors demonstrated a significant rate of improvement, likely reflecting the fact that these children initially had the highest levels of symptoms, and, therefore, had the most room for improvement.

Conversely, children who had high levels of risk on the caregiver disruption index (e.g. family member was killed, child was separated from caregiver at the time of or after the storm, and child was isolated during evacuation) did not show similar significant improvement over time. Given the lack of significance, more research is needed to better understand this potential effect. From these results, we conclude that increased caregiver disruption may impact children differently as compared to other kinds of stressors, reflecting the known unique importance of the parent–child relationship in the early years.

## Limitations and Future Research

The findings of this study are generally robust and make important contributions to the limited literature on young children in post-disaster communities. However, there are a few limitations to the interpretation of findings which should be noted. All of the data in this study were obtained through parent report due to the age range of the children, and there are likely biases in their report of their children's symptomatology. In addition, the study did not measure typologies of *previous* and *subsequent* trauma, and it is possible that these areas of trauma are collinear with our risk indices. As with many longitudinal studies lag time between disaster and data collection may have influenced the results. The effect sizes were also somewhat small based on Cohen's (1988) guidelines. However, we are unable to utilize current best practice methodology to fully interpret their relative effect size (Hill et al. 2007), as there are few comparative studies which explore the relationship between post-disaster risk and longitudinal mental health outcomes in young children. Future studies may benefit from including additional risks associated with caregiver disruption and measurements of attachment classifications, along with inclusion of behavioral and emotional strengths. Also, we did not model caregivers' mental health outcomes, and we acknowledge that this may also be an important moderator of children's outcomes. We suggest that future studies examine the role of moderators on the relationships between the risk indices and the longitudinal development of children's traumatic stress symptoms. Another important contribution for future studies would be to improve understanding of how trauma symptoms in young children impact the parent–child relationship. Finally, heterogeneity in participants' change over time in trauma distress symptoms suggests that a person-centered approach to analyzing these data, such as latent growth mixture modeling, would support an interesting follow-up study.

## Clinical Implications

Bowlby (1952) states that in the preschool age, "wise and insightful management can go far to mitigate ill effects, though in its absence serious reactions…are not uncommon" (p. 26–27). Given Bowlby's assertion, it is reasonable to assume that while preschoolers represent a vulnerable population following a natural disaster and its associated stressors, the disaster's effects may be mitigated by timely and developmentally appropriate interventions. Young children tend to express distress within the context of the relationship with their primary caregiver. For example, anxiety is commonly expressed as clinginess and proximity-seeking towards the caregiver (Osofsky 2011a). Thus, a treatment intervention that is relationship based including both caregiver and child is most likely to be effective. One such treatment approach, Child Parent Psychotherapy (CPP; Lieberman and Van Horn 2008) allows for the joint construction of meaning and a trauma narrative through play. Given that repetitive play about the hurricane is a common symptom of distress, creation of a meaningful narrative about a previously unimaginable experience can significantly

decrease anxiety. Through this narrative, the caregiver's and child's trauma responses are normalized, and the caregiver gains a greater understanding of the child's behavior, which may initially be experienced by the caregiver as willful disobedience or manipulation rather than as a developmentally appropriate expression of depression or anxiety. Further, a natural disaster can render feelings of powerlessness in both caregiver and child. Relationship-based interventions can focus on safety and help the child gain a sense of trust and safety within the child-caregiver relationship. When a child feels safe with their caregiver, the child may be better able to return to a normal developmental trajectory and achieve cognitive, social, and emotional milestones in a timely manner. Interventions, such as CPP, also have the capacity to address complex trauma, an important asset to any trauma treatment, especially since previous loss or trauma is highly predictive of distress following a natural disaster.

Separations, losses and direct exposure experienced by young children following Hurricane Katrina may have been particularly traumatic because of the importance of secure attachments and stability in the early years (Bowlby 1969, 1973; Masten and Osofsky 2010; Osofsky and Osofsky 2010). The findings presented in the paper are clinically relevant and suggest the need for mental and behavioral health treatment for children impacted by disaster, particularly those children who experience trauma exposure or attachment-related stressors such as caregiver disruption or other non-human losses. The preschool period may be a particularly important time for intervention given that this developmental stage marks the beginning of preoperational thought and is an important period of pre-academic, social, and emotional development. During this time, the child grows more independent, learns to interact with peers, and makes important gains in self-help and adaptive functioning skills. Without intervention, symptoms of psychopathology, such as PTSD and depression, can interfere with the child's developmental trajectory leading to long-term social, emotional, and academic difficulties.

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