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Children's Postdisaster Trajectories of PTS Symptoms: Predicting Chronic Distress

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Abstract

Background—There are no studies of the distinct trajectories of children's psychological distress over the first year after a destructive natural disaster and the determinants of these trajectories.

Objective—We examined these issues using an existing dataset of children exposed to Hurricane Andrew, one of the most devastating natural disasters in US history.

Methods—At 3-months postdisaster, 568 children (55 % girls; grades 3–5) residing in areas most directly affected by the hurricane completed measures of hurricane exposure and stressors, social support, coping, and general anxiety. Children also reported major life events occurring since the hurricane (at 7-months) and posttraumatic stress (PTS) symptoms at 3-, 7-, and 10-months postdisaster.

Results—Latent growth mixture modeling identified three trajectories of PTS reactions: resilient (37 %), recovering (43 %), and chronic distress (20 %). Predictors of the trajectories were examined. Odds ratios indicated that, compared to the resilient trajectory, girls were more likely to be in the recovering and chronically distressed trajectories, as were children reporting higher anxiety and greater use of coping strategies that reflected poor emotion regulation. Compared to the recovering trajectory, children in the chronically distressed trajectory had greater odds of reporting high anxiety, less social support, more intervening life events, and greater use of poor emotion regulation strategies.

Conclusions—Hurricane exposure may be less effective in identifying children who develop chronic postdisaster distress than other child (anxiety, coping) and contextual variables (social support, life events). Effective screening after disasters is critical for identifying youth most in need of limited clinical resources.

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Keywords

Natural disasters; Posttraumatic stress; Resilience; Trajectories; Trauma; Children

Introduction

Understanding children's psychological reactions after natural disasters represents an important public mental health concern. During the 1990s, approximately 66.5 million children worldwide were exposed to natural disasters annually (Pronczuk and Surdu 2008). Due to climate change, which is expected to bring about more severe weather events throughout the world, the number of children affected by natural disasters is expected to increase to 175 million children annually over the next decade (Borenstein 2011; Seballos et al. 2011).

As accumulating evidence reveals, a significant percentage of children who are directly exposed to natural disasters display stress reactions, especially symptoms of posttraumatic stress (PTS), which can interfere with functioning and contribute to problems in development (Furr et al. 2010; La Greca and Silverman 2012; La Greca et al. 2010; Yelland et al. 2010). In several studies, over 50 % of children assessed 3–6 months after a destructive natural disaster displayed elevated levels of PTS symptoms (Kolaitis et al. 2003; Scheeringa and Zeanah 2008; Vernberg et al. 1996). Prospective studies reveal that initial postdisaster levels of PTS decline over time in most youth (Bonanno et al. 2010); however, PTS symptoms remain elevated in a significant proportion of youth even 10 months to 2 years postdisaster (Eksi and Braun 2009; Goenjian et al. 2011; La Greca et al. 1996, 2010; Lai et al. 2013; Shaw et al. 1996; Weems et al. 2010).

While research has improved our understanding of children's postdisaster functioning, there are still important gaps in the literature that limit our ability to identify and help youth who are severely affected by disasters. Specifically, there is no study of the distinct trajectories of children's psychological distress over the first year after a destructive natural disaster and the determinants of these trajectories. As a result, we have limited information about factors occurring early on in the postdisaster environment that differentiate children who display persistent or chronic PTS symptoms from those who gradually recover over time. This latter issue is especially important because early screening efforts to identify youth with high levels of PTS symptoms will result in many children being categorized as at-risk, even though most of these youth are likely to recover over time and may not need intensive interventions.

Based on these gaps in our understanding of children's postdisaster reactions, the goals of the present study were: to examine trajectories of children's psychological distress over the first year after a destructive hurricane, and to examine the factors that differentiated the trajectories. Identifying trajectories of PTS reactions represents a person-centered approach to understanding children's postdisaster distress (Bonanno et al. 2010), wherein individuals are characterized by their patterns of PTS symptoms over time. Until now, research examining children's postdisaster reactions has used a variable-centered approach, which focuses on group averages in psychological functioning (e.g., La Greca et al. 1996, 1998; Pina et al. 2008; Sahin et al. 2007). Although this approach has been important and valuable, it does not reveal information about children's differing patterns of distress over time, nor does it reveal the proportion of youth who experience chronic distress versus those who recover.

In fact, studies of adults recently have shifted from a variable-centered to a person-centered approach (Bonanno et al. 2006, 2010; Orcutt et al. 2004; Norris et al. 2009) as a framework for understanding postdisaster resilience and varying patterns of postdisaster distress. Across different types of stressors, including disasters, this research has identified four prototypical patterns or trajectories of adults' responses: resilient, recovering, chronic, and delayed (Bonanno et al. 2005, 2006, 2010). In the context of disasters, the most common pattern (often 50 % or greater) is one of resilience; individuals with this pattern exhibit low levels of psychological symptoms (or a stable trajectory of healthy functioning) over time (Bonanno et al. 2010). Also common is a recovery pattern, characterized by initial elevations in symptoms, but with a gradual decrease in symptoms over time. Much less common is a chronic pattern (30 % or less) reflecting high, persistent symptom levels over time, or a delayed pattern (15 % or less) reflecting moderate symptoms that gradually worsen over time (Bonanno et al. 2010). Individuals exhibiting these latter two patterns are of most concern from an intervention standpoint because they do not appear to recover on their own following the disaster event.

To our knowledge, only one study attempted to characterize youths' patterns of post-disaster distress over time using this resilience framework.Kronenberg et al. (2010) evaluated a mostly adolescent sample of youth (n = 387; mean age 14.27 years) 2 and 3 years post Hurricane Katrina. Using a screening score (i.e., endorsing four or more items at an elevated level) for a 22-item measure that assessed both PTS and depressive symptoms, youth were grouped into four categories: resilient (45 %; consistently below screening cutoff), recovering (27 %; above cutoff at Time 1 but not at Time 2), chronic (23 %; above screening cutoff at both time points), and delayed (5 %; below cutoff at Time 1 but elevated at Time 2). Children, females, youth who experienced loss or trauma before or after the hurricane, and youth who had more life disruption after the hurricane were more likely to have a negative postdisaster pattern.

This study is important because it is the first to evaluate youths' patterns of postdisaster distress. At the same time, several limitations temper the conclusions that can be drawn. First, the initial study assessment was conducted 2 years after the disaster exposure, when many youth have presumably already recovered. The timing of the assessment does not provide information about youths' initial postdisaster functioning; yet, such information is crucial for informing early intervention efforts. Second, the investigators could only include youth with complete data at two time points, thereby reducing the initial sample of 1,826 youth to 387 participants (21 % of the original sample). Finally, the patterns of response were determined a priori rather than empirically. Adult disaster researchers have begun to address this issue by identifying latent trajectories of postdisaster outcomes using growth mixture modeling (Muthen and Muthen 1998–2007); such analyses identify the trajectories that best fit the data and determine trajectory membership on an empirical basis (Bonanno et al. 2010).

The current study addressed the above limitations by using growth mixture modeling to reanalyze and extend findings from a large cohort of children (n = 568) who were assessed 3-, 7- and 10-months after Hurricane Andrew (La Greca et al. 1996; Vernberg et al. 1996). Hurricane Andrew is one of only two Category 5 hurricanes to ever make landfall in the US, and until Hurricane Katrina, it was the most costly and devastating hurricane in US history (Insurance Information Institute 2012). We conducted a reanalysis of this data set because, to our knowledge, this remains the only prospective study of children's reactions after a natural disaster that has data from three postdisaster time-points (including an early postdisaster assessment) and also has a sufficiently large cohort to analyze children's trajectories of PTS symptoms. Advanced longitudinal modeling procedures, such as latent growth mixture modeling (LGMM; Muthen and Muthen 1998–2007), require three or more

assessments, and this type of multi-wave prospective study is exceedingly rare in the child disaster literature.

One important feature of the estimation procedures, especially in the postdisaster context, is that they can include all study participants. In our earlier report of children's functioning after Hurricane Andrew (La Greca et al. 1996), which used regression analyses, we were only able to include children with complete data at all three assessments; this procedure excluded almost 25 % of the initial cohort. Analyses that include all child participants would enhance the representativeness of the study findings, as many children who were adversely impacted by Hurricane Andrew moved, relocated, or were absent from school (La Greca et al. 1996), similar to reports for other prospective disaster studies (e.g., Kronenberg et al. 2010; La Greca et al. 2010; Shaw et al. 1996).

Thus, using our Hurricane Andrew data set, we identified the trajectories of PTS symptoms that characterized children's postdisaster reactions and the prevalence of these trajectories. This allowed us to empirically determine whether or not children's patterns of postdisaster functioning are best captured by the resilient, recovering, chronic, and delayed patterns observed in adults, or by some other types. Our analyses also provided an estimate of the prevalence of the various postdisaster trajectories, which could be useful for planning postdisaster interventions.

Our second, related study aim was to examine variables occurring early on in the postdisaster recovery period that predicted children's postdisaster trajectories over time. Such information could facilitate the early identification of children who go on to experience chronic distress, and help to differentiate these children from those who eventually recover.

Our prior work following Hurricane Andrew (La Greca et al. 1996; Vernberg et al. 1996), as well as work following other natural disasters (Agustini et al. 2011; La Greca et al. 1998, 2010; McDermott et al. 2010; Weems et al. 2007; see La Greca and Silverman 2012) highlights the importance of several conceptual factors that are concurrently or prospectively related to children's PTS symptom severity postdisaster. These factors include: (a) child characteristics (e.g., female gender, ethnic minority status, general anxiety levels); (b) disaster exposure (e.g., greater life threat, greater loss and disruption); and (c) aspects of the postdisaster recovery environment, such as the presence of stressors (e.g., life disruptions, major life stressors), the availability of social support, and strategies children use for coping with the disaster. The present study examined these factors as predictors of children's postdisaster trajectories.

Another novel feature of this reanalysis, which extends our previous findings, is that we included a measure of children's general anxiety levels administered early in the postdisaster period. This variable was not included in our prior analyses of children's disaster reactions (La Greca et al. 1996). However, since that time, other studies have recognized the importance of general anxiety in understanding children's PTS severity after a natural disaster (Bonanno et al. 2010; La Greca et al. 1998; Weems et al. 2007). It is possible that high levels of child anxiety that are apparent during the early disaster recovery period might differentiate those who develop persistent PTS from those who eventually recover. This issue has not been examined in the child disaster literature and we addressed this issue in the present study.

In summary, this study identified trajectories of children's psychological distress over the first year after a destructive hurricane and the determinants of these trajectories. By using LGMM, we were able to include all children who participated in a prior prospective study of children's stress reactions following Hurricane Andrew and to incorporate new data on children's early anxiety levels as a potential predictor variable. In our prior prospective

study (La Greca et al. 1996), we found that children's PTS levels almost a year after the hurricane were predicted by greater levels of hurricane exposure (life threat), greater hurricane stress (greater initial loss/disruption after the hurricane), more life events, less social support, and more negative coping strategies (e.g., blame and anger). However, without information about trajectories, it is not clear how many of the high PTS youth were in the process of recovering versus those who were experiencing chronic distress. Moreover, when we controlled for initial PTS levels in predicting children's distress at 10-months postdisaster, it appeared that only those from minority backgrounds (i.e., Black, Hispanic) and those who experienced intervening life events were less likely to evidence declines in PTS symptoms. These variables were included in the present study analyses, to determine how well they predicted children's patterns of PTS over time.

Method

Participants

Participants were 568 children (56 % girls; M age = 9.33, SD = .98), in the 3rd to 5th grades, who participated in the initial 3-month postdisaster assessment (Time 1) of children's functioning following Hurricane Andrew (see Vernberg et al. 1996 for more details).

Children were enrolled in one of three elementary schools in south Miami-Dade County, FL, and all three schools were in the direct path of Hurricane Andrew, within the "eye wall" of the storm (Powell and Houston 1996). Thus, all schools and the neighborhoods surrounding the schools were severely affected by the storm. Children were ethnically diverse (44 % White, 26 % Hispanic, 22 % Black, 8 % Asian/Other). Due to attrition at Time 2 (7 months postdisaster) and Time 3 (10 months postdisaster), the initial sample was reduced to 442 children (78 % of the cohort) for our prior prospective analyses (see La Greca et al. 1996). However, in the present study, all 568 of the initial participants were included in the analyses.

Procedures

After obtaining approval from the relevant university IRBs (University of Miami, Florida International University) and the Miami Dade County Public Schools, active parental consent was obtained at the beginning of the school year for children to participate in the three-wave prospective study (see La Greca et al. 1996; Vernberg et al. 1996 for more details on the procedures). Written child assent was obtained at the start of each testing session. Children were assessed in November 1992, March 1993, and June 1993 (i.e., 3-, 7-, and 10-months post-hurricane). Questionnaires were administered in groups of 10–25 children, with at least one research team member present per 10 children. Items were read aloud while children followed along and marked their answers; research team members answered any questions that the children had during the administration.

Study Design and Measures

The current study was a three-wave, short-term prospective study of children's postdisaster reactions. The measure used to evaluate children's postdisaster trajectories of PTS symptoms was the *Posttraumatic Stress Disorder Reaction Index for Children* (*PTSD-RI*); it was administered at all three postdisaster time points. The predictors used to differentiate the trajectories were administered at Time 1 (3 months postdisaster). Specifically, at Time 1 (3 months postdisaster), children reported on their demographic characteristics, hurricane-related experiences (including hurricane exposure and hurricane-related stressors), the coping strategies they used with hurricane stressors, their perceptions of social support, and their current levels of anxiety and PTS. At Time 2 (7 months postdisaster), children also

reported on the occurrence of major life events since the hurricane. At Time 3 (10 months postdisaster) children reported current levels of PTS symptoms.

Posttraumatic Stress Symptoms—The *PTSD-RI* (Frederick 1985) assessed children's PTS symptoms. This widely used 20-item self-report measure was based on DSM-III-R criteria for PTSD (American Psychiatric Association 1987); items were worded to reflect children's reactions to Hurricane Andrew. Children rated the frequency of PTS symptoms during the previous few weeks (0 = *none of the time*; 4 = *most of the time*). The PTSD-RI yields a total severity score (range = 0–80), with higher scores reflecting greater PTS severity. The PTSD-RI has been used extensively to study child and adolescent responses to natural disasters, including hurricanes (Lonigan et al. 1991, 1994), earthquakes (Goenjian et al. 2005) and bushfires (Yelland et al. 2010); it has good convergent validity and internal consistency (Frederick 1985); Vernberg et al. 1996). In the present sample, internal consistency was .89 at Time 1.

Demographic Characteristics—At Time 1, a background questionnaire was used to obtain information on children's age, gender, and ethnicity. Gender was coded as 0 = boys, 1 = girls. Ethnicity/race was coded with two dummy codes, one for Black, and one for Hispanic.

Hurricane-Related Traumatic Experiences—*Hurricane-Related Traumatic Experiences* (*HURTE*; La Greca et al. 1996; Vernberg et al. 1996) assessed children's hurricane exposure (perceived and actual life threat) and hurricane-related stressors (immediate loss/disruption). *Perceived life threat* was measured by one Yes/No item (i.e., "Did you think you might die during the hurricane?"). *Actual life threat* was measured with six Yes/No questions about exposure to actual life threatening events during the hurricane (e.g., "Did a window or door break in the home you stayed in during the hurricane?"). Items rated "Yes" were summed to yield a total score, with possible scores ranging from 0 to 6. *Hurricane-related immediate loss and disruption* was assessed with ten Yes/No items ("Did you move to a new place because of the hurricane?"); items were summed to create a total score (possible range from 0 to 10).

Anxiety—The *Revised Children's Manifest Anxiety Scale* (*RCMAS*; Reynolds & Richmond 1985) assessed children's general anxiety levels during the early postdisaster recovery period. The RCMAS contains 28-items that ask about the presence (Yes/No) of anxious symptoms (e.g., "I worry about what other people think about me"). "Yes" responses are summed across items to obtain a total score (range = 0–28). Extensive data support the psychometric properties of this instrument (Reynolds and Richmond 1985); internal consistency in this sample was .86.

Social Support—The *Social Support Scale for Children* (*SSSC*; Harter 1985) is a 24-item self-report measure assessing children's perceptions of social support from their parents, classmates, teachers, and close friends. Children choose between two statements (e.g., "Some kids have a teacher who helps them if they are upset and have a problem, but other kids don't have a teacher who helps them if they are upset and have a problem.") and then indicate if statements are "sort of true" or "really true" for them. Items are scored from 1 to 4, and averaged across relevant items; higher scores indicate greater support. For this study, we averaged children's ratings across all sources of support. This widely used measure has been validated for use with children (Dubow and Tisak 1989; Harter 1985), and internal consistency for this sample was .88.

Children's Coping—The *Kidcope* is a brief coping checklist developed to assess the frequency of children's use of 15 different coping strategies (Spirito et al. 1988). A specific stressor is named (i.e., "the worst things that happened to you because of the hurricane"), and children indicate how frequently they used each coping strategies to deal with the stressor (1 = *not at all*, 4 = *almost all the time*). For the current study, we used the average of the three items that reflected "blame and anger" (blame myself for causing the bad things; blame others for causing the bad things; yell, scream, or get mad). Factor analyses revealed this to be one of the key factors reflected in the *Kidcope* (Vernberg et al. 1996). We selected this factor for the current study because it was the aspect of coping that was most related to children's PTS symptoms in our prior work (La Greca et al. 1996), and because other studies have associated poor emotion regulation strategies with PTS symptom severity (Ehring and Quack 2010).

Life Events—A short form of the *Life Events Schedule* (Johnson 1986) was administered to children 7-months postdisaster, and assessed major life events that occurred during the recovery period. It included 13 items pertaining to major personal loss and life disruption (e.g., death of a parent or family member, divorce, birth of a sibling, hospitalization of a family member), which may or may not have been disaster related. Children marked "yes" for each event's occurrence, and the total number of events was calculated (range = 0–13). Research supporting the validity of this scale has been provided by numerous studies examining the association between life events and child health and adjustment (see Johnson 1986). This measure has also been used in subsequent child disaster research (e.g., La Greca et al. 2010).

Analytic Plan

LGMMs were analyzed using *Mplus* (version 6.11) to identify latent trajectories of children's PTS responses. *Mplus* accommodates missing data by using full information maximum likelihood (Muthen and Muthen 1998–2007), and thus all 568 children who participated in the study were included in the analyses.

The first step in the analyses was to determine the number of trajectories that best fit the data. Unconditional LGMMs (i.e., models with no predictors) were estimated for one- to five-trajectories.

Decisions about the number of trajectories to retain were made based upon fit indices, prior research, parsimony, and interpretability (Jung and Wickrama 2008). Specifically, we examined common fit indices for LGMMs. These fit indices included: entropy, Bayesian Information Criterion (BIC), Lo-Mendell-Rubin likelihood ratio test (LMR-LRT), the bootstrap likelihood ratio test (BLRT), and posterior probabilities (Jung & Wickrama). Entropy is a measure of the degree to which latent trajectories may be clearly distinguished, and entropy values can range from 0 to 1, with higher values indicating greater clarity in distinguishing trajectories. The BIC is partially based on the likelihood function, and smaller BIC values indicate a better model fit. LMR-LRT and BLRT values compare a model with "k" trajectories to a model with "k - 1" (i.e., one fewer) trajectories; thus, if the values for LMR-LRT and BLRT are significant, it indicates that the model with k trajectories is a significantly better fit than the solution with one fewer (k - 1) trajectories. Finally, posterior probabilities indicate the degree to which individuals have been correctly classified into a trajectory; these values range from 0 to 1, with higher values indicating a higher likelihood that children have been correctly classified. Thus, models were judged to have a better fit if they had higher entropy, a lower BIC value, a significant LMR-LRT and a significant BLRT, and higher posterior probabilities (Jung and Wickrama 2008).

Next, using the best fitting models, we ran conditional LGMM models; that is, models containing risk and protective factors as predictors. Risk and protective factors were identified a priori as likely to predict trajectory membership; all the predictors were entered simultaneously. We were aware of the fact that too many predictors with weak associations to children's distress could impair model convergence. Thus, the predictors we included in the covariate analyses were limited to the following: (a) child characteristics (gender, Black and Hispanic ethnicity, general anxiety levels); (b) hurricane-related exposure (perceived and actual life threat) and stressors (initial hurricane-related loss and disruption); and (c) key aspects of the recovery environment (availability of social support, occurrence of major life events, child use of blame-anger coping strategies for hurricane-related stress).

Results

Descriptive Information

Detailed descriptive information on the sample characteristics, variables means, and correlations among the variables have been previously reported for most of the study variables (see La Greca et al. 1996; Vernberg et al. 1996). In addition, children's reports of their general anxiety symptoms, as assessed by the RCMAS, were $M = 10.27$, SD = 7.43 at Time 1.

Trajectories of Children's PTS Reactions

Identifying Trajectories—Table 1 includes a summary of the fit statistics for the unconditional LGMMs with one to five trajectories. The three- and four-trajectory models were both plausible based upon fit indices and theory, as discussed below.

Initially, we selected four trajectories based upon the fit indices and theory. With regard to fit, this model had a comparatively lower BIC score with relatively higher entropy, when compared to the others. The four-trajectory model was of theoretical interest because it appeared to replicate the four trajectories described in adult disaster research (Bonanno et al. 2010): resilient, recovering, chronic, and delayed.

Based on functional form, the trajectories in the four-trajectory unconditional LGMM were labeled: (a) resilient (45 %), (b) recovering (38 %), (c) chronic (13 %), and (d) delayed (4 %). Of note, the delayed class was very small ($n = 21$; less than 4 % of the sample) and was likely to be an unstable trajectory. However, we tested this model further (as described below) before confirming or discarding this model.

Because of the very small size of the "delayed" trajectory in the four-trajectory model, the three-trajectory model was also considered as a potential solution. Based on functional form, the trajectories in the three-trajectory solution were labeled: (a) resilient, (b) recovering, and (c) chronic. The three-trajectory model also provided a good fit for the data (i.e., significant LMR-LRT and good posterior probabilities), and was consistent with theoretical and empirical approaches to understanding children's trajectories of traumatic stress. For example, a study of youths' trajectories of distress following a traumatic injury (e.g., Le Brocque et al. 2010) obtained a three-trajectory solution that reflected resilient, recovering, and chronic distress patterns.

Predictors of Trajectories for the Four-Trajectory Model—Variables that represented risk or protective factors for postdisaster PTS were examined as predictors of children's postdisaster trajectories. These variables were: child characteristics (gender, Black and Hispanic ethnicity, anxiety symptoms); hurricane-related exposure (perceived and actual life threat) and stress (immediate loss/disruption); and early recovery variables

(availability of social support, occurrence of major life events, child use of blame-anger coping). All predictors were included in the model simultaneously (i.e., controlling for each other).

When the risk/protective factors were added to the four-trajectory model, the size and meaning of the model changed. The delayed trajectory disappeared from the model and was replaced by a low symptom trajectory; that is, a group of children who reported low levels of PTS symptoms across time. This instability in trajectory structure indicates potential model misspecification of predictors, but could also indicate that the wrong trajectory solution was selected for this sample. Given the very small size of the delayed trajectory, this instability was not surprising. Based on these results, we considered that the three-trajectory solution might be the preferred solution.

Predictors of Trajectories for the Three-Class Model—We next ran a conditional LGMM for the three-trajectory solution that contained the same a priori risk and protective variables, all entered simultaneously. When these variables were added to the model, the size and meaning of trajectories remained stable, indicating that an appropriate solution was chosen. With the predictor variables entered, the three trajectories of PTS symptoms (and their prevalence) were: resilient (37 %), recovering (42 %), and chronic (20 %). For each trajectory group, mean levels of PTS symptoms at 3 months postdisaster (i.e., the intercept) and of PTS symptom change per month (i.e., slope) are listed in Table 2 and depicted in Fig. 1. Significant values indicate that the intercept or slope for the trajectory was significantly different from zero.

The resilient trajectory showed low levels of PTS symptoms with a small but significant decline across time. The recovering trajectory included children with elevated PTS symptoms at 3-months, which declined sharply by 10 months. Finally, the chronic trajectory consisted of children with clinically significant PTS symptoms, which also declined from 3 to 10 months postdisaster, but which remained above or near the clinical range.

Next, odds ratios were examined to determine which risk and protective factors predicted the likelihood of falling into one of the three trajectories. For these analyses, it was necessary to designate a reference group. Two sets of comparisons were conducted: (a) analyses comparing the recovering and chronic trajectories to the resilient trajectory, and (b) analyses comparing the chronic trajectory to the recovering trajectory (see Table 3). In each analysis, all predictor variables were simultaneously controlled.

Recovering and Chronic Trajectories Versus the Resilient Trajectory—As revealed in Table 3, child gender, anxiety, and coping significantly differentiated the trajectories. Specifically, the odds of being in the recovering trajectory relative to the resilient one were three times higher for girls, as compared to boys; and the odds of being in the chronic rather than the resilient trajectory were six to seven times higher for girls as compared to boys. The odds of being in the recovering or chronic trajectory rather than the resilient trajectory were one-and-a-half to two times greater for each additional symptom of general anxiety children reported, and were five to seven times greater for each additional blame and anger coping strategy children endorsed.

No other risk factor differentiated the recovering or chronic trajectories from the resilient trajectory. Interestingly, children's disaster exposure (i.e., perceived and actual life threat) and disaster-stressors (i.e., loss and disruption) did not differentiate the recovering and chronically distressed trajectories from the resilient one, with all variables simultaneously controlled. Because of this, we also conducted a follow-up analysis using only the disaster-related exposure and stressor variables. In doing so, we found that children who reported

perceived life threat and/or more immediate loss/disruption were two to three times more likely to fall in the recovering or chronic trajectories than the resilient one. In addition, for each additional actual life threatening event children reported, they were about two times more likely to fall in the chronic trajectory than the resilient one (all *p*'s <.05).

Chronic Trajectory Versus the Recovering Trajectory—As seen in Table 3, child anxiety, as well as several recovery variables (social support, major life events, and blame/anger coping) significantly differentiated the chronic from the recovering trajectory. Specifically, the odds of being in the chronic trajectory relative to the recovering trajectory were greater when children reported greater general anxiety, intervening life events, and use of blame/anger coping, and lower levels of social support during the initial recovery period. No other variables significantly differentiated the chronic versus the recovering trajectory.

Again, for a follow-up analysis, we examined only the disaster exposure and disasterstressor variables as predictors. For every additional actual life threatening event or immediate loss and disruption event that children reported, they were almost one and a half times more likely to fall in the chronic versus the recovering trajectory.

Discussion

The current study is the first to examine children's trajectories of PTS symptoms during the first year following a catastrophic natural disaster. We identified three latent trajectories of PTS symptoms (resilient, recovering, and chronic) as well as several risk and protective variables that significantly differentiated the trajectories. Child gender and general anxiety levels, as well as several recovery variables (perceived social support, intervening life events, and child use of blame/anger coping strategies to deal with hurricane-related stressors) differentiated the various patterns of children's postdisaster response. Key findings are discussed below.

Children's Patterns of Postdisaster Distress

Our first study aim focused on identifying children's trajectories of PTS symptoms. This study is the first to utilize LGMM in order to provide empirical evidence for children's trajectories of PTS symptoms during the first year after a natural disaster and for the prevalence rates of these trajectories. This statistical approach is particularly well suited to understanding children's patterns of postdisaster functioning because it can accommodate participants with missing data (which is common in prospective postdisaster studies) and has the possibility of detecting latent trajectories that have not been previously conceptualized (Bonanno et al. 2010). Further, this person-centered statistical approach may be useful in future disaster research to help clarify natural heterogeneity and variability (Bonanno and Mancini 2012) in children's functioning after disasters. For example, person centered analyses could be used to understand children's multiple postdisaster outcomes (e.g., anxiety, depression, as well as PTS symptoms) and whether there may be patterns of these internalized distress outcomes among children. In addition, person centered analyses may help identify heterogeneous patterns of risk and protective factors present among children exposed to disasters.

Using LGMM, three trajectories appeared to best capture children's patterns of PTS severity over the course of the first school year after Hurricane Andrew: resilient, recovering, and chronic distress. Several aspects of these findings are noteworthy.

First, and this is the good news, a large percentage of the children (close to 40 %) had a pattern of response that reflected resilience, even in face of a highly destructive disaster. Hurricane Andrew was particularly devastating (a "high impact" disaster; Norris et al.

2002), as the extremely high sustained-winds (in excess of 160 miles per hour) led to incredible devastation of homes and neighborhoods, and many children and families were in their homes when the destruction occurred. In fact, 60 % of the children in this sample reported that they "thought they would die" (perceived life threat) during the storm and over 60 % reported three or more disaster-events that reflected significant loss and life disruption (e.g., home damaged or destroyed; attending a new school; clothes or toys ruined; trouble getting food or water; separation from parents for a week or more; see Vernberg et al. 1996). Thus, it is remarkable that so many children exhibited a resilient pattern of functioning, and this finding is compatible with postdisaster findings for adults (see Bonanno et al. 2010; Norris et al. 2009).

Second, among the children with initial elevations in PTS symptoms, more than twice as many children appeared to be recovering (43 %) versus those fitting a pattern of chronic distress (20 %). Although this is also good news, it does complicate efforts to identify children in need of support and assistance during the early postdisaster recovery period. Specifically, because many children with initial elevations in PTS symptoms recover over time, efforts to screen youth based only on initial PTS symptoms will also identify youth who eventually go on to recover and may not be in need of intensive services. We address the issue of differentiating youth with recovering versus chronic distress patterns later on.

Third, the overall percentage of children whose pattern of postdisaster functioning reflected chronic distress was relatively small (about 20 %). Nevertheless, those youth are of substantial clinical concern, as they are likely to remain chronically distressed, or recover slowly. Postdisaster studies indicate that children reporting clinical elevations in PTS symptoms close to a year after a disaster are at high-risk for continued distress at 21 months postdisaster (e.g., La Greca et al. 2010; Shaw et al. 1996); others have found that children's PTS symptoms show little decline from 24 to 30 months postdisaster (Weems et al. 2010). Together, such findings suggest that children who fit the chronic trajectory during the first year postdisaster are at high-risk for continuing to exhibit high levels of PTS symptoms over time, and would be prime targets for clinical interventions.

Finally, our data did not provide support for the presence of a "delayed" trajectory of increasing levels of PTS symptoms over time. This trajectory has been reported in many studies of adult trauma survivors (see Bonanno et al. 2010), though certainly not all (e.g., Norris et al. 2009).Kronenberg et al. (2010) tried to identify a delayed pattern of response in youth affected by Hurricane Katrina on an a priori basis, finding that less than 5 % of the youth fit a delayed pattern and such youth did not differ from those with chronic distress. Similarly, La Greca et al. (2010) found that a very small percentage of children (4 % of those evaluated) reported clinically elevated PTS symptoms at 21 months after Hurricane Charley, but not at 9 months postdisaster; however, many of these children were close to clinical cutoffs at 9 months postdisaster. Further replication of the current study findings in other prospective samples of youth would help to clarify this issue. In particular, future child disaster studies that use LGMM to examine children's patterns of postdisaster reactions are needed, as these analyses identify the trajectories that best fit the data and determine trajectory membership on an empirical basis (Bonanno et al. 2010).

Predictors of Trajectories

Our second study aim was to identify predictors of children's various postdisaster trajectories. We were especially interested in identifying the variables that differentiate resilient youth from those who are distressed, and that differentiate children fitting a recovery pattern from those who remain chronically distressed. In this regard, it was interesting to see which variables did and did not differentiate the various patterns of children's postdisaster functioning.

First, in terms of variables that did discriminate the patterns, a key finding was that children's (higher) general anxiety levels, reported early on in the disaster recovery period, differentiated children fitting the recovering and chronic trajectories from those with a resilient pattern. Importantly, general anxiety also differentiated the children fitting the chronic distress pattern from those who appeared to be recovering. It is possible that high anxiety levels after the disaster could reflect ongoing anxiety or trait anxiety that was present even before the hurricane struck. Indeed, other studies have identified children's pre-disaster anxiety levels as a vulnerability factor for poor postdisaster reactions (La Greca et al. 1998; Weems et al. 2007), finding that children with higher anxiety levels *before* a hurricane report greater PTS symptoms afterward. In our study it was not possible to determine whether children's postdisaster anxiety levels were newly elevated or a continuation of predisaster anxiety; nevertheless, the findings are useful as they suggest that the presence of high levels of anxiety during the first few months postdisaster (whether or not anxiety was present before the storm) can help to differentiate children who go on to display chronic distress versus those who are on a path to recovery.

These findings regarding children's anxiety levels are also important because they raise the larger issue of understanding postdisaster comorbidity between PTS symptoms and other predisaster psychological risk factors for poor postdisaster adjustment, *especially* symptoms of anxiety and depression (Asarnow et al. 1999; Bonanno et al. 2010; La Greca et al. 1998; Weems et al. 2007). In fact, we recently reported that children with co-morbid elevations in PTS and depressive symptoms 8 months after Hurricane Ike were slower to recover and more likely to report clinically significant PTS at 15 months postdisaster (Lai et al. 2013) than those with elevated PTS symptoms alone. Although the importance of understanding comorbidity in children and adolescents postdisaster has been recognized (Goenjian et al. 2005; La Greca 2007; Scheeringa and Zeanah 2008), relatively little attention has been devoted to this issue. Yet, children reporting PTS with other comorbid symptom elevations (anxiety, depression) may identify youth who develop chronic distress. At a minimum, our findings suggest that children should be assessed comprehensively postdisaster (e.g., including their symptoms of anxiety and depression, as well as PTS), and that children displaying PTS along with other significant comorbid psychological difficulties may be important targets for early intervention efforts.

Second, this study confirmed the importance of social support, intervening major life stressors, and children's coping skills, in understanding children's postdisaster functioning and, importantly, in differentiating children fitting a pattern of chronic distress versus one of recovery. All these key variables *uniquely added* to the prediction of children's patterns of postdisaster functioning. The data confirm and extend prior findings on children's postdisaster functioning. For example, children's perceptions of social support have been consistently associated with better postdisaster functioning (see Bonanno et al. 2010; Lau et al. 2010; Pina et al. 2008). Life stressors occurring early in the recovery period also predict youths' later postdisaster distress (e.g., Goenjian et al. 2011; La Greca et al. 2010), and contribute to youths' deterioration in social support levels (e.g., La Greca et al. 2010). Other research points to children's avoidant coping behaviors (Pina et al. 2008) or poor emotion regulation strategies (La Greca et al. 1996) as contributing to children's postdisaster distress. An important extension of earlier findings is that together these key contextual variables, along with children's anxiety levels, may be useful in identifying chronically distressed youth.

Third, and also of interest, were the variables that *did not* differentiate the trajectories of postdisaster functioning: namely, disaster-related exposure and stressors. Specifically, children's perceptions of life threat and reports of life-threatening events during the hurricane (e.g., doors or windows breaking during the storm) and of immediate loss and

disruption (e.g., lost clothes and toys; changed schools) did not differentiate the trajectories, at least with all the predictors considered simultaneously. This is surprising, in that children's disaster exposure and stressors have been related to children's PTS symptom levels across multiple disasters (e.g., Goenjian et al. 2001; Yelland et al. 2010), including in our earlier reports on this sample (La Greca et al. 1996; Vernberg et al. 1996).

Further probing with our follow-up analyses indicated that disaster-related exposure and stressors did differentiate the trajectories when they were examined alone, without other predictors. Thus, it is possible that, with further distance from the disaster event, other more proximal variables (e.g., availability of social support, occurrence of other major stressors) influence children's distress levels. In fact, as our data suggest, these proximal, contextual variables may mediate the initial effects of disaster exposure and related stressors. It is also important to note that disaster exposure variables have been related to "levels" of PTS in prior research, but not necessarily to children's "patterns of functioning over time." Exposure variables may help to identify who is distressed but not reveal whether the distressed individual is on the road to recovery or is likely to display chronic problems.

Limitations and Future Directions

Although this study has several strengths and novel findings, several limitations and caveats should be considered when interpreting the results. First, the measures relied on child report. This is common in the child disaster literature and, in fact, there are concerns about the accuracy of adult reports of child PTS symptoms (La Greca et al. 2012). Nevertheless, obtaining multiple perspectives on child functioning would be desirable.

Second, given the school-based nature of the study, it was difficult to obtain information about parental and family functioning. Yet, it remains the case that few studies have a family context to evaluate children's postdisaster functioning, and this should be an important priority for future child disaster studies.

Third, we lacked information on children's predisaster functioning. It is possible that children who were already distressed prior to the disaster were more likely to fit a chronically distressed trajectory. As noted, evidence indicates that pre-disaster anxiety and depression contribute to youths' postdisaster distress (Asarnow et al. 1999; La Greca et al. 1998; Weems et al. 2007). Though challenging, further study of pre-existing factors that contribute to patterns of postdisaster functioning would be highly informative (Bonanno et al. 2010).

Fourth, we also lacked systematic data on interventions that children may have received postdisaster. In the aftermath of Andrew, many organizations provided resources to the schools, including the National Organization for Victim Assistance (http://www.trynova.org), the American Red Cross, and the American Psychological Association's Disaster Relief Network (http://www.apa.org/practice/programs/drn/fact.aspx). In fact, several of the authors of this study developed school-based activities to help children cope with ongoing post-hurricane stressors (La Greca et al. 1994), and helped schools to implement the activities. Although we have no systematic data on which children and families received help, the various resources that were provided to children in schools may have been instrumental in helping many children and families recover from the hurricane. In fact, it is possible that without these psychological resources, the rates of children's recovery and resilience might have been much lower. Future studies that systematically track the availability and potential impact of postdisaster interventions would be highly useful and informative.

Finally, the last assessment was conducted 10 months postdisaster; it would be important to know what the PTS trajectories look like over more extended time periods. Children are a vulnerable population postdisaster (Bonanno et al. 2010; Norris et al. 2002), and some of the "costs" associated with children's disaster exposure include missed school and missed social opportunities, as well as increased exposure to stressors such as family illness and divorce (La Greca and Silverman 2009). Conducting multi-wave prospective studies with children over extended time periods is an important direction for future research, and the LGMM statistical approach used in this study will be important for understanding children's PTS trajectories over extended time periods.

Clinical Implications

In conclusion, our findings have public health implications for identifying and potentially helping youth in the aftermath of large-scale natural disasters. Our findings provide a nuanced picture of the variables that may be important to assess and target early in the postdisaster environment, in order to identify children who go on to experience chronic distress and who may need some form of early intervention. Screening procedures for children early on in the aftermath of disasters might focus on assessing children's PTS levels and also: (a) comorbid anxiety (and possibly other significant psychological problems such as depression; Lai et al. 2013), (b) ongoing stressors that may complicate recovery, especially major life stressors that may or may not be disaster related, (c) children's social support levels (which also can deteriorate as a function of ongoing stressors; La Greca et al. 2010), and (d) ways of coping with stress.

Further, the findings have implications for postdisaster prevention efforts. Efforts to enhance children's social support, help them deal with ongoing stressors, encourage their use of adaptive coping strategies (and avoiding strategies that reflect poor emotion regulation), and reduce anxious or worried feelings may be critical to consider (see La Greca and Silverman 2012).

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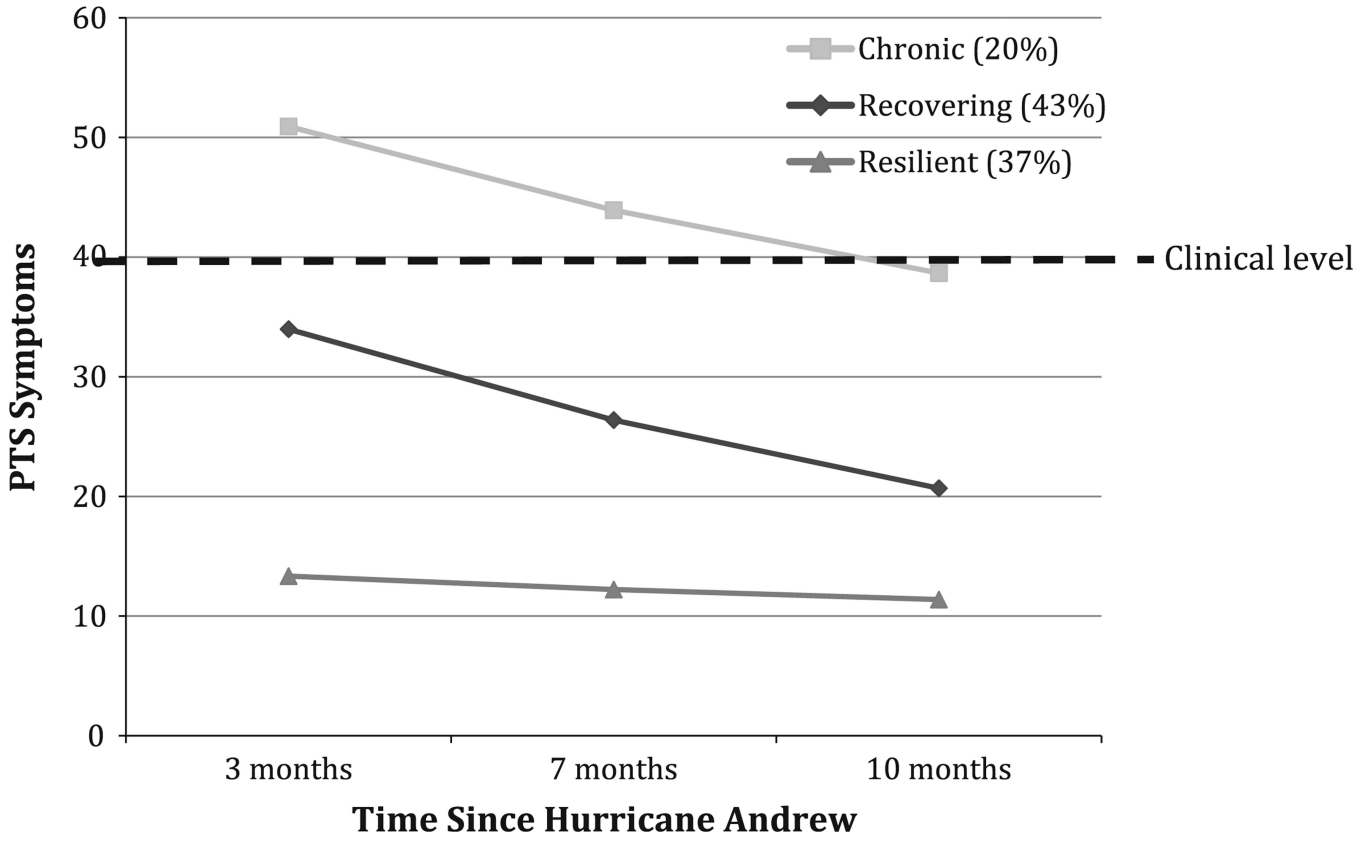

Fig. 1.
Trajectories of distress following hurricane Andrew

Table 1

Fit indices for latent growth mixture models: unconditional trajectory groups

Number of classes	Entropy	BIC	LMR-LRT	BLRT	Posterior probabilities
1	N/A	12,921.46	N/A	N/A	1
2	.73	12,554.03	<.001	<.001	.90–.93
3	.71	12,467.73	.001	<.001	.83–.89
4	.76	12,453.46	.21	<.001	.80–.90
5	.71	12,441.71	.29	<.001	.75–.89

BIC Bayesian information criterion, *LMR-LRT* Lo-Mendell-rubin likelihood ratio test, *BLRT* bootstrap parametric likelihood ratio tests, *N/A* not applicable

Table 2

Latent growth mixture models: three-trajectory group solution

Class	*n*	%	Intercept	Slope
Chronic	113	20	50.92***	−1.75***
Recovering	243	43	33.98***	−1.90***
Resilient	212	37	13.34***	−.28*

* $p < .05$,

*** $p < .001$

Table 3

Latent growth mixture models: odds ratios for the conditional three-trajectory group solution

	Comparison Group	Resilient		Recovering
	Identified Group	**Recovering (95 % CI)**	**Chronic (95 % CI)**	**Chronic (95 % CI)**
Child characteristics	Female	3.25* (1.21–8.74)	6.61* (1.63–26.78)	2.04 (0.76–5.52)
	Black	0.73 (.22–2.51)	0.59 (0.11–3.15)	0.81 (0.23–2.79)
	Hispanic	1.33 (.22–8.26)	1.63 (0.18–14.63)	1.23 (0.39–3.85)
	General anxiety	1.46* (1.19–1.79)	1.89* (1.42–2.51)	1.29* (1.13–1.48)
Hurricane exposure and stressors	Perceived life threat	1.63 (.52–5.08)	2.86 (0.62–13.16)	1.77 (0.42–7.48)
	Actual life threat	1.51 (0.80–2.85)	1.88t (.92–3.85)	1.24 (0.82–1.89)
	Immediate loss/ disruption	1.82t (.97–3.42)	1.95t (.92–4.12)	1.07 (0.80–1.45)
Early recovery variables	Social support	1.95 (.50–7.61)	0.83 (0.17–4.01)	0.43* (0.20–0.93)
	Major life events	1.11 (.68–1.82)	1.56t (.92–2.63)	1.40* (1.08–1.81)
	Blame/anger coping	5.77* (2.41–13.83)	7.79* (2.93–20.72)	1.35* (1.01–1.82)

CI confidence interval

t $p < .10$,

* $p < .05$