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# Trajectories of Psychological Distress Among Low-Income, Female Survivors of Hurricane Katrina

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The purpose of this study was to investigate trajectories of psychological distress among low-income, primarily unmarried and African American women who survived Hurricane Katrina ($N = 386$). Data were collected in the year prior to the hurricane as well as approximately 1 and 3 years thereafter. Using Latent Class Growth Analysis (LCGA), we detected 6 distinct trajectory groups. Over half of the participants fit into a trajectory consistent with resilience; that is, they maintained low levels of psychological distress over the course of the study, but experienced an elevation in symptoms at the first predisaster time point followed by a return to predisaster levels. The other trajectories reflected a range of psychological responses to disasters and indicated that predisaster functioning had a major influence on postdisaster psychological outcomes. Degree of exposure to hurricane-related stressors, experiences of human and pet bereavement, perceived social support, and socioeconomic status were significant predictors of trajectory group membership. Implications for research and policy are discussed.

Hurricane Katrina was one of the most devastating natural disasters in U.S. history, leading to nearly 2,000 deaths and over 650,000 residents displaced (Knabb, Rhome, & Brown, 2006; U.S. Department of Commerce, 2006). Low-income and African American communities were at disproportionate risk of damage and destruction from the storm and its aftermath (Logan, 2006), in part because of their increased likelihood of living in housing that was unable to withstand disaster exposure (Ruscher, 2006; Weems et al., 2007) and their proximity to levees in need of repair (Park & Miller, 2006). Furthermore, existing evacuation policies did not take into account the increased transportation needs of low-income citizens in the days leading up to the storm, heightening their risk for exposure (Lavelle & Feagin, 2006; Park & Miller, 2006) and postdisaster psychological distress (e.g., Brewin, Andrews, & Valentine, 2000). Low-income African Americans also faced additional stressors in the aftermath of the storm, including higher rates of residence in shelters and unemployment (Brodie, Weltzien, Altman, Blendon, & Benson, 2006; Elliot & Pais, 2006).

Not surprisingly, researchers have detected relatively high rates of psychological distress and disorder among women, low-income individuals, and African Americans exposed to Hurricane Katrina (e.g., Elliot & Pais, 2006; Rhodes et al., 2010). Yet, even among vulnerable groups, there is often remarkable strength and fortitude in responses to disasters. The primary purpose of this study is to investigate the variability in trajectories of psychological distress in a sample of low-income, African American mothers. Drawing on a data set that includes a measure of psychological distress from the year prior to the disaster as well as 1 year and 3 years thereafter, we document psychological distress trajectories among the women. In addition, we investigate how factors commonly associated with postdisaster psychological responses (e.g., demographic characteristics, disaster exposure, and social and material resources) predict trajectory group membership.

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## Previous Research on Traumatic Stressors

Although researchers have developed a rich understanding of psychological responses to ongoing adversity, less is known about the psychological trajectories of those facing more acute, traumatic stressors, such as natural disasters (Bonanno, Galea, Bucciarelli, & Vlahov, 2007). This imbalance stems, in part, from the unpredictable nature of disasters and the consequent reliance on cross-sectional, post hoc research designs (Benight & McFarlane, 2007). Indeed, only about 5% of natural disaster studies have included pretrauma data (Norris et al., 2002); yet, in the absence of such data, it is impossible to discern whether postdisaster elevations in psychological symptoms stem from preexisting conditions or are the result of the impact of the disaster and its aftermath. This is particularly concerning, given that previous researchers have found that predisaster indices of psychological symptoms are among the strongest predictors of psychological outcomes (e.g., Ginexi, Weihs, Simmens, & Hoyt, 2000; Weems et al., 2007).

Likewise, in the absence of multiple waves of postdisaster data, it is difficult to decipher whether survivors' initial distress lingers or, as is often the case, returns to predisaster levels. In fact, *resilience*, defined in this study as the return to predisaster levels of functioning after an initial postdisaster elevation in distress, is thought to be the normative psychological response (Bonanno, 2004). Other trajectories, including *chronic distress*,

wherein posttrauma psychopathology persists over time, and *delayed distress*, wherein the survivor has normative levels of functioning initially but later exhibits psychopathology, require both pretrauma data and multiple waves of postdisaster data (Hobfoll et al., 2009). Multiwave data sets are needed to decipher the patterns and predictors of survivors' responses to disasters and the factors that predict such responses.

## Investigating Psychological Distress Trajectories Statistically

Even with multiwave data sets, there is no consensus among researchers on how to best quantify or investigate such trajectories statistically. Continuous measures of psychological distress maximize the statistical variance that can be predicted, but such approaches leave to speculation how to categorize participants' resilience, growth, or decline (Luthar & Cushing, 1999). In addition, conventional growth curve modeling approaches assume that all participants come from the same population, that a single growth trajectory can be approximated for the entire sample, and that covariates affect growth the same way for each participant (Andruff, Carraro, Thompson, Gandreau, & Louvet, 2009; Jung & Wickrama, 2008; Raudenbush, 2001). These assumptions are at odds with theoretical frameworks and research findings that posit subpopulations that vary by socioeconomic status, risk status, and other dimensions and that exhibit varying patterns of growth and decline (Jung & Wickrama, 2008). Therefore, such techniques are thought to oversimplify the complex patterns of growth and decline within a given population (Jung & Wickrama, 2008).

To overcome these limitations, a common approach applied in previous studies of natural disasters is the use of cutoff scores or averages at each time point to categorize participants into groups representing stability and change over time (e.g., Bonanno et al., 2007; Hobfoll et al., 2009). Yet, with multiple waves of data, the sheer number of categories produced could undermine the utility of this approach, and categories with few participants could represent statistical outliers. Furthermore, cutoff points are somewhat arbitrary and do not adequately capture the variance in a data set.

An alternative approach is latent class growth analysis (LCGA), a person-centered technique wherein trajectory classes are produced through statistical analysis. Unlike conventional growth models, wherein it is assumed that all individuals come from the same population distribution, LCGA allows for different estimates for unobserved, or latent, classes within a sample (Nagin & Tremblay, 1999; Raudenbush & Bryk, 2002).[1] This approach fits the aims of the current study in that it allows for empirical identification of groups of individuals based on their patterns of psychological distress over time. These groups, in turn, can then be predicted through more conventional statistical methods (e.g., chi-square tests, analysis of variance).

Although ideally suited, few studies to date have deployed LCGA in their analysis of posttrauma resilience. Bonanno et al. (2008) used this approach in a study of severe acute respiratory syndrome (SARS) survivors in Hong Kong. Drawing from assessments at 6, 12, and 18 months after hospitalization, the researchers identified four latent classes (*chronic dysfunction*: consistently low psychological functioning; *delayed dysfunction*: initially high functioning, followed by a decrease to low functioning; *recovery*: initially low functioning, followed by an increase to high functioning; and *resilience*: consistently high functioning). More recently, deRoon-Cassini, Mancini, Rusch, and Bonanno (2010) used this approach with a sample of traumatic injury survivors at 1, 3, and 6 months after hospitalization and detected the same latent classes. In the aftermath of the September 11, 2001, terrorist attacks, Nandi, Tracy, Beard, Vlahov, and Galea (2009) identified five psychological trajectory groups among a representative sample of adult residents in the New York metropolitan area in the four-wave study, which spanned from approximately 6 to 30 months after the September 11th attack. The most common response was having few symptoms over time, but two groups had sustained increases (mild and severe, respectively), one group evidenced a decrease in symptoms, and the last group evidenced chronic symptoms. Lastly, Norris, Tracy, and Galea (2009) recruited representative samples in four-wave longitudinal studies in the aftermath of two disasters: the 1999 floods in Mexico and the September 11th terrorist attack. Six and seven trajectories were identified, respectively, with the most common response in both disasters being low levels of symptoms over time and lower proportions of other patterns.

Taken together, these studies have demonstrated the utility of LCGA and provided a better understanding of common psychological trajectories after a traumatic event. Yet, because none of the studies included pretrauma assessments, they do not fully measure patterns of responses. The primary purpose of this study was to redress this limitation by conducting LCGA with a three-wave data set that included one predisaster and two postdisaster assessments of psychological distress among low-income women who survived Hurricane Katrina.

In addition to understanding variation in psychological responses to disasters and other traumatic events, it is important for researchers to investigate variables that predict psychological trajectories. That is, what variables predict whether an individual exhibits one pattern (e.g., resilience) over another (e.g., chronic psychological distress)? Along these lines, researchers have identified several variables that seem to predict survivors' psychological responses. First, although the results have been mixed, research has suggested that demographic predictors, such as younger age, having young children, and being an ethnic minority, increase the risk of postdisaster psychopathology (e.g., Brewin et al., 2000; Elliot & Pais, 2006; Gibbs, 1989; Morrow, 1997). More consistently, researchers have demonstrated a dose–response relationship between indices of disaster exposure and postdisaster psychological distress (e.g., Goenjian et al., 2001; Shore, Tatum, & Vollmer, 1986).

[1]This is also true for growth mixture modeling (GMM), of which LCGA is a special case. What differentiates GMM from LCGA is that variance terms are fixed for LCGA; that is, intercept and slope terms are assumed to be constant within each class (Jung & Wickrama, 2008). With variance terms fixed, models are more easily specified and have faster convergence, as there are fewer terms to be estimated. An additional advantage is that LCGA allows for estimation of quadratic effects with only three waves of data, whereas GMM would require four.

Specific stressors endured during disasters, including human bereavement, pet loss, and displacement, have also been shown to heighten risk of psychological dysfunction (Gibbs, 1989; Lowe, Rhodes, Zwiebach, & Chan, 2009; Magdol, 2002). Although disaster exposure and stressors have shown associations with short-term psychological responses, less clear is how they relate to longer term psychological outcomes. Some researchers (e.g., Kaniasty & Norris, 2009; Smith & McCarty, 1996) suggest that persistent postdisaster psychological distress is more related to the chronic stressors following disasters (e.g., unstable housing, disrupted social support networks) than to disaster exposure. For example, lower social support and socioeconomic status are associated with higher levels of postdisaster psychological symptoms (e.g., Brewin et al., 2000; Elliot & Pais, 2006; Lowe, Chan, & Rhodes, 2010).

Again, however, most of this research has been cross-sectional, limiting our ability to understand associations between social and material resources and psychological distress over time. As argued by Luthar, Cichetti, and Becker (2000), resilience is a multidimensional phenomenon, occurring at different levels of analysis, including psychological, social, and economic domains. Phenomena at each level have the potential to be disrupted by a traumatic event and to rebound after such disruption. As such, the secondary aim of this study was to explore predictors of various psychological trajectories. We included variables that prior research has found to predict variation in disaster survivors' psychological responses, including demographic characteristics (age, race and ethnicity, number of children) and those related to disaster exposure (stressors endured during the hurricane, instances of bereavement and pet loss, and moves). We also included assessments of perceived social support and access to social benefits, a proxy for socioeconomic status, to determine how social and economic functioning at all three time points relate to psychological trajectories.

## The Current Study

The primary purpose of this study was to examine trajectories of psychological responses in a sample of low-income women who survived Hurricane Katrina. By conducting LCGA with a three-wave data set, including one predisaster wave, the study extends previous research on psychological responses. Through LCGA, both linear and quadratic patterns of growth and decline among trajectory groups were explored. The secondary purpose of the study was to determine factors associated with membership in each trajectory group, including demographic and disaster-related variables and indices of perceived social support and socioeconomic status assessed at each time point.

## Method

### Participants and Procedure

Participants were initially part of a study of low-income parents who had enrolled in three community colleges in the city of New Orleans in 2004–2005. The purpose of this initial study was to examine whether performance-based scholarships affected the academic achievement, health, and well-being of low-income parents (Richburg-Hayes et al., 2009). To be eligible for the study, students had to be between the ages of 18 and 34, be parents of at least one dependent child under 19, have a household income under 200% of the federal poverty level, and have a high school diploma or equivalent. Students were recruited through a general marketing and outreach campaign, which included flyers, newspaper and radio announcements, and oral presentations in mandatory orientation and testing sessions for incoming freshman. At baseline (i.e., upon enrollment in the study and prior to random assignment), participants provided primarily demographic information (e.g., age, race, number of children).

By the time Hurricanes Katrina and Rita made landfall on August 29, 2005, and September 24, 2005, respectively, 492 participants had been enrolled in the program long enough to complete a 12-month, predisaster follow-up survey (Time 1). Trained interviewers conducted the survey, which included measures of psychological distress and perceived social support and items assessing access to social benefits, over the phone and compensated participants with $20 gift cards. After Hurricanes Katrina and Rita, between May 2006 and March 2007, 402 of these 492 participants (81.7%) were successfully located and surveyed. Trained interviewers administered the postdisaster survey (Time 2), which included the same questions as the 12-month follow-up survey as well as a module of hurricane experiences and a measure of posttraumatic stress, and sent participants $50 gift cards. Approximately 3 years after the hurricanes, between April 2009 and March 2010, trained researchers administered an additional follow-up survey over the phone and compensated participants with $50 gift cards for their participation (Time 3). The Time 3 survey included the same measures as the previous surveys. All participants provided written consent to be part of the original study and verbal consent to participate in the postdisaster survey.

In this study, only participants who completed both the Time 1 and Time 2 surveys were included. Of these 402 participants, the subsample of male participants ($n = 16$) was dropped in light of consistent findings of gender differences in psychological distress following natural disasters (e.g., Norris et al., 2002). The analyses therefore drew on a sample of 386 women, 334 (86.5%) of whom also completed the Time 3 survey.

The mean age of the 386 women at baseline was 26.40 ($SD = 4.43$), and their average number of children at the 1-year follow-up was 1.95 ($SD = 1.06$). All of the participants reported living in an area affected by Hurricane Katrina, and nearly half (48.9%) reported living in areas affected by Hurricane Rita when it struck less than a month later. Most participants (84.8%) self-identified as African American, 10.4% as White, 3.2% as Hispanic, and 1.8% as "other."

### Measures

**Demographic variables.** Participants' age at baseline, race and ethnicity, and number of children at Time 1 were included as covariates. These variables were selected based on previous findings suggesting that they influence postdisaster psychological outcomes (e.g., Brewin et al., 2000; Gibbs, 1989).

**General psychological distress.** The K6 scale, a six-item screening measure of nonspecific psychological distress (Kessler et al., 2003), was used to assess pre- and postdisaster psychological distress. This scale has been shown to have good psychometric properties (Furukawa, Kessler, Slade, & Andrews, 2003) and has been used in previous research on the psychological functioning of Hurricane Katrina survivors (e.g., Galea et al., 2007). Participants rated items (e.g., "During the past 30 days, about how often did you feel so depressed that nothing could cheer you up?") on a 5-point Likert-type scale ranging from 0 (*none of the time*) to 4 (*all the time*). In the current study, linear SEM coefficients of reliability, following the guidelines of Yang and Green (2011), were .71 at Time 1, .80 at Time 2, and .81 at Time 3.

**Posttraumatic stress.** The Impact of Event Scale-Revised (IES-R), a 22-item self-report inventory of symptoms of PTSD (Weiss & Marmar, 1997) with good psychometric properties (e.g., Creamer, Bell, & Failla, 2003), was used to measure PTSD symptoms as a result of hurricane experiences. The total score for this scale ranges from 0 to 88, with scores above 33 classified as indicating probable PTSD (Weiss & Marmar, 1997). Unlike the other mental health measures we used, this measure was specific to the respondent's hurricane experiences and was included only in the post-Katrina surveys. Participants were asked how often, over the prior week, they were distressed or bothered by experiences related to the hurricane, with sample items including "Any reminders brought back feelings about it," "Pictures about it popped into my mind," and "I was jumpy and easily startled." The scale was rated on a 5-point scale, ranging from 0 (*not at all*) to 4 (*extremely*). Linear SEM coefficients of reliability, following the guidelines of Yang and Green (2011), in this study were .95 at Time 2 and .95 at Time 3.

**Hurricane-related stressors.** Four variables were included as indicators of hurricane exposure. First, a *Hurricane-Related Stressors* scale that included 16 questions assessed stressors experienced during the hurricanes and the week that followed. The questions were drawn from a larger survey of the demographic and health characteristics, evacuation and hurricane experiences, and future plans of Hurricane Katrina evacuees. *The Washington Post*, the Kaiser Family Foundation, and the Harvard School of Public Health jointly designed the scale (Brodie et al., 2006). Participants were asked to indicate whether they had experienced the following as a result of the hurricanes: (a) lacked enough fresh water to drink, (b) lacked enough food to eat, (c) felt their life was in danger, (d) lacked necessary medicine, (e) lacked necessary medical care, (f) had a family member who lacked necessary medical care, (g) lacked knowledge of safety of children, and (h) lacked knowledge of safety of other family members. These questions were asked for both Hurricane Katrina and Hurricane Rita, yielding 16 items in total. A composite score with the count of affirmative responses to these items was created (KR-20 = .84).

Second, a dummy code indicating whether participants had lost a family member or close friend because of the hurricanes and their aftermath (*bereavement*) was included, as previous research has indicated this as a stressor that increases survivors' likelihood of psychopathology (e.g., Gibbs, 1989). Third, previous research has found that experiences of pet loss are associated with postdisaster psychological distress above and beyond human bereavement (e.g., Lowe et al., 2009), and so this was included as a dummy-coded variable. Lastly, on the basis of previous research linking residential mobility with decreased social support and increased stress (e.g., Magdol, 2002; Magdol & Bessel, 2003), we included the number of moves in the year after Hurricane Katrina as a continuous variable.

**Social and material resources.** An eight-item measure of perceived support was included in the Times 1 and 2 assessments, the Social Provisions Scale (Cutrona & Russell, 1987; Russell & Cutrona, 1984). Perceived social support, defined as beliefs about the availability of support should a need arise, is generally considered a better predictor of mental health, including posttrauma distress, than the more structural measures of support (Fleming, Baum, Gisriel, & Gatchel, 1982; Kaniasty & Norris, 1993; Kaniasty, Norris, & Murrell, 1990). The 24-item Social Provisions Scale was designed to assess six relational provisions identified by Weiss (1974). Instead of the full scale, which consists of six subscales each with four items, an eight-item version was used. The shortened version included two items from four of the six original subscales: *social integration* (e.g., "I am with a group of people who think the same way I do about things"), *reassurance of worth* (e.g., "There are people who value my skills and abilities"), *guidance* (e.g., "I have a trustworthy person to turn to if I have problems"), and *reliable alliance* (e.g., "There are people I know will help me if I really need it"). The full scale was not employed to reduce the burden on participants, with the intention of increasing retention in the study. The retained items were selected a priori, because they aligned with the goals of the Opening Doors program, which was to increase community college students' sense of social integration, connection, and guidance from their community colleges. Items were rated using a 4-point Likert-type scale ranging from 1 (*strongly disagree*) to 4 (*strongly agree*), and half of the items were reverse scored. Cutrona (1989) provided evidence for the validity of the Social Provisions Scale among young mothers, and reliability (measured with Cronbach's alpha) for the full scale in a previous study was .92 (Cutrona, Russell, & Rose, 1986). In the current study, linear SEM coefficients of reliability, following the guidelines of Yang and Green (2011), were .83 at Time 1, .82 at Time 2, and .81 at Time 3.

Second, as a proxy for socioeconomic status, we used the number of the following social benefits received in the past month: unemployment, social security income, welfare, or food stamps. Access to benefits was assessed at all three data points.

# Results

## Heuristic Analysis

As indicated earlier, this study included only female participants who completed both the Time 1 and Time 2 surveys ($n$ = 386). The results of $t$ tests and chi-square tests found no differences between the participants who completed both assessments and those who only completed the Time 1 survey. In addition, of the 386 women who completed the Time 2 assessment, 334 (86.5%) completed the Time 3 survey. Again, $t$ tests

and chi-square tests detected no significant differences between completers and noncompleters. For the 386 women included in the study, we also tested for differences between participants for whom we had complete data (70.5%, $n = 272$) and those who were missing data on any of the variables included in this study (29.5%, $n = 114$). Only one significant difference was found: Complete cases had significantly higher Time 3 social support than noncomplete cases. Results from all of the comparisons are provided in Table 1.

**Table 1.** *Results of Attrition Analyses and Comparisons of Complete and Noncomplete Cases*

| Variable | $t/\chi^2$ | *df* | M. diff. | *SE* | 95% C.I. |
|---|---|---|---|---|---|
| Participants who completed Time 1 and Time 2 ($n = 402$) vs. Time 1 only ($n = 90$) | | | | | |
| Age | .41 | 490 | .21 | .52 | −.80 to 1.23 |
| Number of children | .50 | 485 | .07 | .13 | −.19 to .32 |
| Race | 1.33 | 3 | | | |
| Time 1 K6 | −.41 | 488 | −.20 | .49 | −1.17 to .76 |
| Time 1 support | −1.11 | 486 | −.37 | .34 | −1.04 to .29 |
| Time 1 benefits | .42 | 490 | .03 | .08 | −.13 to .20 |
| Participants who completed Time 3 ($n = 334$) vs. participants who did not ($n = 52$) | | | | | |
| Age | −1.28 | 384 | −.84 | .67 | −2.14 to .45 |
| Number of children | −.66 | 380 | −.12 | .17 | −.46 to .23 |
| Race | .50 | 3 | | | |
| Time 1 K6 | .31 | 382 | .19 | .61 | −1.02 to 1.39 |
| Time 1 support | .83 | 380 | .36 | .43 | −.49 to 1.20 |
| Time 1 benefits | −1.70 | 384 | −.17 | .10 | −.38 to .03 |
| Hurricane-related stressors | −.36 | 379 | −.18 | .50 | −1.16 to .80 |
| Bereavement | 2.09 | 1 | | | |
| Pet loss | 2.14 | 1 | | | |
| Moves[a] | .45 | 59.27 | .11 | .24 | −.38 to .60 |
| Time 2 K6 | .77 | 383 | 60 | .78 | −.93 to 2.13 |
| Time 2 IES-R | 1.24 | 380 | 4.24 | 3.41 | −2.48 to 10.95 |
| Time 2 support | −.04 | 369 | −.02 | .44 | −.88 to .84 |
| Time 2 benefits | .40 | 238 | .04 | .11 | −.17 to .26 |
| Complete cases ($n = 272$) vs. incomplete cases ($n = 114$) | | | | | |
| Age | −.15 | 384 | −.08 | .50 | −1.05 to .90 |
| Number of children | .03 | 380 | <.01 | .13 | −.25 to .26 |
| Race | .66 | 3 | | | |
| Time 1 K6 | .42 | 382 | .19 | .46 | −.71 to 1.09 |
| Time 1 support | −1.08 | 380 | −.35 | .33 | −.99 to .29 |
| Time 1 benefits | −.79 | 384 | −.06 | .08 | −.21 to .09 |
| Hurricane-related stressors | 1.20 | 379 | .45 | .37 | −.29 to 1.19 |
| Bereavement | .60 | 1 | | | |
| Pet loss | 3.32 | 1 | | | |
| Moves | −.20 | 367 | −.03 | .16 | −.35 to .28 |
| Time 2 K6 | 1.50 | 383 | .87 | .58 | −.27 to 2.01 |
| Time 2 IES-R | 1.61 | 380 | 4.12 | 2.56 | −.92 to 9.15 |
| Time 2 support[a] | −1.19 | 152.23 | −.44 | .37 | −1.16 to .29 |
| Time 2 benefits | .37 | 238 | .03 | .08 | −.13 to .19 |
| Time 3 K6 | 1.32 | 328 | .92 | .70 | −.46 to 2.31 |
| Time 3 IES-R[a] | 1.81 | 73.10 | 6.47 | 3.58 | −.67 to 13.62 |
| Time 3 support | −2.13* | 326 | −1.15 | .54 | −2.21 to −.09 |
| Time 3 benefits | −.06 | 177 | −.01 | .09 | −.19 to .18 |

[a]Levene's test for equality of variances $p < .05$; therefore, equal variances not assumed.
*$p < .05$.

Among the variables that we included in this study, the missing rate was 4.9% at the item level. We conducted multiple imputation using the AMELIA II software (Honaker, King, & Blackwell, 2008) in R to handle missing data, and five complete data sets were then used for statistical analysis. Results represent an average of the five separate analyses with Rubin's (1987) correction of standard error. Notably, we replicated our analysis using only the 272 complete cases, and the trends in the data persisted. Lastly, we examined the univariate normality of the data. We found no severe violation of normality in terms of skewness (all < 1.5) and kurtosis (<3.0) on any of the variables (Tabachnick & Fidel, 2007).

## Trajectories of Psychological Distress

We compared models with different numbers of trajectories, ranging from three to eight trajectories, and including only linear as well as both linear and quadratic effects. A total of 12 models was tested. To compare models, we investigated Akaike's information criterion (AIC), Bayesian information criterion (BIC), and adjusted BIC, with lower values indicating better fit, as well as posterior probabilities, with higher values indicating better fit; additionally, we took into account considerations of parsimony and interpretability (Andruff et al., 2009; Jung & Wickrama, 2008). Fit statistics for each of the models are shown in Table 2. We selected a model with six trajectory groups and linear and quadratic terms as the best representation of the data.

Table 3 lists the mean and standard error of intercept, linear, and quadratic terms for each of the six trajectory groups. As evident in the table, the *resilient* and *increased distress* trajectories were best defined by intercept, linear, and quadratic terms; the *delayed distress*, *decreased distress,* and *improved* trajectories were best defined by intercept and linear terms; and the *coping* trajectory by intercept and quadratic terms. It is important to note here that because of the differing sample sizes within each trajectory group (ranging from 12 to 241), statistical power to detect significant effects varied.

Also in Table 3 are means and standard deviations for K6 scores for each trajectory group at the three time points as well

**Table 2.** *Fit Statistics for Tested Models*

| Number of classes | AIC | BIC | Adjusted BIC | Mean posterior probability (*SD*, Range) |
|---|---|---|---|---|
| Linear only | | | | |
| 3 | 6637.75 | 6681.26 | 6646.36 | .89 (.05, .87–.95) |
| 4 | 6609.31 | 6664.69 | 6620.27 | .88 (.05, .84–.95) |
| 5 | 6595.06 | 6662.31 | 6608.37 | .86 (.06, .78–.94) |
| 6 | 6584.86 | 6663.98 | 6600.52 | .85 (.05, .79–.94) |
| 7 | 6577.60 | 6668.58 | 6595.60 | .86 (.08, .75–.93) |
| 8 | 6575.56 | 6678.41 | 6595.92 | .84 (.10, .70–.98) |
| Linear and quadratic | | | | |
| 3 | 6620.52 | 6675.90 | 6631.48 | .89 (.05, .85–.95) |
| 4 | 6588.77 | 6659.98 | 6602.86 | .88 (.05, .84–.95) |
| 5 | 6579.60 | 6666.63 | 6596.83 | .87 (.07, .78–.94) |
| 6 | 6557.36 | 6660.21 | 6577.71 | .86 (.05, .80–.94) |
| 7 | 6556.24 | 6674.92 | 6579.73 | .84 (.08, .74–.93) |
| 8 | 6550.50 | 6685.00 | 6577.12 | .83 (.09, .69–.94) |

**Table 3.** Growth Parameters and K6 Scores for Six Psychological Trajectory Groups

| Group | Resilient | Coping | Increased distress | Delayed distress | Decreased distress | Improved | | |
|---|---|---|---|---|---|---|---|---|
| *N* (%) | 241 (62.4) | 86 (22.2) | 15 (3.9) | 17 (4.5) | 15 (3.9) | 12 (3.2) | | |
| | Estimate (*SE*) | Estimate (*SE*) | Estimate (*SE*) | Estimate (*SE*) | Estimate (*SE*) | Estimate (*SE*) | | |
| Intercept | 4.34 (0.30)*** | 10.58 (1.56)*** | 17.38 (2.05)*** | 6.30 (2.32)** | 12.06 (1.81)*** | 5.90 (1.76)** | | |
| Linear | −0.49 (0.16)** | 1.01 (0.56) | 3.48 (1.13)** | 4.98 (0.87)*** | −3.86 (1.14)** | −4.10 (1.20)** | | |
| Quadratic | −1.06 (0.29)*** | −2.70 (1.25)* | −3.85 (2.42) | 3.51 (2.04) | 1.20 (1.85) | 1.65(1.68) | | |
| | Mean (*SD*) | Mean (*SD*) | Mean (*SD*) | Mean (*SD*) | Mean (*SD*) | Mean (*SD*) | *F* | Comparisons |
| Posterior probability | 0.94 | 0.82 | 0.89 | 0.82 | 0.87 | 0.80 | | |
| Time 1 K6 | 3.80 (2.43) | 7.00 (2.71) | 9.96 (3.88) | 4.59 (3.01) | 17.23 (3.96) | 12.58 (1.68) | 114.24*** | Resilient < Coping*, Increased Distress*, Decreased Distress***, Improved***; Coping < Decreased Distress***, Improved***; Increased Distress < Decreased Distress**, Improved*; Delayed Distress < Decreased Distress***, Improved***; Decreased Distress > Improved* |
| Time 2 K6 | 4.31 (3.52) | 10.92 (3.95) | 17.59 (4.36) | 5.55 (3.37) | 12.11 (5.53) | 5.95 (3.84) | 73.45*** | Resilient < Coping***, Increased Distress***, Decreased Distress***; Coping < Increased Distress*; Coping > Delayed Distress*; Increased Distress > Delayed Distress,***, Decreased Distress**, Improved**; Delayed Distress < Decreased Distress***; Decreased Distress > Improved** |
| Time 3 K6 | 2.78 (2.46) | 9.11 (2.38) | 17.32 (2.66) | 15.35 (2.36) | 9.48 (3.10) | 3.01 (2.13) | 229.42*** | Resilient < Coping***, Increased Distress***, Delayed Distress***, Decreased Distress***; Coping > Increased Distress*, Delayed Distress*; Coping < Improved***; Increased Distress > Decreased Distress***, Improved**; Delayed Distress > Decreased Distress***, Improved***; Decreased Distress > Improved*** |

*$p < .05$. **$p < .01$. ***$p < .001$.

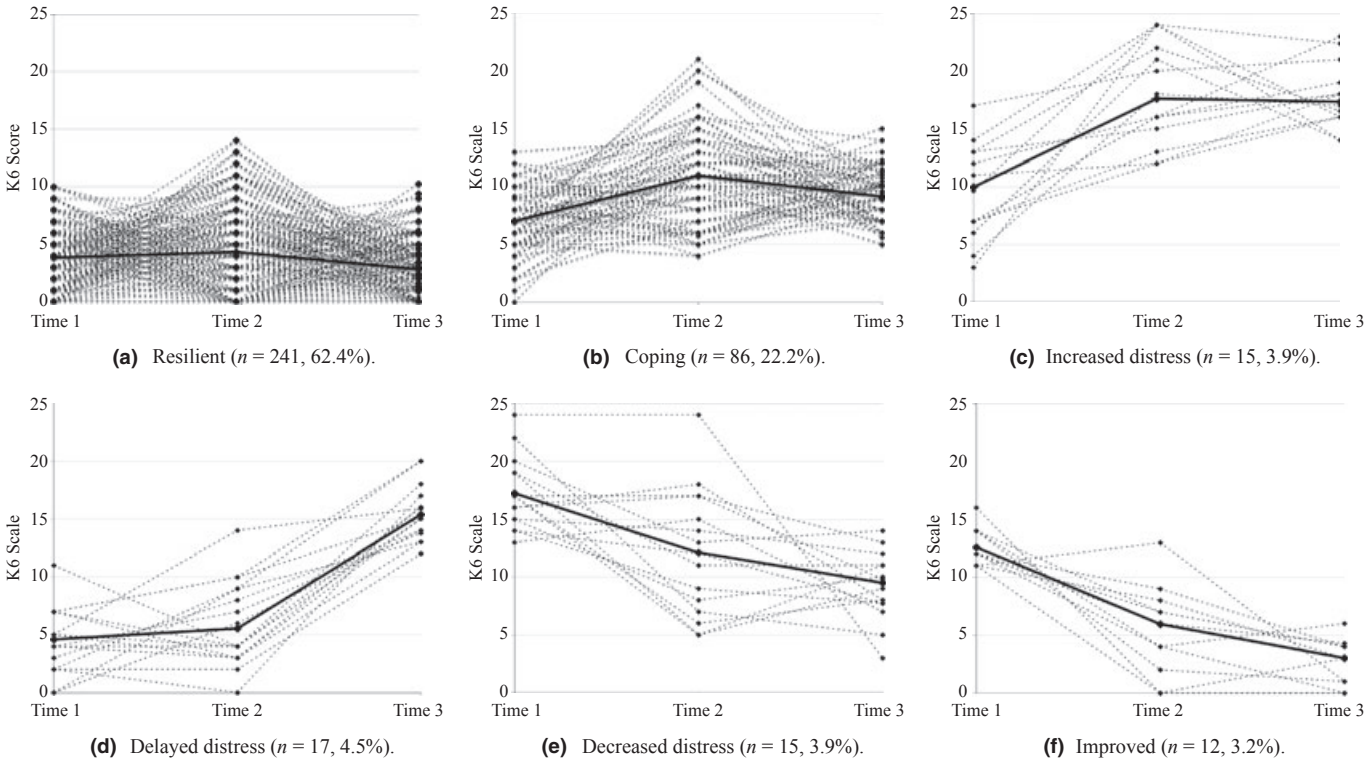


***Figure 1.*** Estimated means and observed individual values for each trajectory group. For each trajectory plot, the bold line indicates the estimated means from the LCGA analysis. The *x*-axis represents the three data waves: −1 (Time 1), 0 (Time 2), and 1 (Time 3).

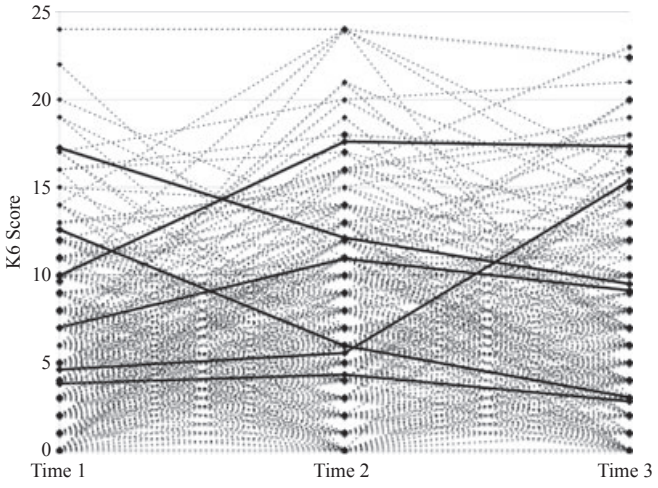


***Figure 2.*** Spaghetti plot with observed individual values for all participants ($N$ = 386) and estimated means for the six trajectories. Bold lines indicate estimated means for the six trajectory groups from the LCGA analysis. The *x*-axis represents the three data waves: −1 (Time 1), 0 (Time 2), and 1 (Time 3).

as the results of analysis of variance (ANOVA) for group differences in K6 and post hoc Bonferoni-corrected pairwise comparisons. As evident in the table, there were several significant differences in psychological distress among the groups at each time point, providing evidence that LCGA produced unique groups. Growth curves for the six trajectory groups, with estimated means and observed individual values for each (from one of the five complete data sets), are shown in Figure 1. In addition, a spaghetti plot, with the six trajectories and observed individual values for the full sample (from one of the five complete data sets), is provided in Figure 2.

The two most prevalent groups, *resilient* and *coping*, evidenced a pattern of growth typically associated with resilience; that is, both groups had an increase in psychological distress from pre- to posthurricane, followed by a decrease in distress between the two postdisaster time points. *Resilient* was the most common trajectory ($n$ = 241, 62.4%), and participants in this group began below the cutoff for probable mild or moderate psychological distress, increased less than one point from pre- to postdisaster, and then decreased to below predisaster levels. *Coping*, the second most common trajectory group ($n$ = 86, 22.2%), exhibited a similar pattern, but at a higher level of psychological distress. On average, participants in this group began below the cutoff for probable mild or moderate psychological distress, increased to above the cutoff, and then decreased but remained above the cutoff.

The remaining four trajectory groups included far fewer participants, but nonetheless were evident in the best fitting model. *Increased distress* and *delayed distress* both evidenced adverse psychological reactions in the aftermath of the storm, but different patterns of growth. Participants in *increased distress* ($n$ = 15, 3.9%), on average, reported levels of psychological

distress in the probable mild or moderate mental illness range and in the probable serious mental illness range (K6 ≥ 13) at both postdisaster time points. In contrast, participants in *delayed distress* ($n$ = 17, 4.5%) reported low levels of psychological distress predisaster and in the first postdisaster period; however, in the second postdisaster period, this group on average reported levels of psychological distress in the probable severe mental illness range.

The final two trajectory groups had average negative linear trajectories; that is, on average, members of these groups had decreases in psychological distress over the course of the study. *Decreased distress* ($n$ = 15, 3.9%), however, reported above average psychological distress throughout the study. At Time 1, they reported psychological distress in the probable severe mental illness category, decreased to probable mild or moderate mental illness from Time 1 to Time 2, and further decreased within the mild to moderate range from Time 2 to Time 3. Members of *improved* ($n$ = 12, 3.2%), the least prevalent group, began just below the cutoff for probable serious mental illness in the predisaster period, decreased to probable absence of mental illness at Time 2, and further decreased from Time 2 to Time 3.

## Relationship Between Distress Trajectories and PTSD Symptoms and Diagnosis

We then conducted analyses to determine whether there were significant differences in posttraumatic stress symptoms and disorder among the six trajectory groups. In doing so, we aimed to determine whether the trajectories with low levels of symptoms over time also had low levels of posttraumatic stress. In addition, we aimed to determine which patterns might be especially associated with posttraumatic stress.

Table 4 includes means and standard deviations for each group on the measure of posttraumatic stress, the IES-R, as well as percentages of participants in each group exceeding the cutoff for probable PTSD (IES-R = 33) at each time point. In addition, Table 2 includes the results of one-way analysis of variance (ANOVA), chi-square, and Bonferroni-corrected post hoc tests, to determine whether there were significant differences in IES scores and PTSD rates at both postdisaster time points.

## Predictors of Psychological Distress Trajectory Groups

Next, we investigated whether predictors of postdisaster psychological responses found in previous literature significantly differentiated between the trajectory groups, using chi-square and one-way ANOVAs and Bonferroni-corrected post hoc tests. First, demographic variables (age, race or ethnicity, number of children) were tested, and no significant differences were detected. Second, predisaster social and material resources were tested. Third, we tested for differences among the groups at the first postdisaster time point (Time 2), including participants' reports of hurricane exposure. Table 5 includes the results of these analyses as well as descriptive data on these variables for the full sample and trajectory groups.

**Table 4.** IES-R Scores and Rates of Probable PTSD for Full Sample and Trajectory Groups

| Group | Full Sample | Resilient | Coping | Increased distress | Delayed distress | Decreased distress | Improved | | |
|---|---|---|---|---|---|---|---|---|---|
| *N* (%) | 386 | 241 (62.4) | 86 (22.2) | 15 (3.9) | 17 (4.5) | 15 (3.9) | 12 (3.2) | | |
| | *M* (*SD*) | *M* (*SD*) | *M* (*SD*) | *M* (*SD*) | *M* (*SD*) | *M* (*SD*) | *M* (*SD*) | $F/\chi^2$ | Comparisons |
| Time 2 IES-R | 33.36 (22.73) | 26.84 (20.49) | 43.87 (20.28) | 49.45 (23.09) | 41.88 (25.02) | 48.77 (25.47) | 39.29 (26.15) | 12.99*** | Resilient < Coping***, Increased Distress*, Decreased Distress* |
| Time 2 PTSD diagnosis | 50.0% | 38.7% | 70.9% | 76.0% | 64.1% | 65.8% | 58.0% | 35.20*** | Resilient < Coping*** |
| Time 3 IES-R | 26.73 (21.59) | 20.37 (18.62) | 37.57 (20.78) | 42.55 (20.85) | 41.43 (24.14) | 36.83 (20.48) | 24.40 (29.64) | 14.54*** | Resilient < Coping***, Increased Distress**, Delayed Distress**, Decreased Distress* |
| Time 3 PTSD diagnosis | 36.6% | 23.3% | 59.8% | 63.4% | 66.8% | 59.1% | 33.4% | 53.62*** | Resilient < Coping***, Delayed Distress*, Decreased Distress* |

*$p < .05$. **$p < .01$. ***$p < .001$.

**Table 5.** Descriptive Data and Trajectory Group Differences for Time 1, Time 2, and Time 3 Variables

| Group | Full Sample | Resilient | Coping | Increased distress | Delayed distress | Decreased distress | Improved | | |
|---|---|---|---|---|---|---|---|---|---|
| *N* (%) | 386 | 241 (62.4) | 86 (22.2) | 15 (3.9) | 17 (4.5) | 15 (3.9) | 12 (3.2) | | |
| | *M* (*SD*) | *M* (*SD*) | *M* (*SD*) | *M* (*SD*) | *M* (*SD*) | *M* (*SD*) | *M* (*SD*) | $F/\chi^2$ | Comparisons |
| Demographics | | | | | | | | | |
| Age | 25.42 (4.43) | 25.26 (4.29) | 25.83 (4.89) | 26.72 (4.61) | 24.64 (4.76) | 26.53 (3.97) | 23.98 (2.95) | 1.18 | – |
| Number of children | 1.95 (1.16) | 1.89 (1.04) | 2.02 (1.48) | 2.06 (1.11) | 2.03 (1.25) | 2.36 (.98) | 1.80 (.97) | .81 | – |
| Race | | | | | | | | | |
| African American | 84.4% | 83.0% | 88.1% | 88.5% | 91.6% | 82.6% | 70.3% | 13.39 | – |
| White | 10.6% | 12.0% | 6.8% | 9.2% | 8.4% | 6.8% | 19.3% | | |
| Hispanic | 3.5% | 3.7% | 3.1% | 2.2% | 0.0% | 10.5% | 1.8% | | |
| Other | 1.6% | 1.3% | 2.1% | 0.0% | 0.0% | 0.0% | 8.6% | | |
| Time 1 variables | | | | | | | | | |
| Time 1 support | 18.35 (3.88) | 18.81 (3.64) | 17.96 (3.90) | 16.93 (4.65) | 18.88 (4.31) | 15.13 (4.87) | 17.08 (3.37) | 3.86** | Decreased Distress < Resilient** |
| Time 1 benefits | .82 (.69) | 0.83 (0.68) | 0.73 (0.64) | 1.11 (0.76) | 0.93 (.76) | 1.08 (0.77) | 0.66 (0.85) | 1.56 | – |
| Time 2 variables | | | | | | | | | |
| Hurricane-related stressors | 3.80 (3.34) | 3.12 (2.83) | 5.17 (3.98) | 4.19 (3.37) | 4.61 (3.10) | 5.79 (4.09) | 3.65 (3.17) | 6.90*** | Resilient < Coping***, Decreased Distress* |
| Bereavement | 28.8% | 24.3% | 38.1% | 32.9% | 28.7% | 47.1% | 28.6% | 9.49[a] | Resilient < Coping*, Decreased Distress* |
| Pet loss | 17.5% | 15.4% | 17.2% | 53.07% | 8.6% | 27.4% | 17.2% | 15.53** | Increased Distress > Resilient***, Coping**, Delayed Distress** |
| Moves | 3.70 (1.39) | 3.59 (1.28) | 4.01 (1.72) | 3.58 (1.33) | 3.46 (1.50) | 3.97 (1.11) | 3.92 (.88) | 1.59 | – |
| Time 2 support | 17.50 (3.87) | 18.18 (3.55) | 16.48 (4.00) | 13.89 (5.18) | 16.77 (3.84) | 17.01 (3.96) | 17.17 (3.75) | 5.98*** | Resilient > Coping*, Increased Distress* |
| Time 2 benefits | .74 (.73) | .71 (.70) | .72 (.73) | .91 (.78) | .75 (.86) | 1.47 (.72) | .44 (.60) | 3.82** | Decreased Distress > Resilient***, Coping**, Delayed Distress*, Improved** |
| Time 3 variables | | | | | | | | | |
| Time 3 support | 17.91 (3.75) | 18.57 (3.52) | 16.91 (3.50) | 14.66 (4.48) | 18.00 (3.80) | 16.50 (5.46) | 17.49 (3.70) | 6.00*** | Resilient > Increased Distress*** |
| Time 3 benefits | .64 (.73) | .59 (.71) | .68 (.76) | .93 (.86) | .64 (.65) | 1.12 (.84) | 0.43 (.59) | 2.29* | No post hoc comparisons significant |

*$p < .05$. **$p < .01$. ***$p < .001$.

## Discussion

The primary aim of this study was to determine rates of resilience and other psychological trajectories in a sample of low-income mothers who survived Hurricane Katrina. In doing so, we built on prior work documenting distinct patterns of symptoms in the aftermath of natural disasters and other trauma (e.g., Bonanno et al., 2008; Norris et al., 2009). Unlike previous studies, however, we benefitted from a data set that includes predisaster (one wave) and postdisaster (two waves) data. As such, we were able to investigate the influence of predisaster mental health in shaping patterns of growth and decline and explore both short- and longer term mental health outcomes.

Using LCGA, we detected six distinct trajectories. The majority (62.4%) of participants fell into a class consistent with the concept of resilience (*resilient*). That is, although they reported relatively low levels of psychological distress at each time point, they experienced an increase in symptoms at the first postdisaster assessment, followed by a return to baseline levels at the second postdisaster assessment. The consistently low levels of distress among the majority of participants align with the results of previous studies using LCGA (e.g., Bonanno et al., 2008; Nandi et al., 2009). The unique contribution of the current study, however, is that we can see that the resilient majority was functioning well prior to the storm and likely had existing psychosocial resources that protected them from adverse postdisaster psychological outcomes. Moreover, the results show that slight elevations in psychological symptoms commonly occur among resilient individuals. Such elevations, although not surpassing cutoffs for probable mental illness, could have a clinically significant impact on survivors. With predisaster data, we were therefore able to show the more nuanced patterns of psychological symptoms among resilient participants.

A second group, comprising nearly a quarter of the sample, exhibited a similar pattern of growth and decline, but did so at a higher level of psychological distress (*coping*). Their initially elevated postdisaster symptoms declined between the two postdisaster assessments, suggesting that they too were coping with the stressors of the storm. It is important to note, however, that they maintained levels of psychological distress in the probably mild or moderate mental illness category over the course of the study. The *coping* trajectory, again, demonstrates the added value of predisaster data to the current study. If we had access to only postdisaster data, we might assume that the *coping* survivors' moderate levels of distress stemmed from their experiences during the disaster and its aftermath, whereas, with predisaster data, it is clear that they were struggling with psychological symptoms prior to the hurricane.

Taken together, the *resilient* and *coping* trajectories constituted 84.6% of the sample and suggest that the pattern of initial elevations in symptoms, followed by decreases to predisaster levels, is normative. Although they each comprised less than 5% over the sample, the remaining four trajectories deviated from this bell-shaped pattern and demonstrate the heterogeneity of psychological responses to disaster.

In contrast to the *coping* trajectory, the *increased distress* trajectory was defined by consistent elevations of postdisaster psychological distress, with levels surpassing the probable severe mental illness cutoff at both postdisaster time points. A chronic distress trajectory has been detected in previous studies of samples exposed to traumatic stress (e.g., Bonanno et al., 2007; Hobfoll et al., 2009). However, the percentage of participants consistently exhibiting postdisaster symptoms is notably smaller than in previous research. For example, Nandi et al. (2009) found that 13.2% of their sample of NYC residents exhibited severe and increasing symptoms, and 8.3% exhibited chronic severe symptoms in the aftermath of the September 11th terrorist attacks. Again, because these studies lack predisaster data, they cannot determine whether participants experienced increases in distress from pre- to postdisaster and therefore likely include survivors who had severe predisaster symptoms in their chronic distress trajectories. In contrast, we provide clear evidence that the *increased distress* group had worsening psychological symptoms in the aftermath of the disaster and distinguish them from survivors suffering from predisaster severe distress (i.e., the *decreased distress* trajectory).

An additional group of participants exhibited severe postdisaster psychological distress. However, this group began with low levels of distress, maintained low levels 1 year after the storm, and reported severe distress at the 3-year postdisaster assessment (*delayed distress*). Previous studies have found mixed results for a delayed trajectory. For example, Norris et al. (2009) found that 14% of their sample of NYC residents experienced delayed distress in the aftermath of September 11, whereas this trajectory was not detected in their comparison sample of survivors of a Mexican flood. This discrepancy could be because of how long participants were followed: The September 11 sample was followed through 30 months postdisaster, whereas the Mexican sample was followed only through 24 months postdisaster. The results of the current study further suggest the advantages of longitudinal studies of trauma survivors that continue to assess survivors well beyond the initial recovery period. Had our postdisaster assessments spanned a shorter period of time, this delayed response would not have been evident.

The final two groups, again both representing less than 5% of the sample, exhibited declines in psychological distress over the course of the study (*decreased distress* and *improved*). The first of these groups began the study with severe psychological distress and, on average, decreased consistently over the course of the study, reporting levels of distress in the probable mild or moderate mental illness category at both postdisaster time points (*decreased distress*). Although the *decreased distress* trajectory is suggestive of postdisaster improvements in psychological functioning, it is possible that participants in this group were experiencing a regression to the mean. That is, because they reported such extreme levels of psychological distress prior to disaster, they were likely to experience some decrease with the mere passage of time, independent of disaster exposure. As with the *coping* and *increased distress* trajectories, the *decreased distress* trajectory demonstrates that the majority of disaster survivors with chronically high levels of psychological symptoms had preexisting psychological conditions. In the absence of predisaster data, we might have erroneously assumed that this trajectory represented an acute postdisaster response and gradual recovery from disaster-related distress to low predisaster levels,

rather than a steady decreasing of symptoms that were present before the disaster struck.

The last trajectory group, which consisted of the smallest proportion of participants, experienced even steeper declines in psychological distress from the predisaster assessment to 1 year after Hurricane Katrina (*improved*). More specifically, they began the study with levels of distress in the probable severe mental illness category, but reported distress levels indicating a probable absence of mental illness at both postdisaster time points. This trajectory group illustrates the broad range of postdisaster psychological responses and supports the notion that some individuals will experience improvements in psychological functioning after exposure to traumatic events (e.g., Tedeschi, Park, & Calhoun, 1998). Without predisaster data, we might have assumed that the participants in the *improved* trajectory were resilient—that they had returned to low levels of predisaster distress after experiencing slightly elevated symptoms. Instead, through our analysis, we have shown that some individuals will experience improved mental health in the aftermath of a major disaster.

## Predictors of Trajectory Group Membership

The six trajectory groups demonstrate the wide variation in human responses to disaster. What factors might explain why some participants are resilient, whereas others experience chronic and delayed distress, or even improvements in functioning, after disasters? The secondary aim of the study addressed this question by investigating differences among the trajectory group in demographic variables, disaster exposure, perceived social support, and access to social benefits.

In exploring predisaster differences among the trajectory groups, we found that the *decreased distress* trajectory group began the study with significantly lower levels of perceived social support than the *resilient* trajectory. Low perceived social support could have accounted for the predisaster psychological symptoms among the *decreased distress* participants and put them at greater risk for exposure to the storm (Lowe et al., 2010). Indeed, those with fewer social resources may have been less likely to secure transportation out of New Orleans and alternative housing for themselves and their children (Lowe et al., 2010). It is perhaps not surprising, then, that *decreased distress* participants experienced significantly more hurricane-related stressors than *resilient* participants, increasing their likelihood of sustaining high levels of distress in the aftermath of the hurricane (e.g., Goenjian et al., 2001). Also distinguishing the *decreased distress* trajectory was their receipt of significantly more social benefits (i.e., food stamps, welfare, unemployment, SSI) in the first postdisaster period (i.e., relative to the *resilient*, *coping*, *delayed distress*, and *improved* groups at Time 2). Perhaps participants in this group had access to fewer family and network resources and were less able to draw on natural supports to reestablish themselves in the aftermath of disaster. Financial distress, in turn, exacerbates women's risk for psychological symptoms (Belle & Doucet, 2003). Alternatively, chronic mental health problems could have prevented participants from engaging in employment activities, increasing their need for social benefits.

The *coping* group experienced significantly more hurricane-related stressors than those in the *resilient* group. This group's relatively higher levels of predisaster psychological distress could have put them at risk for hurricane exposure (Weems et al., 2007). For example, predisaster depressive symptoms, including lack of energy, attention, and concentration, could have interfered with the capacity to formulate and execute evacuation plans. *Coping* participants were also significantly more likely to experience bereavement following the storm than *resilient* participants, which could, in part, account for their consistently higher levels of psychological distress (Gibbs, 1989) as could their significantly lower levels of perceived social support (Kaniasty & Norris, 2009).

Low levels of perceived social support likewise differentiated the *increased distress* trajectory from the *resilient* trajectory at both postdisaster time points. Disruptions in social support networks could therefore account for their sustained psychological distress in the aftermath of Hurricane Katrina (e.g., Hobfoll, 1989). Another unique feature of the *increased distress* trajectory was the significantly higher incidence of pet loss relative to the *resilient*, *coping*, and *delayed distress* trajectories. This finding is consistent with prior research showing that pet loss was a significant predictor of postdisaster distress among Hurricane Katrina survivors (Hunt, Al-Awadi, & Johnson, 2008; Lowe et al., 2009). It could be that losing a beloved pet is experienced as a major loss of social support or stress relief. Alternatively, pet loss could be a proxy for more extreme aspects of exposure and displacement not measured in the current study.

Although the variables included in the study predicted membership in the *decreased distress*, *coping*, and *increased distress* trajectories relative to the *resilient* trajectory, such was not the case for the *delayed distress* trajectory. In fact, the only significant differences between this trajectory and other patterns were the significantly lower incidence of pet loss relative to the *increased distress* trajectory and significantly fewer benefits than the *decreased distress* trajectory at Time 2. It remains unclear why participants in this group went on to experience severe distress 3 years after the disaster. It could be that variables not included in the current study (e.g., children's functioning, residential instability, exposure to additional traumatic events) led to delayed reactions.

Unmeasured variables might also explain the *improved* trajectory. It is remarkable that this small group of participants experienced sharp and sustained declines in distress from pre- to postdisaster, and yet, there was only one significant difference between the *improved* and other trajectories: *Improved* participants received significantly fewer social benefits than *decreased distress* participants at the first postdisaster time point. Although this phenomenon should be explored further, it could be that, for the *improved* participants, the hurricane led to economic opportunities that reduced participants' reliance on social benefits and alleviated financial distress, thereby bolstering their mental health. The *improved* participants might also have experienced other positive changes that researchers have observed among some survivors, including independence from troubled relationships, residence in safer neighborhoods, and access to higher quality schools (Graif, 2010; Lowe, Scoglio, & Rhodes, 2012; Rosen, 2010).

## Implications

The results of this study have implications for research, policy, and practice. To the extent possible, researchers should identify predisaster data when planning postdisaster studies, as predisaster levels of psychological distress had a clear influence on postdisaster psychological trajectories. Efforts to include predisaster data could provide further insight into how natural disasters alter the developmental course of psychological symptoms, particularly if multiple data points had been collected. Of course, identifying and reassessing former participants requires financial and organizational resources and, understandably, disaster studies are often focused on practical matters, such as documenting rates of mental and physical illness and identifying survivors in immediate need of services (Benight & McFarlane, 2007). When interpreting such data, we should be mindful of the influence of predisaster vulnerabilities in determining both disaster exposure and postdisaster psychological responses.

More generally, the results of this study provide support for group-based statistical approaches when studying the effects of disaster exposure and other traumatic events. Although a resilient trajectory represented the majority of the sample, there were clear subgroups of participants that deviated from this pattern. With traditional latent growth curve modeling, we would have overlooked participants with consistent distress and delayed responses as well as those who experienced improvements in functioning in the postdisaster period. A categorical approach, wherein cutoff criteria are used, would have also detected such variability; however, through LCGA, we were able to demonstrate more subtle changes within each trajectory group. For example, we showed that, even among participants without probable mental illness over the course of the study, there was variation in symptoms over time, with symptoms initially increasing after the disaster before returning to predisaster levels.

The psychological trajectories found in our analyses also have implications for postdisaster clinical interventions. Slight elevations in psychological symptoms should be normalized, and communities exposed to disaster should be informed that these symptoms often occur in mild forms (e.g., with low levels of frequency and intensity) and, in most instances, dissipate over time. At the same time, psychoeducational interventions should provide information on what individuals can do in the event of more intense, persistent psychological symptoms.

Additionally, the findings of the study demonstrate that not all survivors are equally vulnerable to postdisaster psychological distress and suggest factors predictive of adverse reactions (e.g., higher predisaster psychological symptoms, lower social support). Screening for these factors could help practitioners identify survivors that might be in particular need of mental health services to whom they could deploy empirically supported treatments (Hobfoll et al., 2007), address grief responses to human and pet bereavement, and bolster social support networks. Connecting survivors with mental health services also would provide opportunities to address more long-standing stressors and symptom histories that rendered survivors vulnerable to postdisaster psychological distress.

Disaster policies should likewise include measures for protecting individuals suffering from psychological distress from disaster exposure, including those ensuring timely evacuation, food and shelter during the storm and its aftermath, and access to medicine and medical care. Including means for evacuating pets and reuniting survivors with their animals could also protect against distressing symptoms. Lastly, policies that promote the long-term financial stability of low-income survivors, including diverse training and educational opportunities, increased earnings, affordable child care, and enforcement of antidiscrimination laws, could help promote the long-term psychological adjustment of low-income women (Jones-DeWeever, 2008; Williams, Sorokina, Jones-DeWeever, & Hartmann, 2006).

## Limitations

Despite its potential to inform research, policy, and practice, this study is not without limitations. First, selecting which LCGA model to use in subsequent analyses involved some subjectivity; that is, although statistical indices of good fit provided insight into the optimal LCGA model, we also interpreted results with previous research findings and theoretical considerations in mind. Likewise, although attempts were made to choose labels representative of the trajectory shapes, the names selected are not value-neutral. For example, we chose the term *resilient* for the trajectory that began low, experienced an initial elevation of symptoms, and then returned to baseline levels of distress because that fits with the scientific definition of resilience. This definition, however, has been used inconsistently in the empirical literature, and, likewise, resilience has different meanings in its common usage (Luthar et al., 2000; Tarter & Vanyukov, 1999). Therefore, although the results provide insight into the rates of a resilient trajectory in a sample vulnerable to postdisaster distress, they do not fully capture the subjective experience of resilience. Likewise, resilience is a multidimensional phenomenon, present in domains beyond psychological functioning, such as physical, educational, and occupational functioning, and in systems beyond the individuals, such as families, social networks, communities, and economic systems. Future researchers should explore different domains of resilience and the interrelationships among them. In addition, qualitative methods should be employed to better understand how survivors of natural disasters and other traumatic events define and experience resilience and the factors they see as promoting positive posttraumatic psychological responses (Luthar & Cushing, 1999). An investigation of how these subjective experiences of resilience map onto statistical trajectories, which would enrich our understanding of how individuals respond and recover in the aftermath of disasters and other trauma, would be appropriate.

Second, future researchers should replicate the results with different samples and in the context of different natural disasters. As stated previously, participants in the study—low-income mothers, primarily unmarried and African American—were especially vulnerable to postdisaster psychological distress. The focus on a vulnerable sample is a strength of the study, yet limits its external validity. All of the participants in the study were community college students, which further limits the generalizability of the study.

Likewise, there were unique aspects of Hurricane Katrina, including the destruction of levees in need of repair and the slow governmental response. Methodologies that capture more normative samples (e.g., random digit dialing) could be employed to address this limitation. If such procedures were being used for another study in progress prior to a disaster, researchers could mobilize their efforts to contact and reassess participants, thereby including predisaster data for a normative sample. Normative data would also permit a better understanding of the role of demographic variables in determining postdisaster psychological outcomes. In addition, with a larger sample size, researchers would have more statistical power to detect statistically significant differences between trajectory groups, particularly those represented by smaller proportions of a given sample. The analysis of predictors of trajectory group membership should also be replicated, as the number of between-group comparisons in the current study elevated the risk of Type I errors.

Third, because our study included only three waves of data and the majority of participants exhibited nonlinear trajectories of psychological distress, we were unable to explore predictors of change within each trajectory group. By collecting additional waves of data, we could continue to understand complex patterns of change in the aftermath of disasters. Likewise, studies with additional waves could better capture the complex relationships between psychological and other domains of functioning over time. Although we were able to show that perceived social support and access to social benefits, depending on the timing of assessment, predicted trajectory membership, we did not model change in these resources. As with psychological distress, resources are likely also changing in nonlinear patterns, and additional data waves would allow for modeling of different domains simultaneously.

Additional limitations inherent to our methodology are also worth noting. We relied on self-report measures, and perhaps different patterns would have emerged had we included more objective methods of disaster exposure or psychiatric diagnoses from more sophisticated assessment tools. Likewise, our inclusion of a screening tool of nonspecific distress further limits the scope of the study. Future analyses of patterns of specific psychological disorders commonly found in the aftermath of disasters (e.g., posttraumatic stress disorder, major depressive disorder) would both improve our understanding of postdisaster psychological responses and have implications for clinical interventions. It is also possible that, for some of the participants, more severe psychological symptoms had dissipated by the time of the first postdisaster assessment, which took place approximately a year after the disaster, indicating the need for data points in closer proximity to the disaster (Steinglass & Gerrity, 1990).

Despite these limitations, this study represents a step toward a deeper understanding of disaster survivors' psychological trajectories. Through our inclusion of predisaster data, we were able to show that, among disaster survivors without preexisting psychological vulnerabilities, psychological resilience is the most common response. Yet, a sizable proportion of survivors, particularly those with predisaster mental health problems, experience adverse psychological reactions. High disaster exposure, experiences of bereavement and pet loss, low perceived social support, and low socioeconomic status influence survivors' course of symptoms, indicating these variables as viable targets for disaster policies and clinical interventions. As we continue to explore psychological resilience and its relationship with other variables, we will be able to further promote this trajectory among disaster survivors.

**Keywords:** women; hurricane survivors; disaster exposure; postdisaster psychological distress; human bereavement; pet loss; displacement; delayed distress; Hurricane Katrina

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