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Long-term psychological outcomes in older adults after disaster: relationships to religiosity and social support

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Objectives: Natural disasters are associated with catastrophic losses. Disaster survivors return to devastated communities and rebuild homes or relocate permanently, although the long-term psychological consequences are not well understood. The authors examined predictors of psychological outcomes in 219 residents of disaster-affected communities in south Louisiana.

Method: Current coastal residents with severe property damage from the 2005 Hurricanes Katrina and Rita, and exposure to the 2010 British Petroleum Deepwater Horizon oil spill were compared and contrasted with former coastal residents and an indirectly affected control group. Participants completed measures of storm exposure and stressors, religiosity, perceived social support, and mental health.

Results: Non-organizational religiosity was a significant predictor of post-traumatic stress disorder (PTSD) in bivariate and multivariate logistic regressions. Follow-up analyses revealed that more frequent participation in non-organizational religious behaviors was associated with a heightened risk of PTSD. Low income and being a coastal fisher were significant predictors of depression symptoms in bivariate and multivariate models. Perceived social support had a protective effect for all mental health outcomes, which also held for symptoms of depression and GAD in multivariate models.

Conclusion: People who experienced recent and severe trauma related to natural and technological disasters are at risk for adverse psychological outcomes in the years after these events. Individuals with low income, low social support, and high levels of non-organizational religiosity are also at greater risk. Implications of these data for current views on the post-disaster psychological reactions and the development of age-sensitive interventions to promote long-term recovery are discussed.

Keywords: natural and technological disasters; post-disaster mental health; post-traumatic stress; long-term recovery; British Petroleum oil spill; environmental loss

Introduction

On 29 August 2005, Hurricane Katrina struck the US Gulf Coast, including Texas, Louisiana, Mississippi, Alabama, and Florida. An estimated 1800 deaths and over \$125 billion in damages were reported (Graumann et al., 2005; updated 2006). Several weeks later, on 24 September 2005, Hurricane Rita struck the western side of Louisiana and southeast Texas. Rita, also a Category 3 hurricane at landfall, directly caused seven fatalities, while property damage reached \$11.3 billion (National Hurricane Center, 2007). The mental health consequences of disasters are well documented in the immediate post-disaster phase (Neria, Galea, & Norris, 2009; Norris & Elrod, 2006). Other research documents the longevity of psychological reactions five years or more after these events (Gleser, Green, & Winget, 1981; Green, Gleser, Lindy, Grace, & Leonard, 1996; Green et al., 1990). Given the likelihood of future storms in the disaster-prone areas, it is increasingly important to understand how the psychosocial factors and the environmental loss affect psychological outcomes in the years following a natural disaster.

The present research addressed two issues with respect to the study of a long-term disaster recovery. Our primary objective was to examine religiosity and perceived social

support as predictors of mental health among the coastal residents of south Louisiana, who experienced catastrophic losses after Hurricanes Katrina and Rita in 2005. Religiosity is particularly relevant in a post-disaster context, as it covers both the personal and social factors that may be associated with health and well-being. In our earlier work (Silva Brown et al., 2010), religious beliefs and practices and religious coping were both negatively correlated with the SF-36 physical health composite and physical function subscale scores at Wave 1 (<5 months after the 2005 storms) and Wave 2 (6–14 months post-event). Silva Brown et al.'s results imply greater reliance on religiosity as a coping mechanism among less physically capable individuals, although generalizations are limited to an indirectly affected sample of middle-aged and older adults living at least 80 miles outside of the severely devastated areas of south Louisiana. In this study, our sampling strategy was expanded to include a wider age range of adults in early to mid-life. The catchment area was also enlarged to cover the geographic areas that were severely devastated by the 2005 hurricanes to include individuals with greater direct storm exposure than in our earlier report. Together, these methodological changes increase the breath of interferences on variables important to the long-term disaster recovery.

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Prior research has shown that religion and spirituality are associated with physical and mental health (Ellison & Levin, 1998; George, Ellison, & Larson, 2002; Hill & Pargament, 2003; Koenig, McCullough, & Larson, 2001). Religiosity is also associated with well-being in later life (Fry, 2000; Jackson & Bergeman, 2011). There is a small but growing literature on the intersection of religion and traumatic stress, which has yielded mixed outcomes. Some studies show that religiosity is associated with positive psychological adjustment, although other evidence indicates non-significant or negative effects (Chen & Koenig, 2006). Variations in how religiosity has been defined and operationalized may be responsible for discrepant outcomes in the literature. Very few studies have examined religiosity after a natural disaster (Chan & Rhodes, 2013; Chan, Rhodes, & Perez, 2012; Cherry et al., 2011; Smith, Pargament, Brant, & Oliver, 2000). Chan et al. (2012) reported that pre-disaster religiousness was associated with better post-disaster social resources, optimism, and sense of purpose in a sample of predominantly African-American low-income women after Hurricane Katrina. Because so many churches and places of worship were destroyed and never rebuilt after the 2005 hurricanes, we also hypothesized that personal factors (religious beliefs and practices) may be more important to psychological outcomes than attendance at a formal place of worship or involvement with others in a faith community.

Perceived social support was also a variable of central interest in this study. Ample evidence documents the positive effect of perceived social support on physical and mental health outcomes after a disaster (Norris & Elrod, 2006; Norris & Kaniasty, 1996). Kaniasty and Norris (2008) have suggested that the relationship between perceived social support and psychological distress is time sensitive. In a longitudinal investigation, they found that the perceived social support was associated with the reduced post-traumatic stress disorder (PTSD) at 6–12 months post-disaster, while greater PTSD was associated with the less social support at 18–24 months. Whether perceptions of social support predict symptom prevalence, at least five years after destructive hurricanes, is not clear and was addressed in this study to provide new evidence on this issue.

Our secondary objective was to assess the impact of the 2010 British Petroleum (BP) Deepwater Horizon oil spill off of the coast of Louisiana on the long-term hurricane recovery. A devastating technological disaster, the BP oil spill, released an estimated 4.9 million barrels of oil into the Gulf of Mexico over a three-month period, threatening the seafood industry and the culture of south Louisiana's coastal parishes and the four other Gulf states directly affected (Mong, Noguchi, & Ladner, 2012). Understanding the impact of multiple disasters, natural and technological, from an adult developmental perspective, is imperative for post-disaster management and age-sensitive interventions to mitigate adversity. The conservation of resources (COR) theory (Hobfoll, 1989, 2001) provides a useful conceptual framework for understanding stressful circumstances and the psychological impact of

the environmental loss related to natural and technological disasters. In brief, COR holds that the loss of valued resources (e.g., material possessions, social capital, and financial stability) is associated with stress and increased vulnerability to negative outcomes. Consistent with the COR theory, prior research documents adverse outcomes for commercial fishers directly affected by an oil spill (Arata, Picou, Johnson, & McNally, 2000) and for the indirectly affected community residents (Palinkas, Peterson, Russell, & Downs, 1993; Picou, Gill, Dyer, & Curry, 1992). In this study, we compared and contrasted former residents who relocated to non-coastal communities after the 2005 storms and current residents who returned and rebuilt homes in the storm-devastated communities to examine environmental influences on the long-term hurricane recovery. To assess the impact of the oil spill, we included commercial fishers who were also lifelong coastal residents with catastrophic property losses in the 2005 hurricanes (e.g., homes, boats, docks, and equipment). The inclusion of commercial fishers provided a unique opportunity for insight and practical knowledge concerning cumulative adversity after exposure to a technological disaster. We hypothesized that commercial fishers with an additional stress exposure related to the 2010 oil spill disaster would show greater symptom prevalence than current and former coastal residents without strong economic ties to the spill. Such a pattern of results would support the COR theory and provide new evidence concerning the effects of recent and serious trauma on psychological outcomes.

Method

Participants and procedure

Participants were recruited from multiple sources in the greater Baton Rouge area and in two coastal communities, St. Bernard and Plaquemines parishes (counties). A recruitment flyer seeking research volunteers and pre-stamped, mail-in postcards were created and distributed widely after informal talks to church groups and civic organizations. Follow-up telephone calls were made to those who returned postcards. Others self-selected to participate based on the word of mouth referrals. In all, 219 individuals participated in this study. Most of them listed their race as Caucasian (79.5%), followed by Isleno (14.2%), Croatian (3.2%), African-American (2.3%), and Hispanic/Latino (<1.0%). Educational attainment was varied; some reported high school or less (28%). Others had at least two years of specialized training or some college (40%), a college degree (16%), or a graduate or professional degree (16%). Most of them were married (65%) and others were single (14%), divorced (9%), or widowed (12%). Additional demographic information appears in Tables 1 (categorical variables) and 2 (continuous variables).

We included an indirectly affected control group of 30 non-coastal residents who lived at least 80 miles outside of the storm-devastated areas of south Louisiana (M age = 60.2 years, SD = 18.8 years, age range: 19–91 years). To

Table 1. Demographics: prevalence by group.

	N (%)				χ^2	p
	Non-coastal residents (n = 30)	Former coastal residents (n = 62)	Current coastal residents (n = 63)	Current coastal fishers (n = 64)		
Gender						
Male	14 (46.7%)	21 (33.9%)	26 (41.3%)	34 (53.1%)	5.00	0.172
Female	16 (53.3%)	41 (66.1%)	37 (58.7%)	30 (46.9%)		
Education						
High school or less	4 (13.3%)	6 (9.7%)	18 (28.6%)	33 (51.6%)	53.12	<0.001
Some college/ specialized training	8 (26.7%)	25 (40.3%)	32 (50.8%)	23 (35.9%)		
College degree	7 (23.3%)	14 (22.6%)	8 (12.7%)	6 (9.4%)		
Master's/doctorate/ professional degree	11 (36.7%)	17 (27.4%)	5 (7.9%)	2 (3.1%)		
Marital status						
Married	17 (56.7%)	41 (66.1%)	39 (61.9%)	46 (71.9%)	2.55	0.467
Single/divorced/widowed	13 (43.3%)	21 (33.9%)	24 (38.1%)	18 (28.1%)		
Income						
Less than \$2000/month	7 (23.3%)	14 (22.6%)	19 (30.2%)	23 (35.9%)	13.04	0.161
Between \$2000 and \$4000/month	5 (16.7%)	14 (22.6%)	18 (28.6%)	20 (31.3%)		
Between \$4000 and \$6000/month	11 (36.7%)	17 (27.4%)	9 (14.3%)	11 (17.2%)		
Over \$6000/month	7 (23.3%)	17 (27.4%)	17 (27.0%)	10 (15.6%)		
Income adequacy						
Less than adequate	2 (6.7%)	8 (12.9%)	4 (6.3%)	4 (6.2%)	2.52	0.472
Adequate or better	28 (93.3%)	54 (87.1%)	59 (93.7%)	60 (93.8%)		
Denominational affiliation ^a						
Catholic	21 (70.0%)	47 (75.8%)	49 (77.8%)	47 (73.4%)	35.83	0.007
Baptist/methodist	5 (16.7%)	5 (8.1%)	6 (9.5%)	3 (4.7%)		
Lutheran/episcopalian	2 (6.7%)	3 (4.8%)	3 (4.8%)	0 (0.0%)		
Jewish	0 (0.0%)	3 (4.8%)	0 (0.0%)	0 (0.0%)		
Non-denominational/ Pentecostal	1 (3.3%)	3 (4.8%)	5 (7.9%)	8 (12.5%)		
None/other	1 (3.3%)	1 (1.6%)	0 (0.0%)	6 (9.4%)		
Official member of a church						
No	6 (20%)	21 (34%)	18 (29%)	19 (30%)	1.90	0.593
Yes	24 (80%)	41 (66%)	45 (71%)	45 (70%)		

Note: ^aBased on 2010 US Census data, the predominant religious tradition is Catholic in St. Bernard and Plaquemines parishes (counties) with population estimates of 40.5% and 38.2%, respectively. By comparison, there are fewer Catholics in East Baton Rouge parish, where the comparable population estimate is 22.2% (Association of Religion Data Archives, 2013).

match the predominant denominational affiliation of former and current coastal residents (Table 1), the majority were sampled from Catholic churches and Catholic Community Services (63.3%). Others were recruited from a continuing care retirement community (16.7%) and by word of mouth (20.0%). Former coastal residents were 62 persons who experienced severe property damage and were permanently displaced to Baton Rouge and other non-coastal communities (M age = 58.4 years, SD = 17.1 years, age range: 18–89 years). They had returned postcards (29.0%) or were recruited from the retirement community (8.1%) and by word of mouth (62.9%). Current coastal residents were 63 persons who were displaced, but returned to their communities and rebuilt their homes (M age = 60.7 years, SD = 15.0 years, age range: 20–83 years). They were

recruited from Catholic churches (25.4%), the St. Bernard Council on Aging (23.8%), the St. Bernard Kiwanas and Rotary clubs (14.3%), and by word of mouth (36.5%). Current coastal fishers were 64 persons in the commercial fishing industry who were unable to work for up to a year or more due to the 2010 BP oil spill (M age = 54.7 years, SD = 15.7 years, age range: 21–90 years). Most (64%) of them were recruited in the same manner as current coastal residents and through contacts at a local marina. Less than half (36%) were members of the United Commercial Fishermen's Association (UCFA). Those who resided within the catchment area were contacted by letter and invited to participate in the study. In all, 55 recruitment letters were mailed (June 2011) and of those 23 were tested for a 43% response rate from the UCFA mailing.

Table 2. Demographics: means by group.

	M (SD)				F	p
	Non-coastal residents (n = 30)	Former coastal residents (n = 62)	Current coastal residents (n = 63)	Current coastal fishers (n = 64)		
Age	60.2 (18.8)	58.4 (17.1)	60.7 (15.0)	54.7 (15.7)	1.63	0.183
Religiosity ^a						
Faith community involvement	6.37 (1.79)	5.32 (2.05)	5.38 (1.95)	4.83 (1.92)	4.27	0.006
Non-organizational religiosity	9.87 (2.80)	8.94 (3.07)	8.73 (3.22)	9.05 (2.85)	0.99	0.40
Religious beliefs and coping	19.47 (3.69)	17.79 (4.69)	18.56 (4.82)	18.38 (3.8)	1.03	0.381
Perceived social support ^b	7.83 (1.32)	7.82 (1.34)	7.43 (1.52)	7.23 (1.51)	2.30	0.079

Note: ^aFaith community involvement reflects the sum of responses to two questions (range: 0–10). Non-organizational religiosity reflects the sum of responses to three questions (range: 0–15). Religious beliefs and coping reflect the sum of responses to five questions (range: 0–22). ^bFrom ISEL (Cohen et al., 1985).

Informed consent was obtained at the beginning of the session. The procedures used were reviewed and approved by the Institutional Review Board of Louisiana State University in Baton Rouge, LA, USA. Participants were tested individually in their home or in a community location in two (or more) sessions that lasted for approximately 90 minutes.

Dependent measures

We assessed current post-traumatic stress symptoms using the 17-item PTSD Checklist-Civilian Version (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996; Weathers, Litz, Herman, Huska, & Keane, 1993). Chronbach's alpha reliability coefficient in this study was 0.932. Participants rated how often they were bothered by each symptom in the past month using a 5-point scale (*not at all* to *extremely*). These items were summed and a cut-off score of 50 indicated PTSD (Conybeare, Behar, Solomon, Newman, & Borovec, 2012). For depression, we administered the PHQ-9, a 9-item self-report depression assessment adapted from the PRIME-MD (Primary Care Evaluation of Mental Disorders) measurement (Spitzer, Kroenke, & Williams, 1999). Chronbach's alpha reliability coefficient was adequate (0.82). Participants rated how often they were bothered by these problems over the last two weeks on a 4-point scale (0 = *not at all*, 3 = *nearly every day*). In this study, any depression was indicated if the respondent had at least one symptom defined as a 2 ('more than half of the days') or higher based on the DSM-IV criteria.¹ The GAD-7, also adapted from the PRIME-MD, consists of seven symptoms of generalized anxiety disorder (GAD) (Kelly, Russo, & Katon, 2001). Chronbach's alpha reliability coefficient was 0.82. Participants rated how often they were bothered by these problems in the last four weeks on a 3-point scale (*not at all* to *more than half the days*). GAD was indicated for point totals of greater than or equal to 10.

The 12-item religiosity questionnaire (RQ; Cherry et al., 2011) was administered to assess participants' faith community involvement, non-organizational religiosity, and religious beliefs and coping. The RQ was scored as in Cherry et al. (2011) with exceptions noted.² Chronbach's

alpha reliability coefficient was 0.907. A 9-item version of the Interpersonal Support Evaluation List (Cohen, Mermelstein, Kamarck, & Hoberman, 1985) was used to assess perceived social support, after Norris and Kaniasty (1996). Participants rated both the positive and negative statements as *probably true* or *probably false* for each item. Responses indicating support were summed to yield a composite perceived social support score. The structured storm questionnaire (SSQ) contains four modules that assess storm exposure and threat to self and family/property, storm-related disruption and stressors, social support, and lifetime exposure to potentially traumatic events (see Cherry et al., 2011, for description). In this study, we summed the 11 individual storm stressor items to create a composite storm stressor total variable. To account for variations in reported stress levels, we also created a conditional probability score, defined as the level of stress reported for each item, conditional on having experienced that item. Three separate proportion scores were calculated for each participant by dividing the number of *yes*, *not stressful*; *yes, moderately stressful*; and *yes, extremely stressful* responses by the total number of items experienced (out of 11).

Statistical analyses

All statistical analyses were carried out using SAS version 9.4 statistical software system. Frequencies and percentages (%) are reported for categorical variables, with χ^2 tests and corresponding *p*-values used to determine group differences. Means and standard deviations are reported for non-categorical variables, with *F*-tests and corresponding *p*-values reported for differences among groups. Bivariate logistic regression analyses were run on all potentially predictive variables in order to determine their relative risk for the symptoms of PTSD, depression, and anxiety. All outcomes are dichotomous. Age was split at the median (58 years) in order to test differences in exposures among the younger adults ($n = 105$; $M = 45.1$ years, $SD = 12.3$ years) versus older adults ($n = 114$; $M = 70.3$ years, $SD = 8.7$ years). Only the number of lifetime traumatic events experienced significantly differed by an age group ($p < 0.003$) with younger adults reporting

fewer traumatic events than their older counterparts (means of 1.4 and 1.8 events, respectively). Consequently, we included age as a variable in the bivariate logistic regressions. Based on the outcomes of the bivariate analyses and prior literature, covariates were selected for inclusion in multivariate regression models that follow.

Results

Demographic characteristics appear in Tables 1 (categorical variables) and 2 (non-categorical variables). Analyses of ratings for denominational affiliation and group yielded a significant association by a χ^2 test ($p < 0.007$) with higher numbers of coastal fishers reporting non-denominational/Pentecostal and none/other. Most (70.8%) of them reported that they were an official member of a church or other place of worship.

Analyses of storm impact measures

Storm exposure and threat to self

An inspection of Table 3 (upper panel) indicates that most former and current residents evacuated from their home, while controls evacuated less frequently ($p < 0.001$). More than one-third of former and current residents and more than half of the controls reported being present for winds/major flooding. All former and current residents reported property damage, while significantly fewer controls did ($p < 0.001$). Most participants reported little to no fear of injury or death and considered themselves to be fairly safe to very safe during the storm.

Storm-related disruption and stressors

None of the controls were displaced from home, yet nearly all of the former and current residents were displaced because of the storm (Table 3, middle panel). Critically, over 90% of the former and current residents reported damage or loss of household contents and sentimental possessions, and more than half of them lost automobiles or trucks in the storm. Loss of pets was infrequent, although former and current residents reported losing pets more often than did controls. Over 90% of the former and current residents reported the loss of crops and trees, while only 13.3% of the control participants did.

Reported storm stressors appear in Table 3 (lower panel). Storm stressor total means differed significantly by group ($p = 0.005$). Pairwise comparisons (t -tests) confirmed that the coastal fishers' mean was significantly greater than the others (all p 's < 0.03), which did not differ from each other. To provide insight into the experience of these storm-related stressors, we conducted follow-up analyses on the level of stress reported for each item, conditional on having experienced that item. Figure 1 presents the mean conditional probability scores for various groups. Kruskal–Wallis tests yielded significant group differences for having experienced the event and rating it as not stressful ($p = 0.038$), moderately stressful ($p = 0.007$), and extremely stressful ($p = 0.013$). The

finding that the coastal fishers had the highest proportion of extremely stressful responses, followed by current residents then former residents and controls implies a possible influence of new life stressors related to the BP oil spill on memory for prior hurricane-related stressors, as discussed more fully later on.

Social support

The groups did not differ in their ratings of someone available for help six months before the storm, confirming the pre-storm group equivalence on this variable; however, the group difference was significant since the storms ($p = 0.012$; see Table 4). Pairwise comparisons (t -tests) confirmed that former and all current residents' (including fishers) ratings since the storm were lower than their ratings for six months before the storm (all p 's < 0.01). A significant group difference occurred for work in the shelters or disaster relief assistance ($p = 0.026$).

Lifetime exposure to trauma

We created two composite variables based on participants' responses to five potentially traumatic events: the sum of lifetime traumatic events experienced and a lifetime trauma total score, which includes trauma experience and the reported fear for life/safety during trauma. The groups significantly differed on both indices of prior lifetime trauma (p 's < 0.05 ; see Table 4).

Analyses of mental health measures by group

Post-traumatic stress in current residents did not significantly differ compared to controls and former residents (Table 5). Coastal fishers had a higher reported prevalence of depression symptoms (51.6%) compared to current residents (34.9%), former residents (19.4%), and controls (33.3%) – a significant difference ($p = 0.002$). GAD ratings did not differ across groups.

Logistic regressions

Bivariate analyses

Odds ratios from bivariate regressions with all covariates of central interest and predictor variables are presented in Table 6. We combined the two control groups (non-coastal and former coastal residents) in these analyses to improve interpretability. Group, education, and income were significantly associated with any symptoms of depression. Perceived social support and both lifetime trauma composite variables were significantly associated with all of the mental health outcomes. Decline in help received from others after the storm and non-organizational religiosity were associated with the increased levels of PTSD. Finally, income was significantly associated with GAD. All variables that were significant in bivariate analyses were included in final multivariate models for each respective outcome.

Table 3. Storm exposure, storm-related disruption, and storm stressors.

	<i>N</i> (%)				χ^2	<i>p</i>
	Non-coastal residents (<i>n</i> = 30)	Former coastal residents (<i>n</i> = 62)	Current coastal residents (<i>n</i> = 63)	Current coastal fishers (<i>n</i> = 64)		
Storm exposure and threat						
Evacuate						
No	27 (90.0%)	5 (8.1%)	18 (28.6%)	8 (12.5%)	79.535	<0.001
Yes	3 (10.0%)	57 (91.9%)	45 (71.4%)	56 (87.5%)		
Present for winds/major flooding						
No	12 (40.0%)	40 (64.5%)	34 (54.0%)	39 (60.9%)	135.650	<0.001
Yes	18 (60.0%)	22 (35.5%)	29 (46.0%)	25 (39.1%)		
Property damage						
No	19 (65.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	135.650	<0.001
Yes	10 (34.5%)	62 (100.0%)	63 (100.0%)	64 (100.0%)		
Fear of injury/death						
No	18 (60.0%)	43 (69.4%)	32 (50.8%)	45 (70.3%)	12.609	0.1811
A little	8 (26.7%)	9 (14.5%)	16 (25.8%)	6 (9.4%)		
Moderately	2 (6.7%)	4 (6.5%)	10 (15.9%)	6 (9.4%)		
Extremely	2 (6.7%)	6 (9.7%)	5 (7.9%)	7 (10.9%)		
Actual safety						
Very safe	13 (43.3%)	34 (54.8%)	32 (50.8%)	31 (48.4%)	12.371	0.193
Fairly safe	14 (46.7%)	20 (32.3%)	16 (25.4%)	23 (35.9%)		
Not too safe	3 (10.0%)	1 (1.6%)	4 (6.4%)	4 (6.3%)		
Not safe at all	0 (0.0%)	7 (11.3%)	11 (17.5%)	6 (9.4%)		
Storm-related disruption						
Displaced from home						
No	30 (100.0%)	1 (1.6%)	1 (1.6%)	0 (0.0%)	203.227	<0.001
Yes	0 (0.0%)	61 (98.4%)	62 (98.4%)	64 (100.0%)		
Loss of services						
Electricity						
No	8 (26.7%)	18 (29.0%)	19 (30.2%)	29 (45.3%)	5.477	0.140
Yes	22 (73.3%)	44 (71.0%)	44 (69.8%)	35 (54.7%)		
Telephone						
No	15 (51.7%)	16 (26.2%)	17 (27.0%)	14 (21.9%)	9.265	0.026
Yes	14 (48.3%)	45 (73.8%)	46 (73.0%)	50 (78.1%)		
Damage or losses						
Household contents						
No	26 (86.7%)	0 (0.0%)	0 (0.0%)	1 (1.6%)	177.820	<0.001
Yes	4 (12.3%)	62 (100.0%)	63 (100.0%)	63 (98.4%)		
Sentimental possessions						
No	29 (96.7%)	3 (4.8%)	1 (1.6%)	3 (4.7%)	163.198	<0.001
Yes	1 (3.3%)	59 (95.2%)	62 (98.4%)	61 (95.3%)		
Automobiles, trucks						
No	30 (100.0%)	25 (40.3%)	23 (36.5%)	21 (32.8%)	42.853	<0.001
Yes	0 (0.0%)	37 (59.7%)	40 (63.5%)	43 (67.2%)		
Pets						
No	30 (100.0%)	55 (88.7%)	50 (80.7%)	47 (73.4%)	12.212	0.007
Yes	0 (0.0%)	7 (11.3%)	12 (19.4%)	17 (26.6%)		
Crops, trees						
No	26 (86.7%)	3 (4.8%)	3 (4.8%)	4 (6.3%)	124.879	<0.001
Yes	4 (13.3%)	59 (95.2%)	60 (95.2%)	60 (93.8%)		
Storm-related stressors						
			<i>M</i> (<i>SD</i>)		<i>F</i>	<i>p</i>
Storm stressor total ^a	12.1 (7.79)	13.3 (5.85)	12.7 (6.04)	16.0 (5.56)	4.20	0.005

Note: ^aSum of the 11 stressors, where each is coded as 0 (no), 1 (yes, not stressful), 2 (yes, moderately stressful), or 3 (yes, extremely stressful): includes cancelled planned events/activities, relatives/friends refused to evacuate, housed evacuees in home, provided assistance to evacuees, lost food in refrigerator or freezer, had trouble getting gasoline, had trouble meeting medical/health needs, cancelled medical treatments, had trouble communicating by telephone or email, had trouble getting around town, and had changes in workplace.

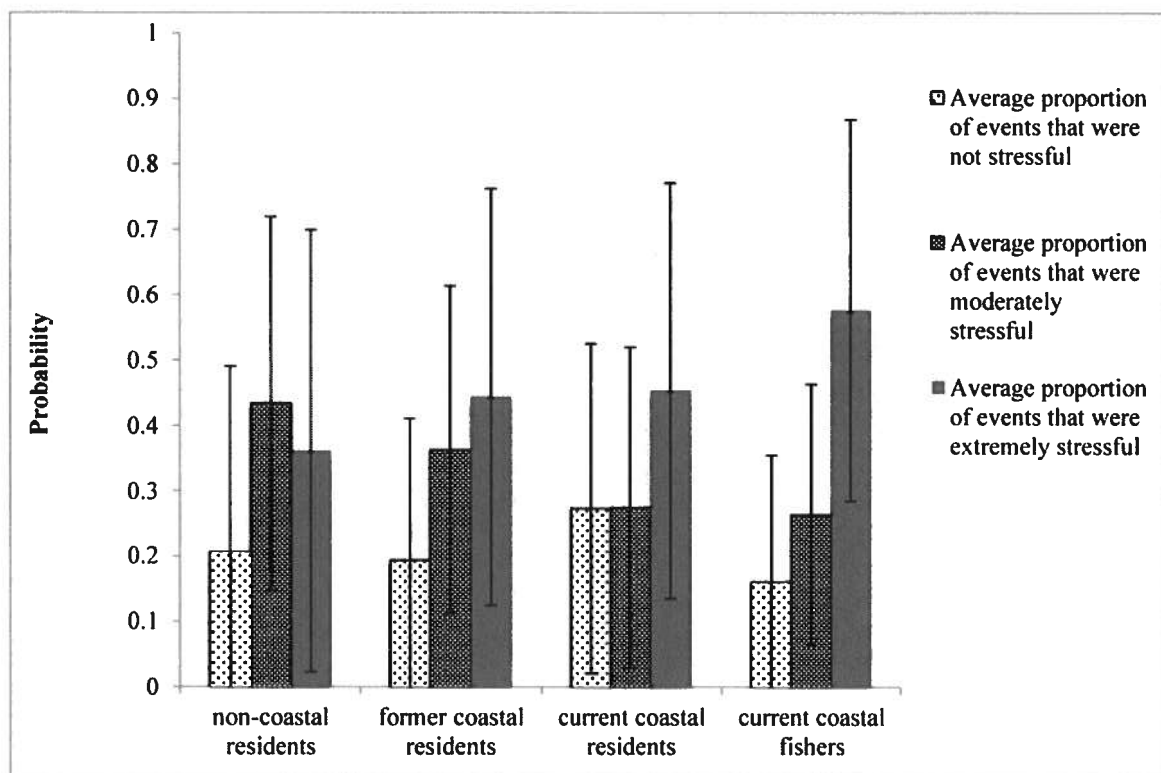


Figure 1. Conditional probabilities of stress out of 11 events.

Multivariate analyses

Final logistic regression models are presented in Table 7. Variables were included based on significant bivariate associations (Table 6). Three additional covariates were included in these regressions based on the prior literature and relevance: gender and marital status (Galea, Tracy, Norris, & Coffee, 2008), and official membership in the church (Krause, 1998). Lifetime trauma variables were no

longer significant in any multivariate models, but perceived social support held significance for depression and GAD (odds ratios were 0.796 and 0.634, respectively). Low income and being a coastal fisher remained a significant predictor of depression symptoms (fishers were 2.69 times more likely, and individuals earning less than \$2000 per month were 3.33 times more likely to have at least one symptom of depression).

Table 4. Social support before and after the storms and lifetime exposure to trauma.

Type of support ^a	<i>M (SD)</i>				<i>F</i>	<i>p</i>
	Non-coastal residents (<i>n</i> = 30)	Former coastal residents (<i>n</i> = 62)	Current coastal residents (<i>n</i> = 63)	Current coastal fishers (<i>n</i> = 64)		
Someone to help you ^b						
Six months before storms	12.9 (3.08)	13.4 (2.18)	13.3 (2.62)	12.8 (3.05)	0.63	0.595
Since the storms	12.6 (2.57)	12.0 (2.97)	10.5 (3.82)	11.5 (3.18)	3.72	0.012
Charitable work done for others ^c						
A typical year before storms	5.2 (2.33)	5.8 (2.20)	5.6 (2.26)	5.1 (2.35)	1.08	0.357
Since the storms	5.2 (2.27)	4.3 (2.07)	5.0 (2.36)	4.8 (2.08)	1.68	0.173
Work in the shelters or provide disaster relief	0.8 (1.65)	0.3 (0.71)	0.4 (0.93)	0.7 (1.12)	3.14	0.026
Lifetime trauma sum ^{d,e}	1.5 (0.57)	1.3 (0.84)	2.0 (1.28)	1.6 (1.23)	4.02	0.008
Lifetime trauma total ^{d,f}	2.3 (1.34)	2.0 (1.47)	2.9 (1.84)	2.4 (2.07)	3.14	0.026

Note: ^aBased on the following scale: 0 = none of the time, 1 = some of the time, 2 = most of the time, 3 = all of the time. ^bBased on the sum of responses to five questions. ^cBased on the sum of responses to three questions. ^dFrom the SSQ (Cherry et al., 2011). ^eSum of the number of events experienced (range: 0–5), not incorporating fear. ^fBased on the sum of five events where each is scored as 0 (no), 1 (yes, but no fear), or 2 (yes, with fear of injury or death during trauma). Traumas include: other natural disaster, serious accident, attacked with a gun/knife/other weapon, attacked without weapon but with intent to kill/injure, and experienced military combat or war zone.

Table 5. Mental health outcomes.

Mental health measures	N (%)				χ^2	p
	Non-coastal residents (n = 30)	Former coastal residents (n = 62)	Current coastal residents (n = 63)	Current coastal fishers (n = 64)		
PTSD						
No	29 (96.7%)	60 (96.7%)	56 (88.9%)	57 (89.1%)	4.49	0.213
Yes	1 (3.3%)	2 (3.2%)	7 (11.1%)	7 (10.9%)		
Any symptoms of depression						
No	20 (66.7%)	50 (80.6%)	41 (65.1%)	31 (48.4%)	14.39	0.002
Yes	10 (33.3%)	12 (19.4%)	22 (34.9%)	33 (51.6%)		
GAD						
No	28 (93.3%)	58 (93.5%)	59 (93.7%)	57 (89.1%)	1.28	0.735
Yes	2 (6.7%)	4 (6.5%)	4 (6.3%)	7 (10.9%)		

Note: PTSD = post-traumatic stress disorder. Any symptoms of depression = at least one response of 2 ('more than half the days') on the PHQ-9. GAD = generalized anxiety disorder.

Non-organizational religiosity and post-traumatic stress

The only variable that kept its significance in the final PTSD multivariate regression model was non-organizational religiosity, with an odds ratio of 1.284, indicating a 28% increased risk of PTSD for those with a higher reported frequency of non-organizational religious behaviors. To provide insight into this counterintuitive finding, we partitioned the sample into thirds based on participants' non-organizational religiosity composite score, forming low (scores of 3–7), medium (scores of 8–10), and high (scores of 11–15) tertiles based on their distribution. Comparing the medium group to the low group yielded an odds ratio of 2.037. However, the high to low group comparison yielded an odds ratio of 9.784 (Table 8). Thus, high non-organizational religiosity scorers were more than nine times as likely to have PTSD compared to low scorers. As it can be seen in Table 8, church membership predicted PTSD in this multivariate analysis as well, implying that the institutionally bounded religiosity also influences post-disaster mental health outcomes.

Discussion

The primary objective of this study was to examine religiosity and perceived social support as determinants of psychological outcomes in a post-disaster environment. We found that non-organizational religiosity was significantly associated with the increased risk of PTSD. Further analyses comparing the upper third of the sample to the lowest third showed that those who are high in non-organizational religiosity were more than nine times more likely to have PTSD than their low-scoring counterparts. Conceivably, persons who suffer most severely from PTSD may seek the solitary forms of religious expression to strengthen a personal sense of worth, virtue, or well-being (Krause & Van Tran, 1989). They may also withdraw after a major life stressor, turning to non-organizational religiosity in response to emotional distress, which seems plausible in a disaster context, where churches were destroyed and familiar social networks disrupted by storm

displacement. Indeed, other evidence has shown that avoidant emotional coping predicted both complicated grief and PTSD severity in college students who had recently experienced traumatic loss (Schnider, Elhai, & Gray, 2007).

Pargament (1997) has noted that higher levels of post-traumatic stress motivate the positive and negative forms of religious coping. Prior studies have shown that positive religious coping is associated with the post-traumatic growth (PTG) (Chan & Rhodes, 2013; Gerber, Boals, & Schuettler, 2011; Pargament, Smith, Koenig, & Perez, 1998), while negative religious coping has been linked to PTSD (Gerber et al., 2011). Gerber et al. also found a small but significant relationship between positive religious coping and PTSD, implying that religious coping strategies influence psychological outcomes in different ways (see also Marks, 2008; Pargament et al., 1998). Use of a cross-sectional design prohibits inferences on the directionality of the relationship between non-organizational religiosity and PTSD observed here, so interpretative caution is warranted. It should also be noted that church membership predicted PTSD in the follow-up PTSD multivariate model, implying that the institutionally bounded religiosity may be associated with the lower PTSD risk in a post-disaster context. Together, the present results highlight the value of considering theoretically distinct dimensions of religiosity in a post-disaster context. Our findings, among others, point to the need for further research to address dynamic relationships among different types of coping strategies and mental health outcomes in the years after disaster.

A protective effect of perceived social support was observed, replicating a well-established finding in the immediate aftermath of a natural disaster (Kaniasty & Norris, 2009; Norris & Elrod, 2006). Kaniasty and Norris (2008) have made the point that the perceived social support/post-traumatic stress relationship changes over time. Using a longitudinal design with four waves of data collected after the 1999 flooding and mudslides in Mexico, they found that the perceived social support was associated with reduced PTSD at 6–12 months; yet greater

Table 6. Bivariate logistic regression analyses predicting mental health outcomes.

	PTSD OR (95% CI)	Any symptoms of depression OR (95% CI)	GAD OR (95% CI)
Group			
Non-residents/former coastal residents	1.00	1.00	1.00
Current coastal residents	3.708 (0.921, 14.936)	1.707 (0.843, 3.457)	0.972 (0.263, 3.594)
Current coastal fishers	3.643 (0.905, 14.668)	3.387 (1.707, 6.722)**	1.760 (0.563, 5.507)
Gender			
Female	0.659 (0.244, 1.778)	0.952 (0.544, 1.666)	0.851 (0.316, 2.296)
Male	1.00	1.00	1.00
Age	1.000 (0.971, 1.031)	1.007 (0.990, 1.024)	0.995 (0.966, 1.025)
Education			
High school or less	0.749 (0.158, 3.556)	3.590 (1.301, 9.907)*	1.158 (0.201, 6.668)
Some college/specialized training	0.922 (0.224, 3.787)	3.192 (1.201, 8.481)*	1.880 (0.385, 9.173)
College degree	1.000 (0.188, 5.331)	1.933 (0.615, 6.074)	1.000 (0.133, 7.527)
Master's/doctorate/professional degree	1.00	1.00	1.00
Marital status			
Married	1.00	1.00	1.00
Single/divorced/widowed	0.556 (0.175, 1.767)	1.119 (0.627, 1.999)	0.769 (0.260, 2.270)
Income			
Less than \$2000/month	3.062 (0.608, 15.437)	3.536 (1.536, 8.080)**	8.333 (1.019, 68.146)*
Between \$2000 and \$4000/month	3.430 (0.679, 17.334)	2.460 (1.050, 5.765)*	3.773 (0.408, 34.919)
Between \$4000 and \$6000/month	0.521 (0.046, 5.942)	1.212 (0.476, 3.084)	3.333 (0.335, 33.202)
Over \$6000/month	1.00	1.00	1.00
Official member of the church			
Yes	0.738 (0.261, 2.090)	1.280 (0.687, 2.382)	0.990 (0.334, 2.935)
No	1.00	1.00	1.00
Religiosity			
Faith community involvement	1.004 (0.783, 1.288)	0.985 (0.856, 1.133)	1.021 (0.795, 1.309)
Non-organizational	1.220 (1.025, 1.452)*	1.009 (0.921, 1.107)	1.091 (0.925, 1.287)
Religious beliefs and coping	1.018 (0.904, 1.146)	1.030 (0.965, 1.100)	0.940 (0.850, 1.040)
Perceived social support	0.675 (0.507, 0.900)**	0.728 (0.598, 0.887)**	0.593 (0.444, 0.793)**
Lifetime trauma sum ^{a,b}	1.891 (1.232, 2.901)**	1.47 (1.124, 1.935)**	1.803 (1.177, 2.763)**
Lifetime trauma total ^{a,c}	1.450 (1.130, 1.861)**	1.294 (1.102, 1.520)**	1.498 (1.166, 1.926)**
Storm stressors total ^{a,d}	1.138 (0.902, 1.435)	0.953 (0.839, 1.083)	0.992 (0.790, 1.245)
Decline in help received from others after the storm ^{a,1,2}	1.150 (1.012, 1.306)*	0.996 (0.921, 1.078)	0.950 (0.821, 1.099)
Decline in charitable work done for others after the storm ^{a,1,3}	1.190 (0.982, 1.443)	1.037 (0.916, 1.175)	0.914 (0.714, 1.169)

Note: OR = odds ratio. CI = confidence interval. Age is treated as a continuous variable. ^aFrom the SSQ (Cherry et al., 2011). ^bSum of the number of events experienced (range: 0–5), not incorporating fear. ^cBased on the sum of five events where each is scored as 0 (no), 1 (yes, but no fear), or 2 (yes, with fear of injury or death during trauma). Traumas include: other natural disaster, serious accident, attacked with a gun/knife/other weapon, attacked without weapon but with intent to kill/injure, and experienced military combat or war zone. ^dBased on the sum of 11 stressors, where each is coded as 0 (no), 1 (yes, not stressful), 2 (yes, moderately stressful), or 3 (yes, extremely stressful). ¹Based on the following scale: 0 = none of the time, 1 = some of the time, 2 = most of the time, 3 = all of the time. ²Based on the sum of responses to five questions. ³Based on the sum of responses to three questions. * $p < 0.05$, ** $p < 0.01$.

Table 7. Multivariate logistic regression analyses predicting mental health outcomes.

	PTSD OR (95% CI)	Any symptoms of depression OR (95% CI)	GAD OR (95% CI)
Group			
Non-residents/former coastal residents	—	1.00	—
Current coastal residents	—	1.177 (0.524, 2.641)	—
Current coastal fishermen	—	2.690 (1.166, 6.203)*	—
Gender			
Female	0.658 (0.192, 2.250)	1.151 (0.582, 2.277)	0.774 (0.225, 2.660)
Male	1.00	1.00	1.00
Education			
High school or less	—	0.966 (0.276, 3.377)	—
Some college/specialized training	—	1.531 (0.503, 4.657)	—
College degree	—	1.592 (0.470, 5.389)	—
Master's/doctorate/professional degree	—	1.00	—
Marital status			
Married	—	1.00	—
Single/divorced/widowed	—	0.710 (0.323, 1.564)	—
Income			
Less than \$2000/month	—	3.329 (1.123, 9.970)*	5.825 (0.673, 50.405)
Between \$2000 and \$4000/month	—	1.817 (0.716, 4.612)	2.255 (0.225, 22.622)
Between \$4000 and \$6000/month	—	0.914 (0.334, 2.498)	2.008 (0.187, 21.607)
Over \$6000/month	—	1.00	1.00
Official member of the church			
Yes	0.460 (0.130, 1.625)	—	—
No	1.00	—	—
Religiosity			
Faith community involvement	—	—	—
Non-organizational	1.284 (1.041, 1.582)*	—	—
Religious beliefs and coping	—	—	—
Perceived social support	0.733 (0.532, 1.010)	0.796 (0.637, 0.994)*	0.634 (0.451, 0.891)**
Lifetime trauma sum ^{a,b}	1.063 (0.318, 3.559)	0.842 (0.369, 1.923)	0.505 (0.132, 1.933)
Lifetime trauma total ^{a,c}	1.186 (0.596, 2.362)	1.392 (0.869, 2.232)	1.918 (0.937, 3.925)
Storm stressors total ^{a,d}	—	—	—
Decline in help received from others after the storm ^{a,1,2}	1.132 (0.993, 1.290)	—	—
Decline in charitable work done for others after the storm ^{a,1,3}	—	—	—

Note: OR = odds ratio. CI = confidence interval. ^aFrom the SSQ (Cherry et al., 2011). ^bSum of the number of events experienced (range: 0–5), not incorporating fear. ^cBased on the sum of five events where each is scored as 0 (no), 1 (yes, but no fear), or 2 (yes, with fear of injury or death during trauma). Traumas include: other natural disaster, serious accident, attacked with a gun/knife/other weapon, attacked without weapon but with intent to kill/ injure, and experienced military combat or war zone. ^dBased on the sum of 11 stressors, where each is coded as 0 (no), 1 (yes, not stressful), 2 (yes, moderately stressful), or 3 (yes, extremely stressful). ¹Based on the following scale: 0 = none of the time, 1 = some of the time, 2 = most of the time, 3 = all of the time. ²Based on the sum of responses to five questions. ³Based on the sum of responses to three questions. * $p < 0.05$, ** $p < 0.01$.

Table 8. Additional multivariate logistic regression model predicting PTSD.

	PTSD OR (95% CI)
Gender	
Female	0.380 (0.124, 1.162)
Male	1.00
Education	
High school or less	0.185 (0.027, 1.251)
Some college/specialized training	0.323 (0.058, 1.807)
College degree	0.698 (0.106, 4.620)
Master's/doctorate/professional degree	1.00
Income	
Less than \$2000/month	6.715 (0.915, 49.267)
Between \$2000 and \$4000/month	0.320 (0.024, 4.307)
Between \$4000 and \$6000/month	0.698 (0.106, 4.620)
Over \$6000/month	1.00
Official member of the church	
Yes	0.202 (0.052, 0.786)*
No	1.00
Non-organizational religiosity	
Low	1.00
Medium	2.037 (0.367, 11.305)
High	9.784 (1.780, 53.782)**

Note: OR = odds ratio. CI = confidence interval. * $p < 0.05$, ** $p < 0.01$.

PTSD was associated with less support at 18–24 months post-disaster. We found a protective effect of perceived social support for the symptoms of depression and GAD in the final multivariate models, implying that the perceived social support benefit may return in time, although interpretative caution is warranted given the absence of immediate impact data in this study. Our results underscore the value of examining post-disaster psychological reactions at least five years after the event to determine whether psychosocial variables that are important in the immediate post-disaster phase still matter in the years after disaster.

Our secondary objective in this study was to address the 2010 BP oil spill's impact on the long-term hurricane recovery. We included commercial fishers directly impacted by the oil spill and the 2005 devastation to permit novel inferences on recent trauma related to natural and technological disaster exposure. A striking finding was that more than half of the fishers (51.6%) reported the symptoms of depression. This result is consistent with the COR theory of stress responses (Hobfoll, 1989, 2001), providing the new evidence of heightened symptom prevalence related to resource losses after the natural and technological disaster. In particular, the losses of coastal fishers who were doubly impacted by the 2005 hurricanes

and the 2010 oil spill span all four resource categories identified within the COR framework: valued objects (e.g., one's home and boat), conditions (job security and social networks), personal characteristics (self-esteem and sense of mastery), and energies (e.g., money and time to rest). A detailed analysis of hurricane-related stressors revealed that the coastal fishers rated their experience of these events in 2005 as extremely stressful more often than did their counterparts (Figure 1). One explanation for this finding is that life stresses related to the BP oil spill have influenced their recollection of Hurricane Katrina-related stressors. Alternatively, coastal fishers spoke of the hurricane's impact on the fishing industry, including storm debris clogging bayous and natural waterways and catastrophic damage to boats, docks, and marinas. Thus, storm-related stressors may have been extreme for the coastal fishers at the time, although this conjecture is speculative given the absence of immediate impact data. Nonetheless, our findings highlight the need for further research on the coastal fishers for whom losses related to hurricanes and the oil spill may be particularly devastating. Future research guided by the COR theory would be useful to identify personal characteristics associated with the post-disaster resilience and long-term recovery. The development of effective post-disaster interventions to alleviate the burden of multiple environmental stressors is an important challenge that awaits further research (Neria, Nandi, & Galea, 2008).

The present results also speak to long-term outcomes in a more general way for people who have experienced recent and serious trauma. Previous trauma has been identified as one of several separate risk factors for PTSD (Brewin, Andrews, & Valentine, 2000). We found that prior lifetime trauma was significantly associated with psychological outcomes at least five years after Hurricanes Katrina and Rita in the bivariate analyses, although not in the final multivariate regression models. Our findings suggest that the current environmental factors related to the more recent technological disaster increase vulnerability and may override the influence of previous trauma. The present results also indicate that the perceived social support seems to be the key in terms of positive mental health outcomes after these disasters. Taken together, these data are consistent with the notion that disaster outcomes depend critically on a combination of risk factors coupled with resilience characteristics (Bonnano, Brewin, Kaniasty, & La Greca, 2010). Consequently, disaster survivors' developmental history should be considered together with their current circumstances when designing post-disaster interventions (Tracy & Galea, 2006). Cultural competency is another key consideration (Jones et al., 2009), which is particularly relevant in this study because our sample included persons of Isleno and Croatian descent.

We also found that older persons had greater prevalence of other lifetime trauma than did their younger counterparts. Age alone was not a significant predictor of psychological outcomes, so interpretative caution is warranted. Nonetheless, it is possible that despite prior lifetime trauma (or maybe because of it), older adults

who survive natural and technological disaster are resilient (see Knight, Gatz, Heller, & Bengtson, 2000; but see Phifer, 1990). Older persons with prior lifetime trauma exposure may also cope differently than do younger persons, a potentially important direction for future research (see Fridman, Bakermans-Kranenburg, Sagi-Schwartz, & Van IJzendoorn, 2011). Finally, the significant age difference in other lifetime trauma prevalence emphasizes the need for age-sensitive training to prepare first responders and personnel involved in disaster planning and post-disaster relief efforts. Other evidence has shown that older age, longer community tenure, and dispositional optimism were associated with increased optimistic bias for hurricane risk among Gulf Coast residents, excluding those geographic areas directly affected by Hurricanes Katrina and Rita (Trumbo, Lueck, Marlatt, & Peek, 2011). Conceivably, older persons in this study, most of whom were lifelong south Louisiana residents affected by earlier hurricanes (e.g., Betsy in 1965 and Camille in 1969) and the 2005 devastation, may be less likely to perceive personal risk of safety or threat to well-being related to the natural and technological disaster. Future research to address hurricane outlook in later life and general tendencies toward optimistic appraisals of disaster hazards is needed.

Six limitations of the study should be noted. First, these data were collected at one point in time; longitudinal assessments with at least three points of reference are desirable to show possible changes in patterns of vulnerability over time (Chan & Rhodes, 2013; Kaniasty & Norris, 2008; Norris, Tracy, & Galea, 2009). Second, the symptoms of post-traumatic stress were assessed without the specific reference to the hurricanes. Thus, it is not clear to what traumatic event participants were referring to when reporting post-traumatic stress symptoms within the last month. Third, many participants (65%) reported no symptoms of depression that met the DSM-IV criterion established in the PHQ-9 (Kroenke, Spitzer, & Williams, 2001). We suspect that a small sample size and possible tendency toward symptom under reporting may be responsible for the limited prevalence of depressive symptoms observed in this study. Fourth, our sampling strategy may have introduced a selection bias which limits generalizability of findings. Individuals faring poorly may not self-select to participate in a study of this nature. Fifth, the sample was predominantly Catholic with fewer Protestants so inferences on religiosity must be confined to Judeo-Christian contexts. Sixth, the study is retrospective, relying on personal accounts of storm experiences. Recognizing the fallibility of memory for traumatic experiences (Brewin, 2007; Dekel & Bonnano, 2013) and memory in later life (Jacoby & Rhodes, 2006; Pierce, Simons, & Schacter, 2004), we note that participants' self-reports are subject to possible biases and unintentional distortions that may increase the measurement errors.

In closing, these data provide a unique contribution to the literature on the long-term Hurricane Katrina recovery for coastal residents (Galea et al., 2008). Our results support Hobfoll's (1989, 2001) COR theory, highlighting the role of the environmental loss in understanding the long-

term psychological outcomes after multiple disasters. Future research to address the generality of these findings is warranted.

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Notes

- 1 Any symptom of depression was indicated when one or more of the eight symptoms on the PHQ-9 was endorsed as a 2 or higher ('more than half of the days'), or if the last symptom ('Thoughts that you would be better off dead or hurting yourself in some way') was endorsed as a 1 or higher ('several days'), after Kroenke et al. (2001).
- 2 Cherry et al. (2011) reported four separate dimensions of religiosity. Because religious beliefs and practices (three questions) and religious coping (two questions) were strongly intercorrelated ($r = 0.83$), we combined these dimensions to form a single religious beliefs and coping dimension (five questions) in this study.

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