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Community organizations and mental health after the 2013 Boston Marathon bombings

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ABSTRACT

Objective: Disasters are place-based traumatic events, yet contemporary understandings of disaster recovery often do not consider the role of community organizations. We examine organization type and proximity as they relate to post-disaster mental health in a longitudinal study following the 2013 Boston Marathon bombings.
Method: Residents of metropolitan Boston (N = 846) were recruited via a probability-based sampling strategy within weeks of the bombings and were surveyed several times over a two-year period. Residents of metropolitan New York (N = 941) were recruited and surveyed at the same time and used for comparison due to similarities in community demographics, geography, and disaster histories. We identified six different organization types nearby resident: safety-based organizations, religious organizations, educational organizations, child- and family-promoting organizations, health-based organizations, and voluntary community organizations. With possible environmental detriments (crowds and noise) or benefits of organizations amplified in areas closest to the resident, the concentration of these local organization types was examined at different distance-based boundaries. Contextual data for both communities came from the U.S. Census, Google Places API, and Guidestar.
Results: For Boston metropolitan area residents, having more safety-based organizations within a half-mile to one-mile area in the aftermath of the bombings was associated with poorer functioning six to seven months later and greater psychological distress two years later. However, the presence of more safety-based organizations in the one to three mile area was associated with decreased psychological distress two years later. More health-based and voluntary community organizations in the half-mile to one-mile area were also associated with fewer fears and worries about future adversity two years post-bombing. Exposure to the bombings and other community traumas moderated this relationship among Boston area participants.
Conclusion: Results suggest that local community organizations are not merely buildings or structures but ecological sources of support to those in need after a disaster.

1. Introduction

One of the most publicized acts of violence in the U.S. in recent years occurred on April 15, 2013 during the Boston Marathon. Pressure cooker bombs detonated at the finish line and left three people dead and around 264 people wounded, marking the first successful act of domestic terrorism since the September 11, 2001 attacks (9/11; Yan, 2014). Like 9/11, the Boston bombings received media attention from national and international press. As indirect exposure to disasters is associated with mental and physical health ailments (Silver et al., 2013), it was no surprise that residents in Boston and New York experienced acute stress symptoms in the weeks following the attack (Holman et al., 2014). Over time, prolonged or severe acute stress may develop into post-traumatic stress disorder (PTSD). PTSD and post-traumatic stress (PTS) symptoms are the most frequently studied mental health problems after natural, man-made, or technological disasters (Neria et al., 2008).

To mitigate the effects of community trauma on individual mental health, researchers have focused on identifying individual and interpersonal factors related to "resilient" (adaptive) outcomes. Resilience has been used to describe survivors of natural (e.g., Hurricane Katrina; Harville et al., 2010) and man-made (e.g., 9/11; Neria et al., 2011) disasters. *Resilience* is typically defined as a limited stress response with rapid return to baseline. Factors associated with resilience include

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demographics (e.g., age, gender, and ethnicity; Bonanno et al., 2007) and dynamic processes such as social support (Chan et al., 2015; Matsuyama et al., 2016; Ozer et al., 2003) and service utilization (Garfin et al., 2014). The context or space where support and services are garnered, though an important catalyst for resilient exchanges, remains a neglected area of study.

Local community organizations are a natural space to acquire tangible amenities (e.g., food, blankets; Chamlee-Wright and Storr, 2009), social support or social capital (i.e., trust, relationships, or information; Kawachi and Subramanian, 2018; Patterson et al., 2010; Paxton, 1999), and health services (Yun et al., 2010) post-disaster. Before a disaster, proximity to certain types of local community organizations is associated with residential health and welfare outcomes (e.g., crime; Wo, 2016). After a disaster, it is less clear how proximity to different types of local community organizations may relate to an individual's psychological health.

1.1. Pre-disaster studies of organizational proximity

When assessing the role of local community organizations on individual mental health, it is essential to consider the spatial location and concentration of organizations. The location of organizations matters because organizations are not randomly distributed across space (e.g., access to community organizations or resources can be better in deprived urban spaces than in deprived rural spaces; Pearce et al., 2008), nor are individuals equally close to the same organizations. Prior studies have used the location of organizations to predict a variety of outcomes including crime (Wo, 2016), service utilization (Allard et al., 2003), and child maltreatment (Coulton et al., 1995). Studies on health care, service utilization, and crime are the most central in understanding how pre-disaster organization proximity might be associated with individual mental health outcomes.

In studies of health service organizations, proximity to physical and mental health service organizations have been found to be associated with an increase in service use among residents "in-need." Specifically, Detroit welfare recipients (Allard et al., 2003) and veterans with substance use problems (Schmitt et al., 2003) who lived closer to mental health and substance use facilities were significantly more likely to use these services, even after adjusting for tract- or county-level demographics (e.g., unemployment and poverty rates) and individual-level demographics (e.g., age, diagnoses, and vehicle access). Given that proximity to health-based organizations is important for service utilization in a *pre-disaster* context where "need" is largely static (for a review of service utilization studies, see Higgs, 2004), it follows that organization location and concentration may be of equal or greater importance in a *post-disaster* context when "need" is high.

For crime, multiple types of organizations have been examined in relationship to pre-disaster crime rates. Slocum et al. (2013) used a cross-sectional design to explore whether living in a block-group with a high concentration of different organization types was associated with decreased crime rates in the South Bronx. Of the nine organization types tested, only two types had a mitigating effect on violent and or property crime rates: organizations that acted as a "bridge" and organizations oriented toward children and families. Using a longitudinal design, Wo (2016) similarly used data across nine U.S. cities to examine how alcohol establishments, banking establishments, civic and social organizations, and "third places" (e.g., cafes) related to crime.

Literature on the pre-disaster relationship between organizations and people/places suggests two things. First, the spatial proximity and concentration of organizations may inform health and behavior. Second, the effect of local organizations varies and not all organizations are beneficial even if they are theoretically intended to have a positive impact on a community (e.g., civic organizations). These findings suggest that local community organizations may also affect mental health outcomes after a large-scale traumatic event like the Boston Marathon bombings (BMB).

1.2. Proximity to organizations in the post-disaster environment

No prior empirical research has directly examined the relationship between the proximity of a range of community organizations and post-disaster well-being (although see Chamlee-Wright and Storr, 2009, for a qualitative analysis of provision of goods by religious organizations after a disaster). However, non-disaster empirical research on organizations and the built environment suggests that the presence of local community organizations nearby may both help and hinder resident post-disaster recovery. On the one hand, local organizations might, for example, foster a healthy mental state post-disaster by providing continued services, support, and social capital to nearby residents or by helping residents feel safe (Wood et al., 2008). On the other hand, it is possible that local organizations may agitate or induce distress by attracting crowds or unfamiliar people and increasing the noise level of a neighborhood (Sullivan and Chang, 2011). As with studies of organizations in a pre-disaster environment (Slocum et al., 2013; Wo, 2016), it may be expected that the effects of living nearby local organizations will vary depending on organization type.

In the aftermath of certain disasters (e.g., natural disasters or 9/11), organizations themselves can be damaged. For community organizations, damage is typically structural (e.g., damaged windows), informational (e.g., lost data), or indirect (e.g., an interruption in production due to transportation problems; Tierney, 2007). To the extent that community organizations remain intact, they can influence resident recovery and may work in tandem with external (emergency) relief aid initiatives (Berke and Campanella, 2006; Olshansky et al., 2006; O'Sullivan et al., 2013).

Following the Disaster Research Center (DRC) typology (Dynes, 1970), disasters can change the classification of pre-existing local community organizations into one of three types: (1) "established organizations" or disaster-ready organizations whose structure and function is built ready to respond to disaster situations (fire stations, hospitals, etc.); (2) "expanding organizations" or organizations whose mission is to respond to disasters but doing so requires temporary structural changes like recruiting and training volunteers (e.g., Red Cross); and (3), "extending organizations" or organizations that use an existing structural base to take on different tasks from their regular day-to-day operations (e.g., religious institutions, schools, and small businesses; Kreps and Bosworth, 2007). The structural and functional changes made by DRC-typed organizations can result in them benefiting a wider array of people post-disaster than pre-disaster. The relationship between local organizations and people thus may differ for residents living within a disaster-exposed community compared to those in a non-disaster area. Moreover, compared to external or temporary organizations, pre-existing local organizations can be especially committed to the needs and welfare of residents, supporting affected populations long after a traumatic event (Wicke and Silver, 2009). The enhanced presence, potential benefits and costs, and non-uniformity of local organizations post-disaster make them important for understanding resident short- and long-term mental health.

1.3. A study of local community organizations and post-disaster mental health

The present study examined associations between types of local community organizations and resident mental health after the 2013 BMB. This tragedy served as an unfortunate but unique event to study given the extensive publicity surrounding the bombings and subsequent lockdown, as well as the limited structural damage to the area, keeping local community organizations intact. We examined six different organization types adopted from prior empirical research on organization types pre-disaster (Slocum et al., 2013) and theoretical groupings of organizations post-disaster (DRC typology; Dynes, 1970): safety-based organizations, religious organizations, educational organizations, child- and family-promoting organizations, health-based organizations, and

voluntary community organizations. With possible environmental detriments (crowds and noise) or benefits of organizations amplified in areas closest to the resident, the concentration of these local organization types was examined at different distance-based boundaries. Six organization type concentrations (i.e., the number of each type) were assessed as predictors of post-disaster acute stress, probable PTSD, functional impairment, psychological distress, and future fears/worries, all common psychological outcomes in the aftermath of a community disaster (see Norris et al., 2002). Moreover, disaster-related exposure (to the BMB and prior community traumas in the Northeast U.S.) was tested as a moderator of the relationship between specific organization types and mental health. As relationships with local organizations may differ for residents living near the Boston metropolitan area compared to elsewhere in the U.S., a second geographic area – the New York metropolitan area – was used for comparison due to similarities in residential demographics (gender, age, race, income), geography (northeast), walk-ability, and shared disaster histories (Superstorm Sandy and 9/11; U.S. Census Bureau, 2013). The New York metropolitan area sample enables us to assess how proximity to and concentration of local community organizations have differential effects on resident mental welfare depending upon whether one is living in a "disaster" or "non-disaster" environment, irrespective of individual event exposure. Without such a comparison sample, it would be difficult to distinguish the utility of organizations in a post-disaster climate from their everyday impact.

We expected that **safety-based organizations** (police and fire stations) and **health-based organizations** (e.g., hospitals) might heighten feelings of alarm and distress if located too close because of the noise pollution produced by sirens. However, effective safety-based organizations also tend to generate feelings of security and safety among residents, aspects inversely related to psychological distress (Ziersch et al., 2005). Thus, safety-based organizations may also reduce distress if located at further distances. Health-based organizations at a distance were expected to be beneficial to residents, as proximity to such organizations is often associated with increased service use for at-risk persons (Allard et al., 2003).

The presence of **religious organizations** was expected to have a positive effect on residents. Participation in or affiliation with religious organizations among non-psychiatric populations has been deemed an effective way to cope with stress and curb mental health difficulties such as depression, anxiety, fear, suicidality, and substance use (Koenig, 2009). **Child- and family-promoting organizations,** such as childcare support, may help children, parents, and families recover after a disaster (Madrid and Grant, 2008). As such, child- and family-promoting organizations were expected to benefit residents post-bombings.

Voluntary community organizations can help people form relationships of companionship and support, two qualities that foster positive mental health and well-being (Thoits, 2011). Low levels of voluntary community membership are also thought to increase one's chances of reporting "poor" or "fair" health (Kawachi et al., 1999). Still, voluntary community organizations can reside in areas where residents need more assistance (i.e., high poverty areas; Peck, 2008). Furthermore, voluntary community organizations generally need time (several years) to improve the neighborhoods in which they reside (e.g., reduce crime; Wo et al., 2016). The relationship between voluntary community organizations and nearby residents in the aftermath of a disaster is therefore less clear. Finally, for **educational organizations**, some research supports considering them "extended organizations" that use their facilities to offer shelter and aid after natural disasters (Chamlee-Wright and Storr, 2009). Educational organizations would therefore be expected to promote positive resident health outcomes post-bombings.

Disaster exposure as a moderator. Persons directly exposed to a disaster or persons with a history of being directly exposed to other large-scale community traumas often report high levels of acute stress, PTSD, and functional difficulties in their aftermath (Norris et al., 2002). Being highly distressed might also lead residents to seek out services or be most comforted by organizations that cater to health issues, families, or community welfare close to home. The three organization types that best fit these criteria are: health-based, child- and family-promoting, and voluntary community organizations. Therefore, disaster exposure was examined as a moderator of the relationship between said organizations and mental health outcomes assessed in the weeks or months post-event. The focus on short-term mental health was guided by the fact that organization concentration and trauma-exposure were expected to have a stronger impact on mental health when the event was still relatively "new" and public distress high. Exposure to the bombings or prior community disaster events was hypothesized to result in lower distress symptoms if participants resided in neighborhoods with a greater number of organizations.

2. Method

2.1. Design and data

This study used data collected as part of an ongoing longitudinal study using the GfK KnowledgePanel. GfK is a survey research company that has created a nationally representative web-enabled panel (KnowledgePanel) using address-based sampling methodology. Panelists complete surveys in exchange for internet access or points for merchandise. Data were collected on representative samples of New York and Boston metropolitan area residents two to four weeks (Wave 1: April 29-May 13, 2013) after the bombings (Boston: $N = 846$, participation rate = 83%; New York: $N = 941$, participation rate = 74%), six to seven months later (Wave 2: October 18-November 17, 2013; Boston: $N = 812$, Wave 1 retention rate = 96%; New York: $N = 901$, Wave 1 retention rate = 96%), and two years post-BMB (Wave 5: April 29-June 26, 2015; Boston: $N = 635$, Wave 1 retention rate = 75%; New York: $N = 699$, Wave 1 retention rate = 74%). (Two additional waves of data were collected but are not reported on as they are not relevant to the present study.) All procedures were reviewed and approved by the Institutional Review Board at the University of California, Irvine.

Participant residential latitude/longitude data (shifted for privacy) were used to determine census block group IDs within ArcGIS (a spatial software program). Neighborhood-level data (population and household income) were combined with participant data using information from the U.S. Census American Community Survey (ACS) five-year dataset. Local community organization information was culled using Google Places Application Program Interface (API) and Guidestar (an online repository of non-profit organizations), and was also combined with participant data in ArcGIS for both Boston and New York metropolitan area participants.

2.2. Participants

Metropolitan area samples excluded participants with invalid latitude and longitude coordinates (Boston: $n = 7$; New York: $n = 4$), persons who reported moving after the BMB (Boston: $n = 50$; New York: $n = 31$), and persons with improbable block group data (i.e., block group population estimated as "0"; Boston: $n = 1$; New York: $n = 5$). The final sample sizes were Boston metropolitan area: $N = 788$; New York metropolitan area: $N = 901$.

2.3. Measures

2.3.1. Predictor variables

Demographics. Participant demographic information used included: age (in years), gender (female = 1, male = 0), race or ethnicity (Hispanic, Black, other race, and multi-race; White as the reference group), household income divided into eight categories (1 = less than $24,999, 2 = $25,000 to $49,999, 3 = $50,000 to $74,999, 4 = $75,000 to $99,999, 5 = $100,000 to $124,999, 6 = $125,000 to $149,999, 7 = $150,000 to $174,999, 8 = $175,000 or more), marital

status (married or cohabitating = 1; widowed, divorced, separated, or never married = 0), education (less than high school education = 1; high school, some college, or Bachelor's degree or higher = 0), and employment status (1 = paid employee or self-employed, 0 = not employed). Updated demographics collected at Wave 5 were used to predict mental health outcomes at two years post-BMB.

Residential location. Residential latitude/longitude coordinates were pulled around the one-year anniversary of the bombings (April 2014). To ensure participant privacy, coordinates were shifted between 100 and 2,000 feet, with the extent of shifting based on the population density of the census block (Jose, 2018). Specifically, coordinates were shifted 100–500, 600–1,000, 1,100–1,500, and 1,600–2,000 feet if block density was greater than 6,177, between 2,656 and 6,176, between 422 and 2,655, and 421 or less, respectively.

Population density. The density per square mile of land area was computed by dividing the census-estimated block-group total population by the total land area. In square meters originally, total land area was divided by 2,589,988 to convert it into square-mile units.

Neighborhood income. Neighborhood income was equal to the census estimated median household income (in dollars) of the block-group.

Local community organizations. Local community organizations were classified into six mutually-exclusive organization types: safety-based organizations (police and fire stations), religious organizations (e.g., churches, synagogues, mosques), educational organizations (e.g., schools, universities), child- and family-promoting organizations (e.g., childcare centers, YMCAs), health-based organizations (e.g., hospitals, mental health facilities), and voluntary community organizations (e.g., senior centers, community centers, cultural centers). Using Google Places API and Guidestar, names, addresses, and latitude/longitude coordinates (for Google Places API) of these six organization types were acquired for Boston and New York metropolitan areas. For Guidestar, addresses were geocoded in ArcGIS and Google Earth Pro to get latitude and longitude information. Addresses that could not be geocoded (less than 5% of entries) were dropped. Organization listings were cleaned by a team of trained research assistants to ensure repeat and invalid entries were removed. Counts of the total number of organizations within a five-mile area of participants were determined in ArcGIS. The vincenty command in STATA was then used to get the number of each organization type at multiple, non-overlapping distance boundaries (see "Data analysis" section).

Prior mental health. Upon entry to the GfK panel and prior to the Wave 1 data collection, respondents completed a survey that assessed their mental health history. Specifically, two items from the Centers for Disease Control National Center for Health Statistics annual National Health Interview Survey (NHIS) were used to measure pre-event mental health. Participants were asked if a medical doctor ever diagnosed them with depression and anxiety disorders. Before the bombings, 75.3% of the participants had completed these questions. Missing values were imputed using the Sequential Hot Deck Imputation method. Values were coded as: 0 = no mental health diagnosis, 1 = one mental health diagnosis, 2 = both depression and anxiety diagnoses. (Conducting analyses with and without imputed data produces similar results but to retain sample size, analyses with imputed data are reported.) To predict Wave 5 outcomes, an updated prior mental health variable was used that incorporated recent doctor diagnoses of anxiety or depression.

Previous community trauma exposure. At Wave 1, participants were asked if they were directly exposed to the 9/11 attacks, Sandy Hook Elementary School shootings, or Superstorm Sandy. Prior direct exposure was measured individually for each event (e.g., the respondent or close other directly experienced event) and then combined to create a cumulative score ranging from 0 to 3.

Direct exposure to the BMB. Participants' exposure to the bombings was assessed in the weeks following the event. A dichotomous measure was created with "1" indicating direct exposure as either the participant or close other was at, injured in, or near the Boston Marathon, in the lockdown area, or the participant knew someone who died; "0" indicated no direct exposure.

Media exposure to the BMB. The total number of hours per day a participant spent attending to bombing-related media (i.e., television, online, social media, print, radio) was measured at Wave 1. The total number of hours was recoded into a quartile-based categorical variable (0 = 0–1.49 h; 1 = 1.5–2.9 h; 2 = 3–5.9 h; 3 = 6 h or more) representing the total number of hours per day of media exposure to the bombings.

2.3.2. Outcome variables

Acute stress. The Stanford Acute Stress Reaction Questionnaire (SASRQ; Cardeña et al., 2000) was used to measure acute stress responses in the weeks post-bombing (Wave 1). The SASRQ is comprised of 30 items assessing disassociation, impairment, avoidance, re-experiencing, and hyperarousal symptoms. Responses were recorded using a six-point Likert scale ranging from "not experienced" (1) to "very often experienced" (6). Models included a summed score of acute stress (range: 30–180; $\alpha_{sample} = 0.96$).

Probable PTSD. Probable PTSD was measured using the four-item Primary Care PTSD Screen (PC-PTSD; Prins et al., 2003) six to seven months post-bombing (Wave 2). Participants were asked the frequency with which they experienced nightmares, avoided situations or thinking about the bombings, or felt on guard or detached from things, places, or people after the bombings. Responses were rated using a five-point scale ranging from "never" to "all of the time." Items were then recoded to match the scale's original "yes" or "no" response categories (0 = never, 1 = all other non-missing responses) and then summed. Participants indicating three or four symptoms in the last month were reclassified as "probable PTSD" (1) and those with fewer than three symptoms deemed "not probable PTSD" (0; Prins et al., 2016).

Functional impairment. Physical and emotional functioning was measured six to seven months post-bombing (Wave 2) using four items modified from the Medical Outcomes Study 36-item Short-Form Health Survey (SF-36; Ware and Sherbourne, 1992). Items asked participants how much their health (physical and emotional) interfered with social activities and made it difficult for them to perform work or other regular daily activities in the last week. Responses ranged from "none of the time" (1) to "all of the time" (5). A functional impairment summary score was created (range: 4–20; $\alpha_{sample} = 0.84$).

Psychological distress. Global distress was measured at the two year anniversary of the bombings (Wave 5) using nine items from the 18-item Brief Symptom Inventory (BSI-18; Derogatis, 2001). Each item was evaluated along a five point rating scale ranging from "not at all" (0) to "extremely" (4) to capture the prior week's distress. Responses were summed to create a total distress score (range: 0 to 36; $\alpha_{sample} = 0.87$).

Future fears/worries. An eight-item measure assessed future fears/worries two years post-bombing (Wave 5). Items asked how often participants feared or worried about acts of terrorism, violence, natural disasters, and financial difficulties affecting themselves, their families, and or their communities in the future. Responses were rated along a five point rating scale ranging from "never" (1) to "all of the time" (5). A summed total score was created to represent future fears/worries (range: 8–40; $\alpha_{sample} = 0.88$).

2.4. Data analysis

The structure of the data was such that individuals (level 1) were nested within census block groups (level 2). In some instances, participants shared block group membership (Boston metropolitan sample: 21%; New York metropolitan sample: 4%). To determine the necessity for a multilevel modeling strategy, null or unconditional means models were estimated on short- (Wave 1–2) and long-term (Wave 5) mental health outcomes post-bombings. Interclass Correlation Coefficients (ICC) from null models indicated that block group identity explained a significant amount of variation in Boston metropolitan area outcomes

(23%–66%) and New York metropolitan area outcomes (29%–75%), except for New York area functional impairment and future fears and worries (zero clustering effect). To reduce standard error bias and Type 1 error, random intercept multilevel mixed effects models were estimated to account for block group clustering. Probable PTSD (a binary outcome) was estimated using multilevel mixed effects logistic regressions. For New York area functional impairment and future fears/worries, Ordinary Least Squares (OLS) regressions or linear regressions were used instead since observations appeared independent (i.e., responses within block groups were no more similar than responses across block groups) and the hierarchal nature of the data was not of substantive interest (McNeish, 2014).

Baseline models including only individual-level and block-group predictors (i.e., population density and neighborhood income) were estimated to interpret significant control coefficients. In subsequent models, service-providing organization counts of each type were examined as predictors of participant mental health. Based on the possibility that organizations within the neighborhood or far from the neighborhood would have differential buffering effects, organization counts were generated within a half-mile area or "immediate environment", half-mile to within a one-mile area or "proximal environment", one mile to within a three mile area or "near-distal environment", and three miles to within a five mile area or "distal environment." Due to statistical collinearity issues for educational and religious organizations, the latter distances were combined and referred to as the "outside environment" (one mile to within a five mile area). Findings reported below are presented by organization type.

Moderation analyses were included to predict whether the relationship between residential proximity to organizations and short-term mental health (i.e., acute stress, probable PTSD, and functional impairment) varied depending on the level of direct bombing exposure or prior community trauma exposure. To test the moderating effects of disaster exposure, interaction terms were generated with one-mile counts of three organization types: child- and family-promoting organizations, health-based organizations, and voluntary community organizations. The decision to use one-mile organization counts over other count areas (e.g., half mile or five mile count areas) was due to the desire to capture a sizeable portion of the neighborhood while still including organizations close to participant residences. Significant interactions were plotted as figures using predictive margin values. All models were estimated separately based on sampled area (Boston and New York metropolitan).

3. Results

Baseline model results and descriptive statistics can be found in Supplemental Tables S1-S3. Below we review the significant direct effects between organization type counts and mental health outcomes for Boston (Table 1) and New York (Table 2) metropolitan residents.

3.1. Safety-based organizations

The number of safety-based organizations was significantly associated with acute stress, functional impairment, and psychological distress among Boston metropolitan residents. For acute stress, each additional safety-based organization in the proximal environment was associated with 1.25 units increase in acute stress scores ($p < .05$). For functional impairment, each additional safety-based organization in the immediate environment and proximal environment was associated with a 0.31 and 0.20 unit increase in functional impairment (in order; $p < .05$), controlling for all other variables. For general psychological distress measured two years post-bombings, having more safety-based organizations in the proximal environment was associated with a 0.38 unit increase in distress scores ($p < .05$). However, having more safety-based organizations in the near-distal environment was associated with a 0.13 unit decrease in distress scores ($p < .01$), controlling for all other variables. Safety-based organizations were not significantly associated with short- or long-term mental health for New York metropolitan area residents.

3.2. Religious organizations

There were no statistically significant relationships between religious organization counts and mental health outcomes for Boston metropolitan residents. For New York metropolitan residents, having more religious organizations in the immediate and proximal environment was associated with a 0.19 unit decrease and 0.11 unit increase in acute stress symptoms (in order; $p < .05$).

3.3. Educational organizations

The presence of educational organizations in the Boston metropolitan area was not associated with resident welfare in the weeks, months, and years following the bombing. In contrast, for New York metropolitan residents, having one more educational organization in the outside environment was associated with a 0.01 unit increase in reported acute stress scores ($p < .05$).

3.4. Child- and family-promoting organizations

No significant relationships were reported between the number of child- and family-promoting organizations and mental health outcomes for Boston metropolitan residents. For each additional child- and family-promoting organization within the near-distal environment, reported acute stress increased by 0.32 units among New York metropolitan residents ($p < .05$).

3.5. Health-based organizations

For Boston metropolitan area residents, each additional health-based organization in the proximal environment was associated with a 0.75 unit decrease in future fears/worries, while each additional health-based organization in the distal environment was associated with a 0.27 unit increase in acute stress scores ($p < .05$). For New York metropolitan area residents, more health-based organizations in the immediate and near-distal environments were correlated with a 0.80 unit ($p < .05$) and 0.17 unit ($p < .01$) decrease in psychological distress, respectively.

3.6. Voluntary community organizations

Among Boston metropolitan residents, the addition of one voluntary community organization in the near-distal environment was associated with a 0.07 unit increase in functional impairment ($p < .01$), whereas the addition of one voluntary community organization in the distal environment was associated with a 0.04 unit decrease in functional impairment ($p < .05$). Having more voluntary community organizations in the proximal environment was associated with a 0.55 unit decrease in reported future fears/worries ($p < .05$), adjusting for all relevant covariates. No significant associations between voluntary community organizations and mental health outcomes were seen among New York metropolitan participants. (For complete model results regarding organization type, see Supplemental Tables S4-S15.)

3.7. Direct exposure and previous community trauma exposure as moderators

Direct exposure to the BMB and direct exposure to previous community traumas (i.e., 9/11, Sandy Hook, and Superstorm Sandy) significantly moderated the effect of organizations on Boston metropolitan area residents' short-term mental health ($p < .05$). Among those who were directly exposed to the bombings, more child- and family-

Table 1
Boston metropolitan area sample organization count effects.

	Acute Stress (Nobs = 777; Nclusters = 617)			Probable PTSD (Nobs = 649; Nclusters = 523)			Functional Impairment (Nobs = 649; Nclusters = 522)			Psychological Distress (Nobs = 573; Nclusters = 466)			Future Fears/Worries (Nobs = 571; Nclusters = 464)		
	b	(95% CI)		*OR*	(95% CI)		*b*	(95% CI)		*b*	(95% CI)		*b*	(95% CI)	
Safety-Based															
Immediate	0.22	(−1.62,2.07)		0.71	(0.40,1.27)		0.31	(0.02,0.61)	*	0.13	(−0.34,0.59)		−0.24	(−0.86,0.38)	
Proximal	1.25	(0.12,2.37)	*	1.34	(0.97,1.85)	†	0.20	(0.03,0.37)	*	0.38	(0.09,0.67)	*	−0.23	(−0.62,0.16)	
Near-Distal	−0.18	(−0.51,0.14)		0.94	(0.85,1.03)		−0.04	(−0.09,0.01)		−0.13	(−0.21,−0.04)	**	−0.06	(−0.17,0.05)	
Distal	0.14	(−0.06,0.34)		1.04	(0.98,1.10)		0.00	(−0.03,0.03)		0.03	(−0.02,0.08)		0.03	(−0.04,0.09)	
Religious															
Immediate	0.06	(−0.33,0.46)		1.04	(0.92,1.18)		−0.02	(−0.08,0.04)		−0.03	(−0.14,0.08)		0.04	(−0.10,0.18)	
Proximal	−0.01	(−0.25,0.22)		0.94	(0.87,1.01)		−0.00	(−0.04,0.04)		−0.00	(−0.06,0.06)		−0.05	(−0.13,0.03)	
Outside	0.01	(−0.01,0.02)		1.00	(1.00,1.01)	†	−0.00	(−0.00,0.00)		−0.00	(−0.00,0.00)		0.00	(−0.00,0.00)	
Educational															
Immediate	−0.35	(−1.20,0.50)		1.06	(0.84,1.33)		0.09	(−0.04,0.22)		0.00	(−0.21,0.22)		0.19	(−0.10,0.48)	
Proximal	0.05	(−0.41,0.50)		0.99	(0.88,1.13)		−0.05	(−0.12,0.02)		−0.06	(−0.17,0.06)		−0.12	(−0.27,0.03)	
Outside	0.02	(−0.01,0.04)		1.00	(1.00,1.01)		−0.00	(−0.00,0.00)		0.00	(−0.01,0.01)		−0.00	(−0.01,0.01)	
Child- and Family-Promoting															
Immediate	0.69	(−1.72,3.10)		1.21	(0.61,2.43)		0.17	(−0.23,0.57)		0.02	(−0.57,0.62)		0.24	(−0.55,1.02)	
Proximal	−1.12	(−2.68,0.44)		0.63	(0.38,1.04)	†	−0.08	(−0.32,0.15)		0.22	(−0.16,0.61)		−0.45	(−0.97,0.07)	†
Near-Distal	0.09	(−0.35,0.52)		1.04	(0.92,1.18)		0.04	(−0.03,0.11)		−0.02	(−0.14,0.09)		0.02	(−0.14,0.17)	
Distal	0.14	(−0.16,0.44)		1.03	(0.95,1.11)		−0.04	(−0.09,0.00)	†	−0.02	(−0.10,0.06)		−0.02	(−0.12,0.09)	
Health-Based															
Immediate	0.46	(−2.26,3.19)		0.89	(0.36,2.19)		0.33	(−0.11,0.77)		0.49	(−0.20,1.17)		0.21	(−0.69,1.11)	
Proximal	−0.63	(−2.34,1.09)		0.99	(0.63,1.56)		0.06	(−0.20,0.32)		0.00	(−0.47,0.48)		−0.75	(−1.37,−0.12)	*
Near-Distal	−0.05	(−0.37,0.28)		1.00	(0.91,1.10)		−0.02	(−0.07,0.03)		−0.03	(−0.12,0.05)		−0.03	(−0.14,0.09)	
Distal	0.27	(0.04,0.49)	*	1.03	(0.97,1.10)		0.01	(−0.03,0.04)		0.00	(−0.05,0.06)		0.02	(−0.05,0.09)	
Voluntary															
Immediate	−1.15	(−3.15,0.85)		0.93	(0.50,1.73)		0.01	(−0.31,0.33)		0.24	(−0.27,0.74)		0.16	(−0.51,0.83)	
Proximal	−0.40	(−1.74,0.93)		1.04	(0.74,1.47)		−0.10	(−0.31,0.11)		0.13	(−0.22,0.49)		−0.55	(−1.02,−0.08)	*
Near-Distal	0.08	(−0.22,0.37)		1.03	(0.94,1.12)		0.07	(0.02,0.12)	**	−0.01	(−0.09,0.06)		−0.03	(−0.13,0.07)	
Distal	0.12	(−0.09,0.33)		1.00	(0.94,1.06)		−0.04	(−0.07,−0.01)	*	−0.01	(−0.06,0.04)		0.02	(−0.05,0.09)	

†$p < .10$. *$p < .05$. **$p < .01$.

Note. Organization counts are within a half-mile (immediate environment), half-mile to within 1-mile (proximal environment), 1-mile to within 3-miles (near-distal environment), 3-miles to within 5-miles (distal environment), and or 1-mile to within 5-miles (outside environment). Multilevel models adjust for individual-level covariates (age, race/ethnicity, gender, income, marital status, education, employment, prior mental health, direct exposure, media exposure to the bombings, and previous community trauma exposure) and block-level covariates (population density and neighborhood income).

promoting organizations located within one mile of one's residence was associated with lower acute stress scores (see Fig. 1). For the previous community trauma exposure interaction, the few persons directly exposed to all three events (Boston: $n = 3$) were grouped with persons exposed to two events. The risk of being classified as having "probable PTSD" was lower among those with more previous community trauma exposure who also lived near more voluntary community organizations (see Fig. 2). (For model statistics, see Supplemental table S16.)

4. Discussion

To our knowledge, this study is the first to examine the relationship between local community organizations and mental health and well-being following a community-wide disaster. Prior work found that local organizations were associated with pre-disaster health and well-being (e.g., Coulton et al., 1995), often aid in post-disaster relief efforts (Dynes, 1970; O'Sullivan et al., 2013; Wicke and Silver, 2009), and that community-level factors are of equal importance to individual-level ones in general (Diez-Roux, 1998). With the exception of safety-based and health-based organizations, it was expected that the presence of more service-providing organizations close to one's residence would be associated with lower levels of distress. Furthermore, as the event occurred in Boston, the beneficial role of organizations was expected to be more pronounced among Boston metropolitan area residents than among New York metropolitan area residents.

As hypothesized, more safety-based organizations in the immediate and proximal environments were associated with poor mental health outcomes, whereas having more of these organizations somewhat further away (in the near-distal environment) was associated with less psychological distress. These significant relationships were only found for Boston metropolitan area residents, suggesting that the presence of safety-based organizations in a post-disaster environment may be different than in a non-disaster environment. One reason for this difference might be that after a disaster, residents may be more attuned to or wary of the sounds and sights of police and fire persons. Contrary to expectations, heath-based organizations in the immediate, proximal, and or near-distal environments were associated with fewer future fears/worries among Boston metropolitan area residents and lower psychological distress among New York metropolitan area residents. At the distal environment, more health-based organizations corresponded to higher reported acute stress scores by Boston metropolitan area residents. For health-based organizations, proximity has been found to correspond with use pre-disaster (e.g., Schmitt et al., 2003), which may underlie the association found.

For educational and child- and family-promoting organizations in the New York area, having more of these organizations at a distance was associated with higher acute stress symptoms. However, no significant relationship emerged between Boston metropolitan area resident mental health and educational or child- and family-promoting organizations, suggesting that such organizations may function differently in a pre-disaster environment. Religious organizations and voluntary community organizations were hypothesized to have distress buffering capacities, yet findings were mixed. For New York area residents, a greater concentration of religious organizations in the immediate environment was indeed associated with lower acute stress scores but, the opposite relationship emerged when considering the religious organizations in the proximal environment. For Boston area residents, having a greater number of voluntary community organizations in the distal and proximal environments was associated with fewer functional impairments and future fears/worries, while at the

Table 2
New York metropolitan area sample organization count effects.

	Acute Stress (Nobs = 886; Nclusters = 847)			Probable PTSD (Nobs = 692; Nclusters = 669)			Functional Impairment (Nobs = 681)			Psychological Distress (Nobs = 654; Nclusters = 631)			Future Fears/Worries (Nobs = 654)		
	b	(95% CI)		*OR*	(95% CI)		*b*	(95% CI)		*b*	(95% CI)		*b*	(95% CI)	
Safety-Based															
Immediate	0.29	(−1.11,1.69)		0.82	(0.57,1.19)		−0.14	(−0.38,0.11)		−0.26	(−0.65,0.14)		−0.26	(−0.74,0.22)	
Proximal	−0.27	(−1.04,0.51)		0.93	(0.76,1.14)		0.00	(−0.13,0.14)		−0.03	(−0.26,0.20)		−0.02	(−0.30,0.25)	
Near-Distal	0.06	(−0.14,0.26)		1.02	(0.97,1.07)		0.00	(−0.03,0.04)		−0.04	(−0.09,0.02)		0.04	(−0.03,0.11)	
Distal	0.02	(−0.11,0.14)		0.99	(0.96,1.03)		−0.02	(−0.04,0.01)		−0.00	(−0.04,0.03)		−0.04	(−0.08,0.00)	†
Religious															
Immediate	−0.19	(−0.38,0.00)	*	0.99	(0.94,1.04)		−0.01	(−0.05,0.03)		0.01	(−0.05,0.07)		−0.05	(−0.12,0.02)	
Proximal	0.11	(0.02,0.20)	*	1.01	(0.99,1.04)		0.00	(−0.02,0.02)		−0.00	(−0.03,0.03)		0.02	(−0.01,0.06)	
Outside	0.00	(−0.00,0.01)		1.00	(1.00,1.00)		−0.00	(−0.00,0.00)		−0.00	(−0.00,0.00)		−0.00	(−0.00,0.00)	
Educational															
Immediate	−0.35	(−0.71,0.01)	†	0.97	(0.88,1.06)		0.00	(−0.06,0.07)		−0.03	(−0.14,0.08)		−0.12	(−0.25,0.01)	†
Proximal	0.03	(−0.15,0.20)		1.00	(0.96,1.05)		−0.01	(−0.04,0.02)		−0.01	(−0.07,0.04)		0.01	(−0.06,0.07)	
Outside	0.01	(0.00,0.02)	*	1.00	(1.00,1.00)		−0.00	(−0.00,0.00)		−0.00	(−0.00,0.00)		−0.00	(−0.00,0.00)	
Child- and Family-Promoting															
Immediate	−0.71	(−2.46,1.05)		0.70	(0.38,1.28)		0.07	(−0.26,0.41)		0.12	(−0.43,0.66)		−0.07	(−0.71,0.57)	
Proximal	−1.11	(−2.38,0.15)	†	1.10	(0.79,1.55)		−0.15	(−0.39,0.09)		−0.28	(−0.68,0.12)		−0.34	(−0.81,0.13)	
Near-Distal	0.32	(0.05,0.60)	*	1.05	(0.97,1.15)		0.02	(−0.03,0.07)		0.02	(−0.07,0.11)		0.04	(−0.07,0.15)	
Distal	0.02	(−0.16,0.20)		0.98	(0.92,1.03)		−0.02	(−0.05,0.01)		−0.03	(−0.08,0.02)		−0.05	(−0.11,0.02)	
Health-Based															
Immediate	−2.32	(−5.11,0.46)		0.76	(0.36,1.60)		0.31	(−0.19,0.82)		−0.80	(−1.61,0.00)	*	−0.84	(−1.80,0.12)	†
Proximal	0.43	(−1.14,2.00)		1.12	(0.76,1.65)		−0.24	(−0.52,0.03)	†	0.22	(−0.24,0.68)		0.12	(−0.42,0.66)	
Near-Distal	0.26	(−0.18,0.70)		1.01	(0.91,1.13)		0.01	(−0.07,0.09)		−0.17	(−0.30,−0.05)	**	−0.03	(−0.17,0.12)	
Distal	0.11	(−0.23,0.44)		1.00	(0.92,1.09)		−0.02	(−0.08,0.04)		−0.01	(−0.11,0.10)		−0.09	(−0.21,0.03)	
Voluntary															
Immediate	−0.45	(−1.67,0.77)		0.88	(0.62,1.24)		−0.03	(−0.27,0.20)		0.05	(−0.34,0.45)		−0.19	(−0.65,0.27)	
Proximal	0.19	(−0.55,0.93)		0.97	(0.81,1.16)		0.02	(−0.11,0.15)		−0.14	(−0.35,0.08)		−0.15	(−0.41,0.11)	
Near-Distal	−0.03	(−0.19,0.14)		1.01	(0.97,1.05)		−0.01	(−0.04,0.02)		−0.02	(−0.07,0.03)		0.04	(−0.02,0.10)	
Distal	0.06	(−0.03,0.16)		1.00	(0.98,1.02)		0.00	(−0.02,0.02)		−0.00	(−0.03,0.03)		−0.03	(−0.07,0.00)	†

†$p < .10$. *$p < .05$.**$p < .01$.

Note. Organization counts are within a half-mile (immediate environment), half-mile to within 1-mile (proximal environment), 1-mile to within 3-miles (near-distal environment), 3-miles to within 5-miles (distal environment), and or 1-mile to within 5-miles (outside environment). Multilevel and linear regression (functioning and future fears/worries only) models adjust for individual-level covariates (age, race/ethnicity, gender, income, marital status, education, employment, prior mental health, direct exposure, media exposure to the bombings, and previous community trauma exposure) and block-level covariates (population density and neighborhood income).

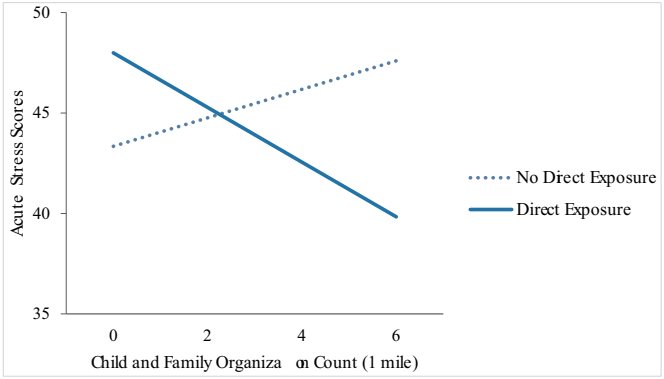

Fig. 1. Relationship between child- and family-promoting organizations, direct exposure to the bombings, and acute stress scores (Boston metropolitan area).

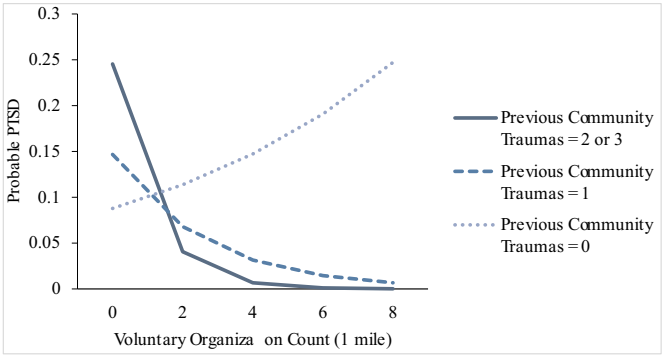

Fig. 2. Relationship between voluntary community organizations, previous community trauma exposure, and probable PTSD (Boston metropolitan area).

near-distal environment having more voluntary community organizations was associated with greater functional impairment. Heightened distress for those with many religious organizations outside their immediate neighborhood might be a consequence of these organizations being feared as "targets" for future terrorism, reminders of post-9/11 crimes committed against religious persons or structures, or perhaps due to the increased crowds found close to religious organizations. Also, the greater functional impairment reported by residents living around voluntary community organizations could be driven by the fact that such organizations tend to exist in areas of high need and cater to at-risk, vulnerable populations.

None of the organization types measured at different distance boundaries were significantly and directly associated with resident probable PTSD (both samples), functional impairment, or future fears/worries (New York metropolitan area sample only). The lack of findings for New York metropolitan residents was not entirely unexpected as most organizations would not be anticipated to bear on resident mental health and functioning unless residents were exposed to the bombings. Models examining disaster exposure as a moderator suggest that residents in a disaster environment with recent or previous disaster exposure may benefit more from child- and family-promoting and voluntary community organizations in their neighborhood.

In the Boston metropolitan area, residents who were directly exposed to the bombings reported lower acute stress scores, on average, with more child- and family-promoting organizations nearby. However, Boston metropolitan area residents not directly exposed to the bombings who had more of these organizations nearby reported higher acute stress scores. Similarly, having a history of direct community trauma exposure and living near more voluntary community organizations was associated with a reduced chance of being labelled as having "probable PTSD." As Seery et al. (2010) found, having *some* history of cumulative lifetime adversity was associated with reduced mental health ailments over a two year period. This protective effect of prior adversities on well-being may also exist when considering previous community traumas. Previous direct exposure to other community traumas may provide residents with an opportunity to engage with or learn about different local community organizations. Doing so may foster positive memories, increase comfort with such organizations, or lower anxiety because residents know how to access available resources (Sullivan and Chang, 2011) - perhaps facilitating effective future use.

4.1. Limitations

Though our findings are suggestive, some limitations must be acknowledged. First, although our participation rate at the start of the study was high, it is likely that individuals who were most affected by the bombings (those injured or hospitalized) were not included in our sample. Second, despite retention being reasonably high across all waves of data collection, attrition resulted in a sample over time that was older and wealthier (drop-out however was not predicted by acute stress at Wave 1). Third, residents' latitude and longitude coordinates were shifted to protect the anonymity of respondents. The degree of shifting varied, with urban areas only shifted a small amount. Nonetheless, it would have been ideal to have the precise latitude and longitude coordinates to increase the accuracy of ecological analyses (block group and organization estimates). Fourth, the process of cleaning and checking the organization entries was labor- and time-intensive. Better practices to deal with such high volume of data, especially data scraped using Google Places API, would benefit future research efforts. Finally, although we were able to obtain information on the proximity and concentration of organizations, we did not collect information on organization participation or use. Therefore, this study cannot comment on how far residents travelled for different services, or how efficacious residents found local community organizations post-disaster. Nonetheless, we maintain that organizational proximity may benefit residents by providing a sense of security that comes from their presence in the community, rather than from direct organizational use or participation, per se. Future research might test this hypothesis directly.

5. Conclusions

Disasters – both man-made and natural – occur with increasing regularity (FEMA, 2017). These events can not only disrupt the functioning of local communities but can negatively influence the welfare of residents. Bringing scientific data to bear on the post-disaster environment can facilitate social and economic recovery. To date, studies on the post-disaster recovery of residents have focused almost exclusively on the individual-level or interpersonal factors associated with well-being (e.g., Ozer et al., 2003). Community factors, however, remain an important, understudied predictor of mental health. Future studies should continue to study the possible protective nature of local community organizations after disasters. Efforts to understand local community organization use and attachment to organizations after man-made disasters also remain an interesting avenue for future research. Replication studies should focus on disaster events of a similar magnitude and nature, where structural damage is localized.

After a disaster, external relief aid is brought into communities to foster recovery. Findings suggest that these external initiatives should consider the availability of local community organizations when allocating services and support. Governments might consider investing in service-providing local community organizations in advance of disasters and in their aftermath. Doing so may prove to be an economical and efficient way to promote resident and community resilience. Furthermore, focusing on local organizations pre-disaster can help identify persons or areas at-risk for poor outcomes.

While local community organizations themselves can both help and hinder recovery after a disaster, they still tend to do more "good" than

"harm" to those most affected by the disaster. Findings showed that Boston area residents with more safety-based organizations at a distance and more health-based organizations close by reported better mental health outcomes post-disaster. Residents with direct or previous disaster exposure also benefited psychologically from having more child and family organizations and voluntary community organizations within one mile of their residence. Expanding our understanding of the complex role of local community organizations can help promote resident – as well as community – recovery post-disaster.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.socscimed.2018.08.019.

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