



Place attachment in disaster studies: measurement and the case of the 2013 Moore tornado

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Abstract

Place attachment has gained considerable attention in disaster studies, though there is little consensus on how to conceptualize or measure this construct in post-disaster environments. Many of the place attachment scales used in disaster studies come from studies of recreational or high-amenity areas, and we do not know whether or to what extent these measures translate to disaster contexts. This paper addresses gaps in our understanding of place attachment in disaster contexts by reviewing the measurement of place attachment in the literature and by presenting findings from an empirical study of place attachment in a post-disaster environment, namely a survey study of survivors ($n = 675$) of the 2013 Moore, Oklahoma, USA, tornado. Through this study, we identified four dimensions of place attachment: place identity, place dependence, neighborhood quality, and detachment. We also identified several factors that were related to dimensions of place attachment after the disaster, including social participation, exposure, and risk perception. We close by suggesting avenues for future research.

Keywords Place attachment · Measurement · Disasters · Natural hazards · Moore tornado

Introduction

Disasters are place-based phenomena that alter the physical and social landscape, challenging how individuals understand where they live and their bonds with that place (Chamlee-

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Wright and Storr 2009; Haney 2018; Li et al. 2010). As such, place attachment has emerged as a critical, yet understudied, concept within disaster studies. The ways in which place attachment is shaped by disasters and shapes disaster recovery decision-making likely has far-reaching consequences for individuals, households, and communities as they prepare for, experience, and recover from disaster events. In this light, a clear understanding of the role of place attachment is critical, particularly when considering how disaster survivors recover and reconcile with their homes (Adams 2016), communities (Oakes 2019), and affected landscapes (Cope and Slack 2017). Beyond the impacts of acute disasters, the consequences of climate change are challenging our understanding of the concept of place. Effects from climate change such as sea level rise and new and worsening flooding are elevating discussions about the adaptive capacity of communities (Mortreux and Barnett 2017) and how we address the risks of and recover from disasters (Agyeman et al. 2009; Farbotko and Lazrus 2012; FEMA 2011; Kennedy 2016; McNamara and Combes 2015; UNISDR 2015).

Place is an important domain in a number of disciplines, with researchers proposing multiple conceptualizations and scales to capture place attachment (Hidalgo and Hernandez 2001; Raymond et al. 2010; Williams and Vaske 2003). The field of disaster studies, as a nascent discipline attracting researchers from a number of different disciplinary backgrounds, has yet to develop a consistent set of measures to capture place attachment. Many of the place attachment scales used in disaster studies come from studies of recreational or high-amenity areas (Jorgensen and Stedman 2001; Trentelman 2009). As noted in the literature (Trentelman 2011; Ulrich-Schad et al. 2019), however, we do not know whether or to what extent these measures translate to routine work, family, community life, or disaster settings.

In this context, the purpose of this paper is twofold. First, we provide a review of the measurement of place attachment in the literature, with an emphasis on place attachment in a post-disaster context. Second, we use empirical data to explore how place attachment manifests in a post-disaster environment. Using a survey of survivors of the 2013 Moore, Oklahoma tornado, we draw upon existing place attachment measures to assess this concept in a post-disaster setting, and then capture how place attachment relates to concepts found to be important in previous studies. Findings from this study provide a foundation to guide future post-disaster place attachment research.

This paper proceeds as follows: as background, we begin by building on a conceptualization of place attachment proposed by Scannell and Gifford (2010) and Lewicka (2011) to summarize the broader place attachment literature, discuss place attachment in the context of disaster studies, and detail how disaster researchers have measured and modeled place attachment in prior work. Next, we detail the case of the 2013 Moore tornado and our data collection instrument and approach. We then describe and discuss our findings, closing by proposing avenues for future research. Broadly, we found four dimensions of place attachment—place identity, place dependence, neighborhood quality, and detachment—were evident after the tornado, and were related to a number of other factors at play in post-disaster settings.

Place attachment

Place attachment is defined as the subjective bonds people develop with particular places they hold as important or meaningful (Hidalgo and Hernandez 2001). Place attachment captures the meaning individuals gain from their environments and how

they interact with those environments (Lewicka 2005) and, as such, is central to a number of social sciences. This concept has been explored by scholars from many disciplines, including psychology (Clarke et al. 2018; Parry and Hassan 2019), economics and tourism studies (Eusébio et al. 2018; Styliadis 2018), political science and public policy (Clermont et al. 2019; Healey 2018), sociology (Cross 2015; McKnight et al. 2017), geography (Brown et al. 2015; von Wirth et al. 2016), climate change scholars (Devine-Wright and Batel 2017; Upham et al. 2018), and disaster studies (Bonaiuto et al. 2016; De Dominicis et al. 2015).

This variety of disciplines, however, has led to a fractured literature that inconsistently defines (Brown et al. 2003), measures (Rollero and De Piccoli 2010), and models (Suntikul and Jachna 2015) place attachment. A number of researchers have recognized the variety of definitions as a challenge to developing a meaningful knowledge base related to place attachment (Jorgensen and Stedman 2001; Low and Altman 1992; Pretty et al. 2003; Scannell and Gifford 2010). While disparate disciplinary foci explain, in part, this diversity in definition and conceptualization, it inhibits scholars' ability to accurately bound the concept and limits their capacity to draw meaningful comparisons across studies. Additionally, it hinders the ability of future studies to explore or measure this concept.

In an attempt to rectify these differences, several authors conceptualize place attachment as a "tripartite" behavioral phenomenon formed by three interrelated, but also separable fundamental components: place, person, and process (Lewicka 2011; Scannell and Gifford 2010). We use this conceptualization to organize the following review of the place attachment literature, and then turn to a discussion of place attachment in disaster studies, which is the focus of this paper.

Place (the object of attachment)

The place component of place attachment captures the particular characteristics of place with which individuals develop a bond. Scannell and Gifford (2010) further divide these characteristics into two dimensions—physical and social characteristics—that manifest from the individual to community level. Physical characteristics are the tangible elements that make a place functionally desirable for an individual (Pretty et al. 2003). This could include, for example, the presence of jobs and public transportation (White et al. 2008), the availability of natural resource-based industries (Berchin et al. 2017; Oakes 2019), the appropriateness, affordability, and desirability of housing (Brown et al. 2004a), proximity to sacred spaces (Mazumdar and Mazumdar 2004), and access to natural resources (such as a beach, the mountains, or greenspace) (Arnberger and Eder 2012; Cope et al. 2018). These physical characteristics are closely related to the concept of place dependence, or the functional connections individuals have to a place (Brown et al. 2015). Social characteristics reflect the people who live in an area and the bonds individuals share with those people (Airriess et al. 2008). Previous studies in this vein have found that place attachment is positively influenced by developing relationships with (Mesch and Manor 1998) and engaging in activities with one's neighbors (Cuba and Hummon 1993).

Person (the actor in the attachment)

The person component of place attachment encompasses the bonds formed at an individual level or a community/cultural level with a specific location imbued with

meaning. At an individual level, meaning is cultivated through experience and may be influenced by personal attributes. Personal experiences—both positive and negative—in a given place influence the meanings associated with that place, and these meanings may vary significantly from person to person (Vorkinn and Riese 2001). Influential experiences might include growing up, getting married, losing a loved one, or enduring a disaster event, all of which are place-based (Morgan 2010).

Beyond experience, internal attributes may influence personal meanings associated with place. Parameters such as age (Gilleard et al. 2007), gender (Anton and Lawrence 2014), income (Anton and Lawrence 2014), education (Hornbaker and Cullen 2010), and ethnicity (Oh 2004) have been identified as factors that influence the formation of place attachments. There is, however, disagreement regarding the role of internal attributes in developing personal attachments. For example, there is conflicting literature regarding whether age relates to place attachment (Gilleard et al. 2007; Rollero and De Piccoli 2010). Likewise, gender is not consistently correlated with place attachment; studies suggest that women report higher levels of place attachment than men (Anton and Lawrence 2014; Hidalgo and Hernandez 2001), that men exhibit higher levels of place attachment than women (Dallago et al. 2009), and that there is no relationship between gender and place attachment (Devine-Wright 2013; Lewicka 2010). Studies of place attachment and income are also equivocal. While previous studies have found no relationship between income (Brown et al. 2003) or social class (Hidalgo and Hernandez 2001) and place attachment, Anton and Lawrence (2014) found that lower-income individuals may have stronger attachments to place, perhaps reflective of a justification of residential decisions where lower incomes translate into fewer residential options. When considering ethnicity and place attachment, findings have been mixed, ranging from modest (Bailey et al. 2012) to no relationship (Brown et al. 2004b).

At the community or cultural level, the person component of place attachment reflects the shared meaning of a place among residents (Scannell and Gifford 2010). This shared meaning can be understood as various interconnected concepts such as social capital (Forrest and Kearns 2001) and the perseverance of cultural values (Lewicka 2005). Place may play an important, and varying, role in forming the social ties between community members. For instance, past research has found that in low-income, disadvantaged areas, residents often perceive their neighborhood as a shelter for coping with the difficulties of everyday life and that they form social ties based on shared coping strategies. In affluent areas, in contrast, residents typically form fewer social ties in their neighborhood but form stronger connections with community settings and landscape (Forrest and Kearns 2001). While community gatherings can preserve cultural values and increase place attachment, poverty and a sense of instability can significantly discourage people from preserving their social rootedness, reducing the chance of community participation (De Donder et al. 2012), limiting involvement in formal neighborhood associations (Hays and Kogl 2007), and creating indifference regarding shared social and historical values (Letki 2008).

Process (the psychology of attachment)

The third component of place attachment is process, specifically the process of psychological attachment between person and place. Scannell and Gifford (2010)

divide process into three sub-components: affect, cognition, and behavior. Affect refers to the positive or negative emotional connections individuals form with a place (Halpenny 2010). Cognition is the collection of thoughts, feelings, notions, and attitudes by which people characterize themselves in terms of attachment to a particular place (Hernández et al. 2007). In this way, the cognitive component of place attachment is closely related to the concept of place identity, commonly addressed in the literature (*c.f.*, Proshansky et al. 1983), and which produces continuity, self-esteem, self-efficacy, and distinctiveness (Twigger-Ross and Uzzell 1996). The last component, behavior, captures attachment as living in a setting, which manifests as people live in a setting for an extended period, longing to return if away from it, or, in the case of a vacation site or religious pilgrimage destination, attaching significance to a site (Scannell and Gifford 2010). Of the three sub-components, cognition is frequently highlighted in the literature, with previous studies finding that the cognitive component of place attachment grows over time (Anton and Lawrence 2014), that place attachment influences perceptions of one's community (Brown et al. 2003), that psychological processes associated with place attachment foster a protective response when place is threatened, and that environmental threats to a community often encounter local opposition because they threaten place identity (Devine-Wright 2009).

Place attachment and disasters

Overall, place attachment remains an understudied construct in the disaster literature. Research that has been conducted to date can generally be grouped into two categories: studies that explore how disasters shape place attachments (broadly, place attachment as a dependent variable) and studies that explore how place attachments shape disaster experiences and responses to disaster events (broadly, place attachment as an independent variable).

A number of researchers have attempted to capture how disasters shape place attachments. Disasters often significantly alter the natural environment and disrupt social bonds, thereby affecting both functional and cognitive components of a community. In a study after flooding in Carlisle, UK, Carroll et al. (2009) found that the flooding disrupted survivors' bonds to their homes and possessions. As a result, displaced residents felt alienated from their homes and their communities, residents who stayed felt like "squatters in their own homes", and survivors from both groups experienced losses in their personal relationships and mental health. When exploring place attachment following flooding in Alberta, Canada in 2013, Haney (2018) found that both the flood and the subsequent displacement increased civic engagement among survivors, but decreased place attachment. Silver and Grek-Martin (2015) found that tornado survivors experienced a cycle of disorientation and reorientation (Cox and Perry 2011), in which they had an initial negative reaction to the loss of place and later experienced a reinvigorated bond and commitment to people and place, and a desire to memorialize the event and be involved in the recovery process.

Relatedly, several studies have considered what factors mediate the relationship between place attachments and the disaster recovery process. Much of this literature considers the role of demographic characteristics or social capital, defined as the relationships of trust, social norms, and networks that individuals have access to in times of crisis (Adger 2000). Minorities and individuals with less access to resources

typically suffer the most losses in disasters and have the hardest time recovering from their losses (Cutter et al. 2014; Peacock et al. 2015). Likewise, populations traditionally defined as vulnerable such as low-income households, females, and the elderly, may have less access to social support and federal aid in the wake of disasters (Ingram et al. 2006). This disenfranchisement may lead to feelings of inequality and detachment from their communities that can intensify social disruptions following disasters (Cox and Perry 2011). Fried (2000) suggests that the re-establishment of place attachment is a highly adaptive process that can be considerably affected by “communal attributes” of the society such as age, income, employment rate and ethnicity. Further, he notes that local connections to friends and family serve as a primary source of post-disaster aid, which reinforces place attachments for those with such connections but may hinder recovery for those who lack them.

Studies examining how place attachment influences how people respond to and recover from disasters have often focused on how place attachment shapes adjustments made by survivors after an event, their behaviors in post-disaster recovery, or perceived risk from future events. When considering post-disaster adjustments, the literature suggests that individuals with high levels of place attachment suffer increased levels of distress after a disaster (Cox and Perry 2011) and will resist change and work to re-establish place as they knew it before the event (Adams 2016; Hauer et al. 2019). For residents living in areas at risk to hazards, high levels of place attachment may result in an underestimation of risk and reduce the likelihood of adopting protective measures, such as keeping emergency food and water supplies on hand (Armaş 2006; De Dominicis et al. 2015). These findings were reinforced by a meta-analysis of the literature in which Bonaiuto et al. (2016) found that individuals with high levels of place attachment are generally aware of risks but often underestimate their potential impacts. In a survey exploring individual perceptions of environmental, social, and economic risks, Bernardo (2014) found that place attachment increased risk perceptions regarding high probability events while decreasing risk perceptions related to low probability events.

Place attachment has also been found to influence residents’ decision to return to their community after a disaster, though other factors also influence these decisions (Bohra-Mishra et al. 2017; Codjoe et al. 2017; DeWaard et al. 2016; Koubi et al. 2016). When speaking to Hurricane Katrina survivors, for example, Chamlee-Wright and Storr (2009) found that Katrina brought place attachments to the forefront of survivors’ consciousness, often motivating them to overcome considerable obstacles to return and reestablish those bonds. Many survivors who did not return to New Orleans noted the lack of basic infrastructure associated with place dependence, or, relatedly, suggested that they found better schools, jobs, housing, and quality of life elsewhere. Place attachment may also influence the resilience of communities and their recovery priorities. In an exploration of two coastal communities in Cornwall, UK, Faulkner et al. (2018) found that place attachment was an important component of community resilience, serving as a foundation for the development of cooperative behaviors. Residents with stronger place attachments want more influence over recovery priorities and possess considerable local knowledge that communities can leverage to ensure recovery protects valued landmarks (Clarke et al. 2018). Similarly, good governance in the wake of a disaster, particularly the use of participatory processes, may reduce place disruption and bolster healthy place attachments. Research suggests that where

community consultation is inadequate, place attachment processes may become threatened (Anton and Lawrence 2016; Fresque-Baxter and Armitage 2012). Inclusive and participatory governance processes can reduce place disruption and may positively influence place-related values (Adger et al. 2016).

Measurement and modeling of place attachment in the disaster literature

Given the disciplinary differences noted above and the conceptual muddiness inherent in place attachment, researchers have measured place attachment at different scales and in a number of ways, even in the context of disaster studies. In respect to scale, researchers have measured place attachment in relation to towns and communities (Clarke et al. 2018; Silver and Grek-Martin 2015), neighborhoods and homes (Gorman-Murray et al. 2014; Morrice 2013), and at multiple levels of measurement in the same study (Bihari and Ryan 2012; Kick et al. 2011; Quinn et al. 2019).

When attempting to capture place attachment quantitatively, many researchers use scales from previous studies that were designed to explore thematically different types of issues. In a study of repeat flooding in the Philippines, for instance, Anacio et al. (2016) used twelve questions to capture place identity, place attachment, and place dependence (four questions per item), relying on a scale originally used by Jorgensen and Stedman (2001) to explore sense of place among lakeshore property owners in Wisconsin. These scales are often once or twice removed from their original source, undergoing modifications each time they are used. When measuring place attachment among rural and urban populations in Australia with varying wildfire exposure, for example, Anton and Lawrence (2014) conceptualized place attachment as place identity and place dependence, which they measured using six identity and five dependence items. Their scale was the same as one employed by Brown and Raymond (2007), who adapted their scale from Williams and Vaske (2003), who built their scale based on Williams and Roggenbuck (1989). In a similar case, when exploring place identity, place dependence, and place affect in relation to pro-environmental behavior, Zhang et al. (2014) used five questions adapted from Vaske and Kobrin (2001), who adapted their measures from Williams and Roggenbuck (1989), and Halpenny (2010), whose scale was based on Jorgensen and Stedman (2001), which was originally derived from the same Williams and Roggenbuck's (1989) work. As with the examples above, Williams and Roggenbuck (1989), the original source of many of the measures employed in the disaster literature, designed their items to assess attachment to tourism sites.

In other cases, researchers either created their own scales or used measures as proxies of place attachment. These often came in the form of direct questions about attachment. In a survey flood-affected residents of Calgary, Haney (2018) asked residents whether or not they felt attached to their neighborhood and if they felt it was an excellent place to live. When studying how individuals decided to continue living in the same area in the wake of climate change-related impacts in Peru, Adams (2016) used a survey to ask respondents whether positive or negative attachment to place influenced their residential decision. In another example, Nawrotzki et al. (2014) used tenure and homeownership as proxy measures of place attachment.

Other researchers, acknowledging the complexity, subjectivity, and contextuality of place attachment, have captured place attachment via qualitative measures or mixed

methods. These studies typically focus on capturing individual- and collective-level understandings of place and the importance of place in the wake of disaster events. For example, Burley et al. (2007) used a phenomenological approach, employing interviews to explore place attachment in relation to coastal wetland loss in Louisiana. When exploring how survivors understood place in the wake of the Christchurch earthquake, Winstanley et al. (2015) conducted individual and group interviews with residents exploring place attachment, place identity, and how place facilitated social interactions. They then used this information to develop a survey to explore how feelings about place and disaster experiences influenced perceptions of resilience within the community. In a study of communities affected by floods, Kick et al. (2011) used interviews with FEMA officials and surveys with residents to understand how attachment to both home and community, among other factors, influenced mitigation decisions.

Finally, a small number of disaster researchers have attempted to model the relationship between disasters and place attachment. Brown and Perkins (1992) suggest that this happens in three phases: (1) the development of place attachments; (2) a stressful interval of disruption, where a disaster or the threat of a disaster interrupts normal community functioning and causes individuals to reckon with and reconsider their place-based bonds; and (3) a period of coping with losses and the establishment of new place attachments, where individuals mourn the loss of attachments and negotiate new attachments, either in the same community or in a new location. Devine-Wright (2009) uses a similar approach to capture how individuals protect place from outside threats, suggesting that residents move through a five-step process of becoming aware of a threat, interpreting potential impacts of the threat on their community, evaluating the potential changes, assessing potential personal impacts from the threat, and acting.

The current study

With this disparate literature in mind, we now present an empirical study designed to improve our understanding of place attachment in disaster contexts. The purpose of this study was to begin the process of developing new place attachment scales for use in disaster settings and explore key factors associated with place attachment in a post-disaster environment. Specifically, we sought to address the following research questions: (RQ1) What dimensions of place attachment were evident in the post-disaster environment? (RQ2) What other factors were associated with place attachment in this disaster context?

Data presented here are drawn from a study of residents of Moore, Oklahoma, which was struck by an EF5 tornado (the most severe of six categories used to classify tornados, indicating wind speeds greater than 200 mph) on May 20, 2013. Moore, with a population of approximately 55,000 (Census 2016) is considered part of the Oklahoma City metropolitan area, situated just south of the state's capital city. The tornado touched down southwest of Moore at 2:56 pm and was on the ground for 37 min, impacting an area 14 miles long and up to 1.1 miles wide and ultimately claiming 24 lives (including seven children who lost their lives when portions of Plaza Towers Elementary School collapsed) while injuring another 212 persons. This was the ninth deadliest tornado in the state's history, and the third in a series of EF4 (tornados

with wind speeds between 166 and 200 mph) and EF5 tornados to strike the town within a period of 20 years (FEMA 2014). The City of Moore (2014) estimated the total damages at \$2 billion, including damages to two schools, a school administration building, a regional hospital, 90 businesses, and over 2400 housing units, representing a significant housing loss among residents. Despite these losses and the history of major disasters in the area, the vast majority of residents chose to remain in Moore (Nejat et al. 2018). Given the extent of the damage to the physical and social environment from this and previous disasters and the decisions by residents to remain in their community, this event presented an opportunity to examine place attachment in a post-disaster setting.

Methods

Respondents

Using a modified version of Dillman's (1978) strategy, 5130 surveys were randomly distributed to households located within the path of the tornado, consisting of an initial post card and three subsequent waves of surveys with return mailers included, an approach common to studies of adult survivors in the disaster social sciences (Lindell et al. 2009; Zavar et al. 2016). Surveys were distributed beginning in October 2015, roughly 1.5 years after the event. Addresses were identified by creating a map of the tornado path and extracting residential addresses from the county assessor's website within the tornado path, allowing us to capture the households located within the path of the tornado and within Moore city limits (Fig. 1; see Nejat et al. (2018) for a detailed description of this process). A total of 566 surveys were returned as undeliverable, and 780 completed packets were returned, resulting in a 17% response rate. While larger response rates are desirable, this response rate is considerably higher than recently published averages of 7% for mail surveys (Dillman et al. 2014), and represents a sample size larger than is typical in the disaster social sciences, where fewer than one in four studies are based on samples of more than 400 participants (Norris 2006).

Demographic characteristics of these respondents are presented in Table 1 and compared to 2015 American Community Survey data from the ten census tracts in Moore from which completed surveys were received. In general, our participants had lived in Moore longer than the general population, were older and better educated, and had lower incomes than the general population. These differences should be taken into consideration in interpreting the study's findings, as previous studies have suggested that demographic characteristics influence disaster experiences and decision-making processes (c.f., Bonanno et al. 2007; Nejat et al. 2018; Norris et al. 2002). Given the differences in our sample tenure from the population, findings from the literature review suggest that our sample may exhibit higher levels of attachment than the general population of Moore. That said, there were no notable gaps in our sample, and these differences do not represent a significant concern for the study as a whole. As a final note on demographics, we limit the sample to homeowners for some of our analyses. Renters were not well represented in our sample (3.8%), and, more importantly, the literature suggests that renters may experience place attachment differently than homeowners (Brown et al. 2004a).

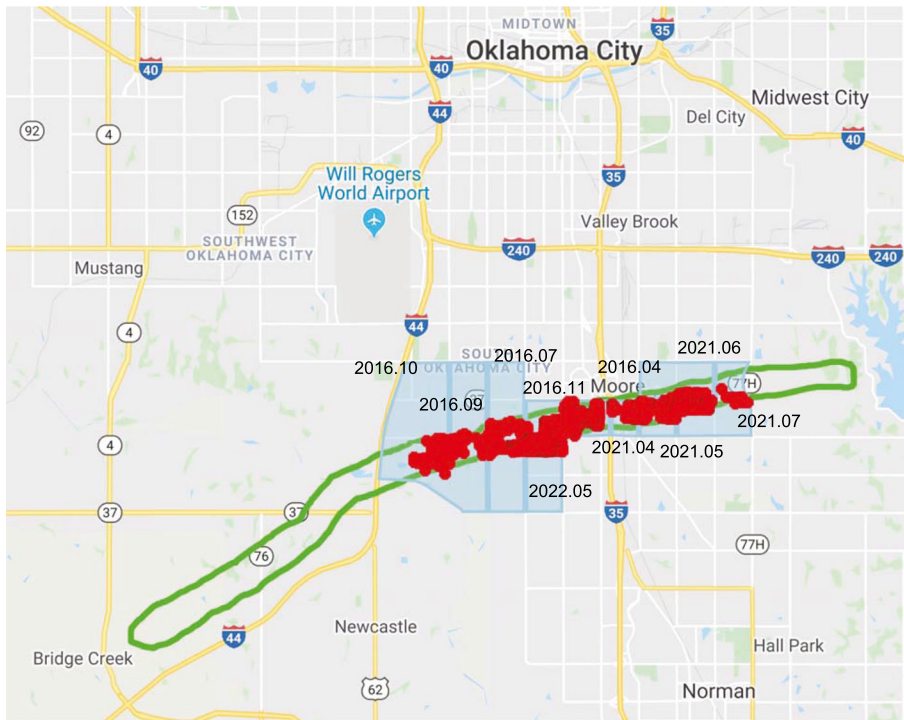


Fig. 1 Location of respondents and their census tracts (Google Maps)

Table 1 Comparison of participants’ responses to covariates with available 2015 American Community Survey data

Covariate	Sample data (2015)	American Community Survey data* (2015)
Years of residence \geq 16 years	55.4%	20.8%
Age 65+	22.9%	8.4%
Children in home	37.4%	49.4%
Income \geq \$100 K	14.6%	30.9%
	<ul style="list-style-type: none"> • 0-\$19 K: 4.3% • \$20 K-\$39 K: 20.4% • \$40 K-\$59 K: 24.9% • \$60 K-\$79 K: 18.5% • \$80 K-\$99 K: 17.4% • \$100 + K: 14.6% 	<ul style="list-style-type: none"> • 0-\$24 K: 9.91% • \$25 K-\$49 K: 18.75% • \$50 K-\$74 K: 21.73% • \$75 K-\$99 K: 18.72% • \$100 + K: 30.9%
Without Mortgage	30.0%	23.5%
Female	64.7%	51.6%
Education**	38.4%	26.9%

*Census tracts included are 2016.04, 2016.07, 2016.09, 2016.10, 2016.11, 2021.04, 2021.05, 2021.06, 2021.07, and 2022.05

**Education attainment of bachelor’s degree and higher for the population 25 years old and over (2015)

Measures

The questionnaire included several measures of place attachment in addition to measures for other factors we hypothesized as being associated with place attachment in disasters. Place attachment scales and items used in this study reflect those that are commonly used in studies that are conceptually related to our work, such as studies conducted in the disaster or environmental social sciences (c.f., Araya et al. 2006; Jorgensen and Stedman 2006; Scannell and Gifford 2010) or those that are widely cited among place attachment studies more generally (c.f., Halpenny 2010; Williams and Vaske 2003). In an effort to capture a wide range of factors related to place attachment, we included a total of 27 place attachment items that represented measures of place identity (Williams and Vaske 2003), place dependence (Jorgensen and Stedman 2006; Williams and Vaske 2003), place affect (Halpenny 2010; Scannell and Gifford 2010), and neighborhood quality (Araya et al. 2006). Given the traditional focus on attachment to high amenity and recreational areas in place attachment scales, the authors included three additional items designed to capture place attachment in broader contexts. In addition to, we included measures for two social factors that reflect connections to place: social cohesion and trust (Araya et al. 2006).

Beyond place attachment, we assessed factors that have been shown to be associated with place attachment in the literature. We hypothesized that there would be a statistically significant relationship between each of these factors and place attachment. Specifically, we included measures of social participation (Mitchell and LaGory 2002), hazard exposure (Greer et al. 2018), perceived risk of recurrence of a similar event (Tierney and Sheng 2001; Turner et al. 1986), and perceived personal and household risk from future disasters (Lindell and Hwang, 2008). Respondents were also asked about their residential plan, specifically how many more years they intended to live in their current residence (Gill and Steven Picou 1998)). Finally, respondents were asked to provide demographic data, including age, number of children under 18 in the home, estimated household income both before and after the tornado, the number of years remaining on their mortgage, sex, race, and highest level of education completed. To address RQ2, we tested the following hypotheses: There is a significant relationship between place attachment and (H1) social participation, (H2) hazard exposure, (H3) residential plan, (H4) risk perception, and (H5) demographics. Each hypothesis was tested using the place attachment factors identified through RQ1, as described below.

Data analysis and results

We analyzed our data in two steps. To begin, we addressed RQ1 (*What dimensions of place attachment were evident in the post-disaster environment?*) using factor analysis. This analysis technique allows us to reduce a set of items to a number of independent constructs. In this case, we began with place attachment measures that have emerged from other literatures. Factor analysis allows us to identify patterns of responses across all of the included measures, thus identifying the underlying, unseen dimensions of place attachment in a disaster context. Once the underlying dimensions of place attachment are identified, we then address RQ2 by conducting a series of hypothesis tests (H1–H5) to examine the relationship between place attachment and other relevant factors. We do this

using correlation analyses, which allows us to assess the degree to which pairs of variables are correlated and the intensity of the relationship between the two variables. Here, these analyses provide insight into whether and to what degree place attachment, as measured by our factors established below, may influence or be influenced by social participation, risk perception, hazard exposure, and other relevant constructs.

Factor analysis and the structure of place attachment

To address our first research question related to the dimensions of place attachment evident in the post-disaster environment, we conducted a factor analysis to examine how items included in standard place attachment scales behave in disaster settings. Cases with missing data on any of the 27 place attachment items included in the questionnaire were excluded from our analyses, leaving a sample size of 694. We ran bivariate correlations on the 27 place attachment items and removed three items due to high correlation coefficients ($r > .8$). The remaining 24 items were included in the analyses. We then conducted a parallel analysis using the maximum likelihood method (Ledesma & Valero-Mora, 2007), which initially suggested a five-factor solution. We then conducted an exploratory factor analysis, using Oblimin rotation to account for our assumption that all factors were correlated. Upon further inspection, four items were removed due to cross-loading and a four-factor solution was determined to best represent the remaining 20 items and existing place attachment theory. Confirmatory factor analysis verified this model.

We labeled the four factors as: (1) Place Identity, (2) Neighborhood Quality, (3) Detachment, and (4) Place Dependence. Factors 1 (*Place Identity*) and 4 (*Place Dependence*) both reflect commonly accepted dimensions of place attachment (c.f., Anton and Lawrence 2014; Williams and Vaske 2003). As described in the literature review, place identity captures the emotional or psychological ties to place, and ways in which place is part of one's identity. The items that loaded onto Factor 1 reflect these notions (e.g., *I feel my community is a part of me*). Place dependence, broadly, refers to the functional attachments between person and place. Function, though, varies depending on context: while a navigable river represents a functional attachment to a high-amenity or recreational area (Williams and Vaske 2003), functional attachments to one's community are better reflected in areas like the availability of affordable housing, nearby green spaces, access to food sources, or transportation options that allow one to get to and from work. We have labeled Factor 4 *Place Dependence* because it reflects the functionality of the physical environment in meeting residents' felt needs.

We have labeled Factor 2 *Neighborhood Quality*, a term borrowed from Araya et al. (2006), but applied here with a slightly different meaning. The items that loaded onto this factor reflect the social environment in one's neighborhood, including perceptions of trustworthiness of other community members and crime. We labeled Factor 3 *Detachment*, as it reflects aspects of detachment or disengagement from one's neighborhood, including the propensity to relocate in the event of another disaster, perceived social distance, and perceived undesirability of the neighborhood (Devine-Wright 2009; Mihaylov and Perkins 2014). The results of the factor analysis, including items associated with each factor, are displayed in Table 2. Cronbach's alpha, a measure of scale reliability that reflects internal consistency among items included in each factor, was 0.93, 0.79, 0.78, and 0.71, respectively, reflecting reliability ratings between *good* (above 0.7) and *excellent* (above 0.9).

Table 2 Summary of factor analysis

	Place identity	Neighborhood quality	Detachment	Dependence
I feel my community is a part of me	0.83			
Living in my community says a lot about who I am	0.79			
I am very attached to my community	0.83			
No other place can compare to my community	0.77			
My community is the best place for what I like to do	0.75			
I have strong, positive feelings about my community	0.83			
I feel a sense of pride in my community	0.82			
I feel like I belong to my community	0.81			
I regularly stop and talk with people in my community	0.54			
Generally speaking, most people can be trusted		0.70		
In general, crime is not a major problem in my community		0.60		
I trust people in my community		0.97		
As far as I'm concerned, there are better places to be than in Moore			0.66	
Given the opportunity, I would like to move away			0.81	
I feel different from people in my community			0.54	
There are other places that are more desirable places to live			0.72	
The natural environment makes it a special place to live				0.70
The man-made environment makes it a special place to live				0.76
There are not enough green areas or trees in my community				-0.34
I think of my community as a desirable place to live				0.74
Cronbach's alpha	0.93	0.79	0.78	0.71

Correlation analyses

RQ2 built on RQ1, exploring key factors associated with place attachment in post-disaster environments. To address RQ2, we conducted correlation analyses to test our research hypotheses, which were adjusted to account for each of the four place attachment factors identified through the factor analyses (pairwise correlation values for items included in the correlation analyses are displayed in Table 3). Table 4 presents a summary of hypotheses tests. For these analyses, we made two adjustments to our

Table 3 Pairwise correlation table of place attachment factors and social participation, exposure, residential plan, perceived risk, and demographics (Pearson method)

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
Participated in activity (1)	–																			
Involved in a group (2)	.23**	–																		
Volunteered (3)	.25**	.38**	–																	
Extent of damage to home (4)	.07	.09*	.04	–																
Extent of damage to community (5)	.03	.06	.03	.24**	–															
Damage from another tornado (6)	–.00	.04	.00	–.06	–.05	–														
Residential plan (7)	.02	.03	.04	.00	.01	.08	–													
Likelihood of event of similar magnitude (8)	–.03	.01	–.01	.05	–.07	–.04	.09*	–												
Likelihood of major damage to home (9)	–.12**	–.08	–.11**	–.01	.04	.03	.00	–.18**	–											
Likelihood of health problems (10)	–.09*	–.06	–.10*	.02	.01	.02	–.02	–.01	.39**	–										
Likelihood that you would move away (11)	–.08	–.08	–.10*	.08	–.03	–.07	–.15**	–.08	.28**	.19**	–									
Children in home (12)	.00	.13**	.19**	.04	–.01	–.04	.06	–.02	–.04	–.13**	–.01	–								
Sex (13)	–.03	.01	.03	.02	.17**	.00	.03	–.01	.10*	.10*	.03	.06	–							
Education (14)	.12**	.09*	.12**	–.07	–.02	–.03	.00	–.15**	.01	–.06	.09*	.12**	.01	–						
Tenure (15)	.10*	.00	–.04	.08	.02	.13**	–.05	–.03	–.11**	.06	–.29**	–.29**	.06	–.22**	–					
Place identity (16)	.19**	.21**	.28**	.10*	.11**	.00	–.06	.10**	–.16**	–.15**	–.38**	.13**	–.12**	–.11**	.21**	–				
Neighborhood quality (17)	.15**	.15**	.21**	.04	.09*	–.05	–.15**	.14**	–.23**	–.22**	–.22**	.03	.07	–.01	.10**	.47**	–			
Detachment (18)	–.09*	–.10*	–.13**	–.08*	–.07	.05	.07	–.05	.16**	.16**	.47**	–.04	–.13**	.10**	–.25**	–.66**	–.33**	–		
Dependence (19)	.11**	.12**	.14**	.04	.08*	–.03	–.06	.08*	–.14**	–.14**	–.31**	–.01	–.02	–.11**	.12**	.64**	.36**	–.54**	–	

*Statistically significant at $p \leq .05$,

**Statistically significant at $p \leq .01$

Table 4 Summary of hypotheses tests

	H1:Social participation			H2:Exposure				H3:Residential plan				H4: Risk perception				H5: Demographics			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				
Place Identity	+	+	+	+	+			+	-	-	-	+	-	-	+				
Neighborhood quality	+	+	+		+		-	+	-	-	-				+				
Detachment	-	-	-	-					+	+	+		-	+	-				
Place dependence	+	+	+		+			+	-	-	-				+				

Gray: significant at alpha level 0.01; white: significant at alpha level 0.05, the rest no significant evidence was observed

sample. First, as described above, we limited these analyses to homeowners. Similarly, as our intent was to examine attachment to one's home community, respondents whose primary residences were not impacted by the tornado were excluded from our analysis. Of the original sample of 780 respondents, this resulted in a subsample of $n = 675$. Here, we discuss notable findings from these analyses.

H1 examined the relationship between place attachment and social participation. Social participation was positively correlated with three place attachment factors, namely *Place Identity*, *Neighborhood Quality*, and *Place Dependence*. Specifically, participation in a community activity ($r = .19, p < .01, r = .15, p \leq .01, r = .11, p \leq .01$), involvement in a group ($r = .21, p \leq .01, r = .15, p \leq .01, r = .12, p \leq .01$), and volunteer activity in the community ($r = .28, p \leq .01, r = .21, p \leq .01, r = .14, p \leq .01$), were positively correlated with the respective place attachment factors, indicating that active involvement in one's community is associated with an increase in positive aspects of place attachment. There were significant negative correlations, conversely, between each of these items and *Detachment*, indicating that detachment increases as social participation decreases.

H2 examined the relationship between place attachment and hazard exposure. Here, the most notable findings were related to perceived damage to the community from the 2013 tornado, which was significantly positively correlated with *Place Identity* ($r = .11, p \leq .01$), *Neighborhood Quality* ($r = .09, p \leq .05$), and *Place Dependence* ($r = .08, p \leq .05$), but not significantly correlated with *Detachment*. The extent of damage to one's home from the 2013 tornado was negatively correlated with *Detachment* ($r = -.08, p \leq .05$) and positively correlated with *Place Identity* ($r = .10, p \leq .05$), suggesting that there may be value in future studies examining attachments to home and attachment to community independently.

H3 examined the relationship between place attachment and relocation intention ("How long do you plan to live at your current residence?"). Surprisingly, this item was only significantly correlated with one place attachment factor, showing a negative correlation with *Neighborhood Quality* ($r = -.15, p \leq .01$). Additional research is needed to understand this relationship. While the correlation between these factors was relatively weak, the finding that higher perceptions of neighborhood quality were associated with shorter relocation timelines is unexpected.

H4 examined the relationship between place attachment and risk perception. Here, two notable findings emerged. First, perceived likelihood of a future event of similar magnitude as the 2013 tornado impacting the community was positively correlated with

Place Identity ($r = .10, p \leq .01$), *Neighborhood Quality* ($r = .14, p \leq .01$), and *Place Dependence* ($r = .08, p \leq .05$), indicating that increased place attachment was associated with the belief that another, similar event was unlikely. Second, the perceived likelihood of negative consequences (damage to one's home, health problems for members of the household, and likelihood of relocation) should another event of similar magnitude impact the community was negatively correlated with *Place Identity* ($r = -.16, p \leq .01, r = -.15, p \leq .01, r = -.38, p \leq .01$, respectively), *Neighborhood Quality* ($r = -.23, p \leq .01, r = -.22, p \leq .01, r = -.22, p \leq .01$, respectively), and *Place Dependence* ($r = -.14, p \leq .01, r = -.14, p \leq .01, r = -.31, p \leq .01$, respectively), and positively correlated with *Detachment* ($r = .16, p \leq .01, r = .16, p \leq .01, r = .47, p \leq .01$, respectively). Taken together, these findings suggest that stronger place attachment is associated with lower expectation of damage or harm from future hazards.

H5 examined the relationship between place attachment and demographics and, in keeping with previous studies, significant correlations were identified for sex, educational attainment, and tenure. Of note, there was a positive correlation between educational attainment and *Detachment* ($r = .10, p \leq .01$). Taken together with the negative correlation between educational attainment and *Place Dependence* ($r = -.11, p \leq .01$), this finding may reflect greater employment mobility among individuals with higher levels of education. Not surprisingly, tenure (as measured in the number of years the respondent has lived in Moore) was positively correlated with *Place Identity* ($r = .21, p \leq .01$), *Neighborhood Quality* ($r = .10, p \leq .01$), and *Place Dependence* ($r = .12, p \leq .01$).

Discussion

In this paper, we sought to improve the state of place attachment research in disaster contexts by examining two research questions: (1) What dimensions of place attachment were evident in the post-disaster environment? (2) What other factors were associated with place attachment in this disaster context? Applying several pre-established place attachment measures to a community directly impacted by an EF5 tornado, we identified four dimensions of place attachment. Two of these dimensions—*Place Identity* and *Place Dependence*—reflect accepted dimensions of place attachment identified through previous studies in disaster and non-disaster settings (c.f. Brown et al. 2015; Proshansky et al. 1983). The remaining two dimensions—*Neighborhood Quality* and *Detachment*—are referenced in the broader place attachment literature but are less prominent in the disaster literature. *Neighborhood Quality* captures residents' broad assessments of safety and trust within their community (c.f. Norris 2006; Poortinga et al. 2017; Ross and Searle 2019), while *Detachment* captures perceptions of division and disconnection from place and community (c.f. Adams 2016; Mihaylov and Perkins 2014; Scannell and Gifford 2010; Silver and Grek-Martin 2015).

In examining what factors are related to place attachment in disaster contexts, we found that at least one dimension of place attachment was related to each factor we explored, results that support our stated hypotheses. In many instances, these results were also in keeping with findings from previous studies, while in other cases our findings added nuance to existing knowledge. Higher levels of social engagement were positively associated with *Place Identity*, *Neighborhood Quality*, and *Place*

Dependence, for example, which is reflective of previous studies that have suggested connections between place attachment and social attachments within one's community (Anton and Lawrence 2014; Brown et al. 2004b; Cox and Perry 2011; Lewicka 2005; Silver and Grek-Martin 2015). Findings suggest that the experience of extensive damage to participants' homes and community actually reinforced place attachments, but they also indicate that future studies should parse out the impacts of perceptions of damage to home versus community (Lewicka 2010).

With regard to risk perception, place attachment may play a mediating role, with individuals with high place attachment underestimating or downplaying hazard risk (Armaş 2006; De Dominicis et al. 2015), and detached residents perceiving future hazards as more threatening. Findings related to demographics largely reflected the literature. Of note, the negative relationship between education level and both *Place Identity* and *Place Dependence*, in concert with the positive relationship between education level and *Detachment*, may reflect the heightened mobility of educated, and likely better resourced, individuals (Anton and Lawrence 2014).

Finally, findings related to place attachment and residential plan were unexpected but should be considered in light of related findings on relocation intention. While we found a weak negative correlation between *Neighborhood Quality* and relocation intention ("How long do you plan to live at your current residence?"), the *Detachment* factor suggests that place attachment is related to a desire to relocate. The intention to relocate away from one's community in the event of another major disaster was positively associated with *Detachment*, but negatively associated with the three other factors. As was true in post-Katrina findings (Morrice 2013), while high levels of place dependence may make residents unwilling or unable to relocate (e.g., if one's job is local), these findings suggest that place attachment, once damaged or disrupted, may make relocation more likely.

Taken together, our findings suggest that place attachment in disaster-affected areas is more complex than previous empirical studies have suggested, and that current place attachment measures likely fail to capture important attributes of attachment among disaster-affected households and communities. As such, the findings also suggest several lines of future research. First, while the factor analyses results indicated items that can be used to capture each of the four place attachment factors, future studies should refine these measures and propose more valid, reliable, and succinct scales. Second, the field would benefit from future studies that replicate this process in the communities affected by different hazard types and in developing contexts to assess additional place attachment measures. Third, our study was based on cross-sectional data collected post-event, though it would be preferable to measure place attachment both pre- and post-event to capture how the event influenced place attachment. Fourth, qualitative studies should be conducted to capture the breadth and depth of place attachment as a subjective construct, and to assess the validity of quantitative place attachment scales. Ultimately, disaster researchers must seek to develop new place attachment measures so that we can more fully and accurately capture the role of place attachment in household mitigation and recovery decision-making, disaster response dynamics, post-disaster and climate-induced relocation processes, and a myriad of other place-based questions currently facing the field.

This study had a number of limitations that should be considered, including the response rate (17%) described above. Our survey instrument reflected several existing place attachment measures, but due to instrument size constraints did not reflect the full breadth of existing measures previously applied in the literature. The use of different measures would almost certainly have altered the results of the exploratory factor analysis. As such, we present the findings from this study as an early attempt at establishing more accurate and appropriate measures for place attachment in disasters. While place dependence is a relatively well-established factor in the literature, we would suggest that it, in particular, requires additional attention. There are challenges inherent in translating place dependence questions from the high-amenity and recreational literature where it originated (Ulrich-Schad et al. 2019). Place dependence is intended to capture one's functional or practical connections to place, though this likely manifests differently in recreational or high amenity locations (e.g., best location for recreational fishing) and working settings (which include access to employment, schools, transportation, and related considerations), and better questions are needed to capture these differences.

Conclusion

Place attachment is a critical, though understudied, construct in disaster studies. The place attachment literature has developed through multiple streams, and research on this construct has been consistently hampered by a lack of agreement on the definition of place attachment, imprecise or inadequately tested measures, and limited theory to guide research. These issues have been further complicated by efforts to translate place attachment across various fields and applications. Disaster studies have felt these gaps acutely. A clear understanding of the role of place attachment is critical for the field as all disasters are, fundamentally, place-based phenomena. If unaddressed, these gaps will continue to limit our ability to understand disasters and, in turn, limit our ability to support households and communities as they prepare for, experience, and recover from disaster events.

This paper presents results from a study designed to improve our understanding of place attachments in disaster contexts, drawing on the experiences of a community impacted by an EF5 tornado. Findings suggest that place attachment in disaster contexts encompasses residents' perceptions of safety, trust, and detachment, in addition to more standard concepts of identity and dependence. Further, a number of key factors were found to be associated with place attachment in disaster settings, including social participation, damage to one's home, and likelihood of relocation in the event of another disaster. This study represents a starting point for future research, and a step toward the development of more appropriate place attachment measures in disaster settings. By increasing our understanding of place attachment and more fully appreciating its impacts across all phases of the disaster cycle, we can better support individuals, households, and communities as they prepare for, experience, and recover from disaster events.

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References

- Adams, H. (2016). Why populations persist: Mobility, place attachment and climate change. *Population and Environment*, 37(4), 429–448.
- Adger, W. N. (2000). Social and ecological resilience: Are they related? *Progress in Human Geography*, 24(3), 347–364.
- Adger, W. N., Quinn, T., Lorenzoni, I., & Murphy, C. (2016). Sharing the pain: Perceptions of fairness affect private and public response to hazards. *Annals of the American Association of Geographers*, 106(5), 1079–1096.
- Agyeman, J., Devine-Wright, P., & Prange, J. (2009). Close to the edge, down by the river? Joining up managed retreat and place attachment in a climate changed world. *Environment & Planning A*, 41(3), 509–513.
- Airriess, C. A., Li, W., Leong, K. J., Chen, A. C. C., & Keith, V. M. (2008). Church-based social capital, networks and geographical scale: Katrina evacuation, relocation, and recovery in a New Orleans Vietnamese American community. *Geoforum*, 39(3), 1333–1346.
- Anacio, D. B., Hilvano, N. F., Buriás, I. C., Pine, C., Nelson, G. L. M., & Ancog, R. C. (2016). Dwelling structures in a flood-prone area in the Philippines: Sense of place and its functions for mitigating flood experiences. *International Journal of Disaster Risk Reduction*, 15, 108–115.
- Anton, C. E., & Lawrence, C. (2014). Home is where the heart is: The effect of place of residence on place attachment and community participation. *Journal of Environmental Psychology*, 40, 451–461.
- Anton, C. E., & Lawrence, C. (2016). Does place attachment predict wildfire mitigation and preparedness? A comparison of Wildland–urban Interface and rural communities. *Environmental Management*, 57(1), 148–162.
- Araya, R., Dunstan, F., Playle, R., Thomas, H., Palmer, S., & Lewis, G. (2006). Perceptions of social capital and the built environment and mental health. *Social Science & Medicine* (1982), 62(12), 3072–3083.
- Armaş, I. (2006). Earthquake risk perception in Bucharest, Romania. *Risk Analysis*, 26(5), 1223–1234.
- Amberger, A., & Eder, R. (2012). The influence of green space on community attachment of urban and suburban residents. *Urban Forestry & Urban Greening*, 11(1), 41–49.
- Bailey, N., Kearns, A., & Livingston, M. (2012). Place attachment in deprived neighbourhoods: The impacts of population turnover and social mix. *Housing Studies*, 27(2), 208–231.
- Berchin, I. I., Valduga, I. B., Garcia, J., & de Andrade Guerra, J. B. S. O. (2017). Climate change and forced migrations: An effort towards recognizing climate refugees. *Geoforum*, 84(June), 147–150.
- Bernardo, F. (2014). Impact of place attachment on risk perception: Exploring the multidimensionality of risk and its magnitude. *Estudios de Psicología*, 34(3), 323–329.
- Bihari, M., & Ryan, R. (2012). Influence of social capital on community preparedness for wildfires. *Landscape and Urban Planning*, 106(3), 253–261.
- Bohra-Mishra, P., Oppenheimer, M., Cai, R., Feng, S., & Licker, R. (2017). Climate variability and migration in the Philippines. *Population and Environment*, 38(3), 286–308.
- Bonaiuto, M., Alves, S., De Dominicis, S., & Petrucci, I. (2016). Place attachment and natural Hazard risk: Research review and agenda. *Journal of Environmental Psychology*, 48, 33–53.
- Bonanno, G. A., Galea, S., Bucciarelli, A., & Vlahov, D. (2007). What predicts psychological resilience after disaster? The role of demographics, resources, and life stress. *Journal of Consulting and Clinical Psychology*, 75(5), 671–682.
- Brown, B. and Perkins, D.. 1992. “Disruptions in place attachment.” Pp. 279–304 in *Place Attachment. Human Behavior and Environment Advances in Theory and Research*, edited by I. Altman and S. Low. Boston: Springer.
- Brown, G., & Raymond, C. (2007). The relationship between place attachment and landscape values: Toward mapping place attachment. *Applied Geography*, 27(2), 89–111.
- Brown, B., Perkins, D. D., & Brown, G. (2003). Place attachment in a revitalizing neighborhood: Individual and block levels of analysis. *Journal of Environmental Psychology*, 23(3), 259–271.

- Brown, B. B., Perkins, D. D., & Brown, G. (2004a). Incivilities, place attachment and crime: Block and individual effects. *Journal of Environmental Psychology, 24*(3), 359–371.
- Brown, G., Brown, B. B., & Perkins, D. D. (2004b). New housing as neighborhood revitalization: Place attachment and confidence among residents. *Environment and Behavior, 36*(6), 749–775.
- Brown, G., Raymond, C. M., & Corcoran, J. (2015). Mapping and measuring place attachment. *Applied Geography, 57*, 42–53.
- Burley, D., Jenkins, P., Laska, S., & Davis, T. (2007). Place attachment and environmental change in coastal Louisiana. *Organization and Environment, 20*(3), 347–366.
- Carroll, B., Morbey, H., Balogh, R., & Araoz, G. (2009). Flooded homes, broken bonds, the meaning of home, psychological processes and their impact on psychological health in a disaster. *Health & Place, 15*(2), 540–547.
- Census, U. S. 2016. “U.S. Census Bureau QuickFacts: Moore City, Oklahoma.” Retrieved (<https://www.census.gov/quickfacts/fact/table/moorecityoklahoma/PST045216>). Accessed 15, December 2017
- Chamlee-Wright, E., & Storr, V. H. (2009). There’s no place like New Orleans: Sense of place and community recovery in the Ninth Ward after Hurricane Katrina. *Journal of Urban Affairs, 31*(5), 615–634.
- City of Moore. 2014. Moore, Oklahoma disaster recovery program action plan. Moore, OK Retrieved (<https://www.cityofmoore.com/departments/grants-programs/disaster-recovery>). Accessed 28, August 2019
- Clarke, D., Murphy, C., & Lorenzoni, I. (2018). Place attachment, disruption and transformative adaptation. *Journal of Environmental Psychology, 55*, 81–89.
- Clermont, H. J. K., Dale, A., Reed, M. G., & King, L. (2019). Sense of place as a source of tension in Canada’s west coast energy conflicts. *Coastal Management, 47*(2), 189–206.
- Codjoe, S. N. A., Nyamedor, F. H., Sward, J., & Dovie, D. B. (2017). Environmental Hazard and migration intentions in a coastal area in Ghana: A case of sea flooding. *Population and Environment, 39*(2), 128–146.
- Cope, M. R., & Slack, T. (2017). Emplaced social vulnerability to technological disasters: Southeast Louisiana and the BP Deepwater Horizon oil spill. *Population and Environment, 38*(3), 217–241.
- Cope, M. R., Lee, M. R., Slack, T., Blanchard, T. C., Carney, J., Lipschitz, F., & Gikas, L. (2018). Geographically distant social networks elevate perceived preparedness for coastal environmental threats. *Population and Environment, 39*(3), 277–296.
- Cox, R. S., & Perry, K. M. E. (2011). Like a fish out of water: Reconsidering disaster recovery and the role of place and social capital in community disaster resilience. *American Journal of Community Psychology, 48*(3–4), 395–411.
- Cross, J. E. (2015). Processes of place attachment: An interactional framework. *Symbolic Interaction, 38*(4), 493–520.
- Cuba, L., & Hummon, D. M. (1993). A place to call home: Identification with dwelling, community and region. *The Sociological Quarterly, 34*, 111–131.
- Cutter, S. L., Schumann, R. L., & Emrich, C. T. (2014). Exposure, social vulnerability and recovery disparities in New Jersey after Hurricane Sandy. *Journal of Extreme Events, 01*(01), 1450002.
- Dallago, L., Perkins, D. D., Santinello, M., Boyce, W., Molcho, M., & Morgan, A. (2009). Adolescent place attachment, social capital, and perceived safety: A comparison of 13 countries. *American Journal of Community Psychology, 44*(1–2), 148–160.
- De Dominicis, S., Fornara, F., Cancellieri, U. G., Twigger-Ross, C., & Bonaiuto, M. (2015). We are at risk, and so what? Place attachment, environmental risk perceptions and preventive coping behaviours. *Journal of Environmental Psychology, 43*, 66–78.
- De Donder, L., De Witte, N., Buffel, T., Dury, S., & Verté, D. (2012). Social capital and feelings of unsafety in later life. *Research on Aging, 34*(4), 425–448.
- Devine-Wright, P. (2009). Rethinking NIMBYism: The role of place attachment and place identity in explaining place-protective action. *Journal of Community and Applied Social Psychology, 19*, 426–441.
- Devine-Wright, P. (2013). Explaining ‘NIMBY’ objections to a power line: The role of personal, place attachment and project-related factors. *Environment and Behavior, 45*(6), 761–781.
- Devine-Wright, P., & Batel, S. (2017). My neighbourhood, my country or my planet? The influence of multiple place attachments and climate change concern on social acceptance of energy infrastructure. *Global Environmental Change, 47*(August), 110–120.
- DeWaard, J., Curtis, K. J., & Fussell, E. (2016). Population recovery in New Orleans after hurricane Katrina: Exploring the potential role of stage migration in migration systems. *Population and Environment, 37*(4), 449–463.
- Dillman, D. A. (1978). *Mail and telephone surveys: The total design method*. Hoboken: Wiley.

- Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys: The tailored design method* (4th ed.). Hoboken: John Wiley & Sons, Inc..
- Eusébio, C., Vieira, A. L., & Lima, S. (2018). Place attachment, host–tourist interactions, and residents’ attitudes towards tourism development: The case of Boa Vista Island in Cape Verde. *Journal of Sustainable Tourism*, 26(6), 890–909.
- Farbotko, C., & Lazrus, H. (2012). The first climate refugees? Contesting global narratives of climate change in Tuvalu. *Global Environmental Change*, 22(2), 382–390.
- Faulkner, L., Brown, K., & Quinn, T. (2018). Analyzing community resilience as an emergent property of dynamic social- introduction: A new lens on community. *Ecology and Society*, 23(1).
- Federal Emergency Management Agency. 2011. “National disaster recovery framework.” Washington, D.C. Retrieved (https://www.fema.gov/media-library-data/1466014998123-4bec8550930f774269e0c5968b120ba2/National_Disaster_Recovery_Framework2nd.pdf). Accessed 26, August 2019
- Federal Emergency Management Agency. 2014. *Formal Observation Report, Tornado: Moore, Oklahoma, May 20, 2013. Safe room performance, observations, and conclusions*. Washington, D.C. Retrieved August 29, 2019 (https://www.fema.gov/media-library-data/1418307179636-a018b8744801f8a770e6ea5c65eb54d/FEMA_P-1020_Moore_Tornado_Report_508.pdf).
- Forrest, R., & Kearns, A. (2001). Social cohesion, social capital, and health. *Urban Studies*, 38(12), 2125–2143.
- Fresque-Baxter, J. A., & Armitage, D. (2012). Place identity and climate change adaptation: A synthesis and framework for understanding. *Wiley Interdisciplinary Reviews: Climate Change*, 3(3), 251–266.
- Fried, M. (2000). Continuities and discontinuities of place. *Journal of Environmental Psychology*, 20(3), 193–205.
- Gill, D., & Steven Picou, J. (1998). Technological disaster and chronic community stress. *Society and Natural Resources*, 11(8), 795–815.
- Gilleard, C., Hyde, M., & Higgs, P. (2007). On aging the impact of age , place , aging the over 50s in England. *Research on Aging*, 29(6), 590–605.
- Gorman-Murray, A., McKinnon, S., & Dominey-Howes, D. (2014). Queer Domicide. *Home Cultures*, 11(2), 237–261.
- Greer, A., Wu, H.-C., & Murphy, H. (2018). A serendipitous, quasi-natural experiment: Earthquake risk perceptions and hazard adjustments among college students. *Natural Hazards*, 93(2), 987–1011.
- Halpenny, E. A. (2010). Pro-environmental behaviours and park visitors: The effect of place attachment. *Journal of Environmental Psychology*, 30(4), 409–421.
- Haney, T. J. (2018). Paradise found? The emergence of social capital, place attachment, and civic engagement after disaster. *International Journal of Mass Emergencies and Disasters*, 36(2), 97–119.
- Hauer, M. E., Dean Hardy, R., Mishra, D. R., & Scott Pippin, J. (2019). No landward movement: Examining 80 years of population migration and shoreline change in Louisiana. *Population and Environment*, 1–19.
- Hays, R. A., & Kogl, A. M. (2007). Neighborhood attachment, social capital building, and political participation: A case study of Low- and moderate-income residents of Waterloo, Iowa. *Journal of Urban Affairs*, 29(2), 181–205.
- Healey, P. (2018). Creating public value through caring for place. *Policy and Politics*, 46(1), 65–79.
- Hernández, B., Carmen Hidalgo, M., Esther Salazar-Laplace, M., & Hess, S. (2007). Place attachment and place identity in natives and non-natives. *Journal of Environmental Psychology*, 27(4), 310–319.
- Hidalgo, M. C., & Hernandez, B. (2001). Place attachment: Conceptual and empirical questions. *Journal of Environmental Psychology*, 21, 273–281.
- Hornbaker, M. H., & Cullen, A. (2010). The precautionary principle in practice: Applying the Ashford framework to technological risk. *Human and Ecological Risk Assessment*, 9(3), 37–41.
- Ingram, J. C., Franco, G., del Rio, C. R., & Khazai, B. (2006). Post-disaster recovery dilemmas: Challenges in balancing short-term and long-term needs for vulnerability reduction. *Environmental Science & Policy*, 9(7–8), 607–613.
- Jorgensen, B. S., & Stedman, R. C. (2001). Sense of place as an attitude: Lakeshore owners attitudes toward their properties. *Journal of Environmental Psychology*, 21, 233–248.
- Jorgensen, B. S., & Stedman, R. C. (2006). A comparative analysis of predictors of sense of place dimensions: Attachment to, dependence on, and identification with lakeshore properties. *Journal of Environmental Management*, 79(3), 316–327.
- Kennedy, Merrit. 2016. “Threatened by rising seas, Alaska Village decides to relocate.” National Public Radio, August. (<https://www.npr.org/sections/thetwo-way/2016/08/18/490519540/threatened-by-rising-seas-an-alaskan-village-decides-to-relocate>). Accessed 15, December 2017

- Kick, E. L., Fraser, J. C., Fulkerson, G. M., McKinney, L. A., & De Vries, D. H. (2011). Repetitive flood victims and acceptance of FEMA mitigation offers: An analysis with community-system policy implications. *Disasters*, 35(3), 510–539.
- Koubi, V., Spilker, G., Schaffer, L., & Böhmelt, T. (2016). The role of environmental perceptions in migration decision-making: Evidence from both migrants and non-migrants in five developing countries. *Population and Environment*, 38(2), 134–163.
- Ledesma, R. D., & Valero-Mora, P. (2007). Determining the number of factors to retain in EFA: An easy-to-use computer program for carrying out parallel analysis. *Practical assessment, research & evaluation*, 12(2), 1–11.
- Letki, N. (2008). Does diversity erode social cohesion? Social capital and race in British neighbourhoods. *Political Studies*, 56(1), 99–126.
- Lewicka, M. (2005). Ways to make people active: The role of place attachment, cultural capital, and neighborhood ties. *Journal of Environmental Psychology*, 25(4), 381–395.
- Lewicka, M. (2010). What makes neighborhood different from home and City? Effects of place scale on place attachment. *Journal of Environmental Psychology*, 30(1), 35–51.
- Lewicka, M. (2011). Place attachment: How far have we come in the last 40 years? *Journal of Environmental Psychology*, 31(3), 207–230.
- Li, W., Airriess, C. A., Chen, A. C. C., Leong, K. J., & Keith, V. (2010). Katrina and migration: Evacuation and return by African Americans and Vietnamese Americans in an eastern New Orleans suburb. *The Professional Geographer*, 62(1), 103–118.
- Lindell, M. K., Arlikatti, S., & Prater, C. S. (2009). Why people do what they do to protect against earthquake risk: Perceptions of Hazard adjustment attributes. *Risk Analysis*, 29(8), 1072–1088.
- Lindell, M. K., & Hwang, S. N. (2008). Households' perceived personal risk and responses in a multihazard environment. *Risk Analysis: An International Journal*, 28(2), 539–556.
- Low, S. M., & Altman, I. (1992). Place Attachment. In S. M. Low & I. Altman (Eds.), in *Place Attachment* (pp. 1–12). Boston: Springer US.
- Mazumdar, S., & Mazumdar, S. (2004). Religion and place attachment: A study of sacred places. *Journal of Environmental Psychology*, 24(3), 385–397.
- McKnight, M. L., Sanders, S. R., Gibbs, B. G., & Brown, R. B. (2017). Communities of place? New evidence for the role of distance and population size in community attachment. *Rural Sociology*, 82(2), 291–317.
- McNamara, K. E., & Combes, H. J. D. (2015). Planning for community relocations due to climate change in Fiji. *International Journal of Disaster Risk Science*, 6(3), 315–319.
- Mesch, G. S., & Manor, O. (1998). Social ties, environmental perception, and local attachment. *Environment and Behavior*, 30(4), 504–519.
- Mihaylov, N., & Perkins, D. D. (2014). Community Place Attachment and Its Role in Social Capital Development. In L. C. Manzo & P. Devine-Wright (Eds.), in *Place attachment: Advances in theory, methods and applications* (pp. 61–74). New York: Routledge.
- Mitchell, C. U., & LaGory, M. (2002). Social capital and mental distress in an impoverished community. *City and Community*, 1(2), 199–222.
- Morgan, P. (2010). Towards a developmental theory of place attachment. *Journal of Environmental Psychology*, 30(1), 11–22.
- Morrice, S. (2013). Heartache and hurricane Katrina: Recognising the influence of emotion in post-disaster return decisions. *Area*, 45(1), 33–39.
- Mortreux, C., & Barnett, J. (2017). Adaptive capacity: Exploring the research frontier. *Wiley Interdisciplinary Reviews: Climate Change*, 8(4), e467.
- Nawrotzki, R. J., Brenkert-Smith, H., Hunter, L. M., & Champ, P. A. (2014). Wildfire-migration dynamics: Lessons from Colorado's Fourmile canyon fire. *Society and Natural Resources*, 27(2), 215–225.
- Nejat, A., Binder, S. B., Greer, A., & Jamali, M. (2018). Demographics and the dynamics of recovery: A latent class analysis of disaster recovery priorities after the 2013 Moore, Oklahoma tornado. *International Journal of Mass Emergencies and Disasters*, 36(1), 23–51.
- Norris, F. H. (2006). Disaster research methods: Past progress and future directions. *Journal of Traumatic Stress*, 19(2), 173–184.
- Norris, F. H., Friedman, M. J., & Watson, P. J. (2002). 60,000 disaster victims speak: Part II. Summary and implications of the disaster mental Health Research. *Psychiatry*, 65(3), 240–260.
- Oakes, R. (2019). Culture, climate change and mobility decisions in Pacific Small Island developing states. *Population and Environment*, 40(4), 480–503.
- Oh, J. H. (2004). Race/ethnicity, homeownership, and neighborhood attachment. *Race and Society*, 7(2), 63–77.

- Parry, S., & Hassan, L. M. (2019). Understanding the relationship between smoking and place across multiple places through the lens of place attachment. *Journal of Environmental Psychology*, 62(May 2018), 115–123.
- Peacock, W. G., Van Zandt, S., Yang, Z., & Highfield, W. E. (2015). Inequities in long-term housing recovery after disasters. *Journal of the American Planning Association*, 80(4), 356–371.
- Poortinga, W., Calve, T., Jones, N., Lannon, S., Rees, T., Rodgers, S. E., Lyons, R. A., & Johnson, R. (2017). Neighborhood quality and attachment. *Environment and Behavior*, 49(3), 255–282.
- Pretty, G. H., Chipuer, H. M., & Bramston, P. (2003). Sense of place amongst adolescents and adults in two rural Australian towns: The discriminating features of place attachment, sense of community and place dependence in relation to place identity. *Journal of Environmental Psychology*, 23(3), 273–287.
- Proshansky, H. M., Fabian, A. K., & Kaminof, R. (1983). Place identity: Physical world socialization of the self. *Journal of Environmental Psychology*, 3, 57–83.
- Quinn, T., Bousquet, F., & Guerbois, C. (2019). Changing places: The role of sense of place in perceptions of social, environmental and overdevelopment risks. *Global Environmental Change*, 57(June 2018), 101930.
- Raymond, C. M., Brown, G., & Weber, D. (2010). The measurement of place attachment: Personal, community, and environmental connections. *Journal of Environmental Psychology*, 30(4), 422–434.
- Rollero, C., & De Piccoli, N. (2010). Place attachment, identification and environment perception: An empirical study. *Journal of Environmental Psychology*, 30(2), 198–205.
- Ross, A., & Searle, M. (2019). A conceptual model of leisure time physical activity, neighborhood environment, and sense of community. *Environment and Behavior*, 51(6), 749–781.
- Scannell, L., & Gifford, R. (2010). Defining place attachment: A tripartite organizing framework. *Journal of Environmental Psychology*, 30(1), 1–10.
- Silver, A., & Grek-Martin, J. (2015). ‘Now we understand what community really means’: Reconceptualizing the role of sense of place in the disaster recovery process. *Journal of Environmental Psychology*, 42, 32–41.
- Stylidis, D. (2018). Residents’ place image: A cluster analysis and its links to place attachment and support for tourism. *Journal of Sustainable Tourism*, 26(6), 1007–1026.
- Suntikul, W., & Jachna, T. (2015). The co-creation/place attachment nexus. *Tourism Management*, 52, 276–286.
- Tierney, K. and Sheng, X.. 2001. *Explaining support for seismic loss-reduction measures: Data from a household survey*. Retrieved (<http://udspace.udel.edu/handle/19716/12854>). Accessed 28, August 2019
- Trentelman, C. K. (2009). Place attachment and community attachment: A primer grounded in the lived experience of a community sociologist. *Society and Natural Resources*, 22(3), 191–210.
- Trentelman, C. K. (2011). Place dynamics in a mixed amenity place: Great salt Lake, Utah. *Human Ecology Review*, 18(2), 126–138.
- Turner, R., Nigg, J., & Paz, D. (1986). *Waiting for disaster: Earthquake watch in California*. Berkeley: University of California Press.
- Twigger-Ross, C. L., & Uzzell, D. L. (1996). Place and identity processes. *Journal of Environmental Psychology*, 16(3), 205–220.
- Ulrich-Schad, J. D., Cross, J. E., Gordon Arbuckle, J., Eaton, W. M., Burnham, M., Church, S. P., & Eanes, F. R. (2019). Trouble with sense of place in working landscapes. *Society and Natural Resources*, 32(7), 1–14.
- United Nations International Strategy for Disaster Risk Reduction (UNISDR). 2015. “Making development sustainable: The future of disaster risk management.” Retrieved (https://www.preventionweb.net/english/hyogo/gar/2015/en/gar-pdf/GAR2015_EN.pdf). Accessed 20, August 2019
- Upham, P., Johansen, K., Bögel, P. M., Axon, S., Garard, J., & Carney, S. (2018). Harnessing place attachment for local climate mitigation? Hypothesising connections between broadening representations of place and readiness for change. *Local Environment*, 23(9), 912–919.
- Vaske, J. J., & Kobrin, K. C. (2001). Place attachment and behavior. *The Journal of Environmental Education*, 32(4), 16–21.
- von Wirth, T., Grêt-Regamey, A., Moser, C., & Stauffacher, M. (2016). Exploring the influence of perceived urban change on residents’ place attachment. *Journal of Environmental Psychology*, 46, 67–82.
- Vorkinn, M., & Riese, H. (2001). Environmental concern in a local context. *Environment and Behavior*, 33(2), 249–263.
- White, D. D., Virden, R. J., & Van Riper, C. J. (2008). Effects of place identity, place dependence, and experience-use history on perceptions of recreation impacts in a natural setting. *Environmental Management*, 42, 647–657.

- Williams, D. R. and Roggenbuck, J. W.. 1989. "Measuring place attachment: Some preliminary results." in *Paper presented at the NRPA Symposium on Leisure Research*. San Antonio, TX.
- Williams, D. R., & Vaske, J. J. (2003). The measurement of place attachment : Validity and generalizability of a psychometric approach. *Forest Science*, 49(6), 830–840.
- Winstanley, A., Hepi, M., & Wood, D. (2015). Resilience? Contested meanings and experiences in post-disaster Christchurch, New Zealand. *Kotuitui*, 10(2), 126–134.
- Zavar, Elyse and Hageman Iii R.R. 2016. "Land use change on U. S. floodplain buyout sites." *Disaster Prevention and Management* 25(3): 360–374.
- Zhang, Y., Zhang, H. L., Zhang, J., & Cheng, S. (2014). Predicting residents' pro-environmental behaviors at tourist sites: The role of awareness of disaster's consequences, values, and place attachment. *Journal of Environmental Psychology*, 40, 131–146.

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