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The Social Consequences of Disasters: Individual and Community Change

Mariana Arcaya,^{1,*} Ethan J. Raker,^{2,*}
and Mary C. Waters^{2,*}

¹Department of Urban Planning, Massachusetts Institute of Technology, Cambridge, Massachusetts 02138, USA; email: marcaya@mit.edu

²Department of Sociology, Harvard University, Cambridge, Massachusetts 02138, USA; email: eraker@g.harvard.edu, mcw@wjh.harvard.edu

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*These authors are listed alphabetically and contributed equally to this article

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Abstract

We review findings from the last decade of research on the effects of disasters, concentrating on three important themes: the differences between the recovery of places versus people, the need to differentiate between short- and long-term recovery trajectories, and the changing role of government and how it has exacerbated inequality in recovery and engendered feedback loops that create greater vulnerability. We reflect the focus of the majority of sociological studies on disasters by concentrating our review on studies in the United States, but we also include studies on disasters throughout the world if they contribute to our empirical and theoretical understanding of disasters and their impacts. We end with a discussion of the inevitability of more severe disasters as climate change progresses and call on social scientists to develop new concepts and to use new methods to study these developments.

INTRODUCTION

Social scientists have approached disasters from a variety of perspectives. Disasters have been studied as phenomena in themselves—how they develop; how they are defined; how individuals, institutions, and governments react to them; and how they end. Scholars have also studied the underlying causes of disasters and the short- and long-run impacts of disasters both for places and for the people who survived.

In addition to exploring the nature, causes, and consequences of disasters themselves, scholars have used disasters to better understand other phenomena. Disasters are sometimes conceived of as exogenous shocks that expose some survivors, but not otherwise similar individuals, to traumas, to new neighborhoods, and to other meaningful changes in risks and resources that matter for a range of individual outcomes (e.g., Kirk 2009, 2020; Torche 2018). Although disasters often follow known patterns, striking more frequently under particular built-environment and social conditions, in specific geographic regions (e.g., Tornado Alley), and at particular times of the year (e.g., hurricane season), one cannot predict which specific individuals will be affected and when. Exploiting disaster-induced variation in exposures of interest, researchers have learned, for example, that stress negatively affects birth outcomes (Torche 2018), neighborhood change after prison reduces recidivism (Kirk 2009, 2020), and neighborhoods with greater sprawl increase body mass index (BMI) over time (Arcaya et al. 2014a). In addition to revealing whether specific exposures cause specific outcomes, disasters have been used as strategic research sites that lay bare societal processes and inequalities.

Despite unpredictability in exactly when and where the next disaster will strike, disasters are regular occurrences and thus provide regular opportunities for study. Climate change is increasing the likelihood of extreme weather and climate disasters, leading to more numerous destructive heat waves, wildfires, droughts, hurricanes, typhoons, and floods (IPCC 2012, 2018). Sea-level rise leads both to “sunny day” tidal flooding and to increases in damaging storm surges. Earthquakes have not necessarily increased due to human activities—although fracking may have increased them in some areas. Yet earthquakes have the potential to be much more destructive in the future because of population growth near active faults.

The growth of high-profile disasters, including the 2011 Joplin tornado, Superstorm Sandy, and the California Camp Fire, has led to a large number of social science studies since the last *Annual Review of Sociology* article on disasters (Tierney 2007). Since then, the Intergovernmental Panel on Climate Change has issued unequivocal reports detailing the existence of human-caused climate change and the link between climate change and the increasing intensity and frequency of many types of natural disasters (IPCC 2012, 2018). Therefore, as international leaders reflect on the state of the climate, now is a critical time for academic reflection and a review of what we have learned in terms of the social consequences of disasters.

In this article, we review the last decade of research on the effects of disasters in terms of three important themes. First, we discuss the differences in studying the recovery of places versus the recovery of people. Second, we review the findings on disaster recovery based on short- and long-term studies. We do so with respect to the trajectories that individuals experience in mental and physical health, mortality, socioeconomic attainment, and community rebuilding. Third, we review what is known about the ways in which government and societal responses to disasters have changed over time as the costs of disasters have increased and as political and economic conditions in the United States have changed. We reflect the focus of the majority of sociological studies on disasters by concentrating our review on studies in the United States, but we also include studies on disasters throughout the world if they contribute to our empirical and theoretical understanding of disasters and their impacts. As we note below, there is evidence that disasters have very different

effects on populations in developed- versus developing-country contexts. We end with a discussion of future methods and approaches that the field should adopt as well as the unanswered questions and important avenues future studies should pursue, particularly in light of anthropogenic climate change.

DEFINITION OF TERMS

We begin with a brief introduction to terminology in this subfield, noting where definitions and preferred terms have changed over time. A hazard refers to an ongoing environmental risk that has the potential to become a disaster. For example, earthquake faults and floodplains are hazards. A disaster occurs when the hazard potential is realized, or a hazardous weather-related or physical event occurs that involves extensive social disruption and loss (Tierney 2019). While a powerful tornado in a remote, undeveloped area is not a disaster, a similar-magnitude tornado in a populated suburban area is considered one. A federal disaster declaration in the United States is a political decision that has ramifications for federal money flowing to localities and individuals. Under the 1974 Disaster Relief Act (later amended in 1988 as the Stafford Act and again in 2000), upon a request from a state's governor, the President of the United States can release federal funds from the Federal Emergency Management Agency (FEMA) with a disaster declaration. Political scientists have analyzed the political conditions under which presidents declare a disaster, documenting that concerns for the electorate and political partisanship have a direct effect on whether a president grants a governor's request (Garrett & Sobel 2003, Reeves 2011). The federal declaration of a disaster is thus not an objective measure of the severity of a disaster, and researchers often use other measures, such as property damage, wind speed, flood depth, or Richter scale measurement, to operationalize disaster severity.

Tierney (2019, p. 5) traces the history of the concept of disaster in sociological research. The idea that a disaster is a discrete event that occurs when a hazard is realized has been superseded by an approach that sees disasters as social processes that can be very long term in both genesis and effects and are social in nature, not simply environmental or natural events. In the past, researchers differentiated between natural and technological disasters: Technological disasters (e.g., an oil spill) were regarded as human caused, and natural disasters (e.g., a hurricane) arose from the environment or the natural world. As Hurricane Katrina or the California Camp Fire makes clear, however, this distinction often breaks down because human agency is involved in all types of disasters (Tierney 2019). Many disasters are what Picou (2009) calls a "natech" disaster. Hurricane Katrina caused widespread flooding in New Orleans only because the levees failed and because a city had been built below sea level in an area that sees frequent hurricanes. The causes of the widespread destruction of Hurricane Katrina were social and long term in nature; the event of the hurricane set in motion the destruction for which humans created the conditions.

The concepts of vulnerability and resilience are increasingly used to understand the social, rather than physical, roots of disasters. As Tierney (2019, p. 72) notes, the concept of vulnerability "encompasses both the probability of suffering the negative effects of hazards and disasters and the likelihood that some groups will be less able than others to navigate the recovery process successfully." Scholars draw upon distinct dimensions of vulnerability to natural disasters, differentiating the social attributes of vulnerability from the locational, or physical, aspects of vulnerability. These unique concepts are multifaceted and complicate the field of disaster studies (Donner & Rodriguez 2008). On the one hand, geographers developed the concept of the hazardousness of place, or locational vulnerability, which refers to attributes of places that make them more or less vulnerable to disasters, for instance, location in a floodplain (Cutter et al. 2000). On the other hand, social vulnerability to hazards refers to the susceptibility of demographic groups to loss from

a disaster (Blaikie et al. 2005). Social scientists have provided evidence that rebuts the platitude that disasters hit all people equally. Social inequality shapes who is most at risk in disasters, with race, socioeconomic status, gender, and age all shown to affect vulnerability to disasters (Peacock et al. 1997, Bolin 2007, Enarson 2012). Social vulnerability can also be influenced by access to resources (e.g., economic, political, or information based), beliefs and customs, history, and other factors. Crucially, recent research stresses that social vulnerability is intersectional. In other words, it combines race, age, class, and gender, together with other conditions that create vulnerability; social isolation, poor physical or mental health, and precarious legal statuses create different levels of social vulnerability vis-à-vis different disasters. For instance, Fothergill & Peek (2015) show how some children were particularly vulnerable to Katrina and its aftermath, suffering from what they term “cumulative vulnerability.”

Locational and social vulnerability can also intersect and reinforce one another. Recent research shows that the built environments of historically redlined neighborhoods, which still disproportionately comprise poor and racial/ethnic minority residents, produce higher land-surface temperatures than neighboring areas during heat events (Rothstein 2017, Mitchell & Franco 2018, Hoffman et al. 2020), illustrating just one example of how historic and present-day social and physical features combine to increase vulnerability to disaster (Rothstein 2017, Mitchell & Franco 2018, Hoffman et al. 2020).

The concept of resilience is also widely used in both social science and engineering studies of disaster. Defining and measuring the resilience of communities to adversity have a long and contentious history (Olsson et al. 2015), with the concept evolving from one that largely described a community’s ability to withstand, absorb, or bounce back from shock to a notion that also integrates the capacity of a system to adapt to, thrive after, and even benefit from adverse events (Adger 2000). Scholars have attempted to identify capacities that are associated with resilience, including the ability to prevent, anticipate, absorb, adapt to, and transform in the face of disaster (Manyena et al. 2019). Yet some scholars question the usefulness of a concept that seeks to combine the inherently contradictory attributes of static resistance and dynamic adaptation (Olsson et al. 2015). Another critique notes that the absence of key social science concepts, including power and agency, from the descriptive notion of resilient systems risks depoliticizing how we discuss and deploy resources to face disasters (Olsson et al. 2015). McLaughlin & Dietz (2008) argue that any theory of vulnerability must take into account history and how it has shaped the social structures in society, as well as human agency and culture and how they shape understandings of how to cope with risk and disaster, and should consider how history and culture define the social boundaries that create the categories of who is considered vulnerable. These critiques notwithstanding, international bodies such as the United Nations and the World Bank, as well as federal government programs across a wide number of agencies, have issued calls for disaster resilience in localities and societies, and the question of how culture and social organization can foster resilience has been pursued. For instance, VanLandingham (2017) makes a provocative argument that the cultural and social attributes of the Vietnamese community in New Orleans rendered them resilient and allowed them to recover more quickly and completely than others who experienced Hurricane Katrina.

Finally, the concept of risk and its identification, characterization, and governance intersect with the study of disasters. While societies and individuals have always had to cope with danger and manage risks, theorists such as Ulrich Beck, Anthony Giddens, and Niklas Luhmann have argued in recent decades that globalization and technological development and complexity have led to a very different level of risk, what Beck (1992) first called the “risk society.” Disasters such as Chernobyl and Fukushima demonstrate that risk and the management of disasters cannot be confined within nation-states. Climate change is a prime example of this kind of global risk. Rosa

et al. (2013) provide an overview of theoretical advances in this area, along with empirical research, arguing that global risks require new social theories as well as new methods of assessment and governance.

CONSEQUENCES OF DISASTER: EFFECTS ON PEOPLE VERSUS PLACES

Disaster research is interdisciplinary, with a reach across the social and natural sciences. A key contribution of sociologists has been in studying the effects of disasters on social groups and communities, as well as the effect of community- or place-based resources on recovery. Erikson's (1976) classic study of the 1972 Buffalo Creek flood in West Virginia argued that the destruction of community and the dispersal of survivors demonstrated a severe myopia in immediate disaster response, a myopia that persists to this day. Aid was delivered to individuals, but the flood destroyed deep-rooted communities, and without the community, the residents of Buffalo Creek could not be made whole again. This emphasis on community has been a through line of sociological research on the consequences of disasters—including studies which demonstrate that social capital and strong community ties can prevent deaths (Klinenberg 2002) or facilitate recovery (Wooten 2012, Aldrich & Meyer 2015, VanLandingham 2017).

However, what happens to affected communities after a disaster—in terms of the built environment, infrastructure, demographic composition, or ecosystem function—is a different question than what happens to affected individuals and families. Drawing conclusions about individuals using community-level, rather than person-level, data is a type of ecological fallacy (Robinson 1950) that is particularly risky in disaster research because disasters can spur large-scale migration (Hunter et al. 2015, DeWaard et al. 2020) that prevents displaced survivors from being included in data sets on postdisaster communities. Information on how places change following disaster is much more accessible than locating and assessing displaced disaster survivors. Yet, community-level data by themselves cannot answer a critical question that individuals and policy makers face after the destruction of a locality: Is it better to encourage people to move or to help them rebuild in the same spot? As climate change heightens the danger of living on the coast, an urgent question arises about whether managed retreat is the best option or whether people should stay and rebuild in a way that makes them more resilient to future hazards (Siders et al. 2019). The answers to these questions are particularly complicated in the case of indigenous communities for whom place is inextricably linked to identity (Whyte et al. 2016, Norgaard 2019).

A robust literature on the consequences of disasters considers what places look like after a natural disaster. While some scholars compare effects on different nations (Lin 2015), most study within-nation variation. Analyses exist at disparate subnational contexts, including the county level (Fussell et al. 2017), tract level (Pais & Elliott 2008), block group level (Raker 2020), and parcel level (Peacock et al. 2014).

These studies show that natural disasters change the demographic profile of affected places (Logan et al. 2016, Fussell et al. 2017, Raker 2020). After hurricanes, counties experienced reduced population growth, particularly a reduction in the white and young adult populations, with the effects most pronounced in counties with lower poverty rates (Logan et al. 2016). Logan et al. (2016) interpret their findings as support for a postdisaster migration process that motivates advantaged groups to move out and renders socially vulnerable groups stuck in place, which they term “segmented withdrawal.” Others suggest that the effects on communities differ based on the type of disaster; community demographics, namely local socioeconomic level; and temporal span (Fussell et al. 2017, Raker 2020). Seltzer & Nobles (2017) argue that population changes may be further complicated over time by differential fertility among in- and out-migrants. The findings

of demographic studies contradict earlier conclusions that natural disasters led to no changes in the population makeup of communities (Friesema et al. 1979, Wright et al. 1979).

The community-level studies of postdisaster change extend beyond demographics. For example, natural disasters cause changes in various attributes of the built environment. Disasters affect the organizational ecology of communities, and studies document an association between disaster damage and an increase in the local concentration of both for-profit and some types of nonprofit institutions (Smiley et al. 2018). Hazardous events can also accelerate local land development, creating new conditions to develop on previously undeveloped land (Elliott & Clement 2017). This process of redevelopment tends to accelerate inequality within a community. Applying the growth machine thesis to postdisaster recovery, Pais & Elliott (2008) advance a theoretical model that contends that disasters transform places into recovery machines in which progrowth coalitions, business interests, and political actors exploit recovery capital to promote uneven and unequal recovery (see also Gotham & Greenberg 2014).

Disaster-induced changes in the local housing market are consequential given the importance of housing in residents' livelihoods (Comerio 1998). Natural disasters influence the housing stock by disproportionately damaging rental units, older homes, and manufactured houses (Peacock et al. 2014), while also creating conditions for new development of housing units that may increase the total stock (Pais & Elliott 2008). The damage to housing units varies by disaster case. For example, Hurricane Katrina damaged between one-half and two-thirds of housing units in the city of New Orleans (Vigdor 2008, Fussell 2015); Superstorm Sandy caused damage to 13% of residential buildings in New York City's inundation zone (Ortega & Taşpınar 2018); and Hurricane Andrew caused damage to half of the housing units in Dade County (Smith & McCarty 1996). Moreover, differences in insurance coverage moderate the structure of postdisaster housing recovery (Kousky 2019). Economists have shown that homes sell for lower prices in both disaster-prone and postdisaster neighborhoods (Ortega & Taşpınar 2018, Bernstein et al. 2019). For example, in an analysis of properties damaged by Superstorm Sandy, Ortega & Taşpınar (2018) find that home prices fell between 17% and 22%.

Still, disasters can invigorate local economies over the long run, particularly when the disaster harms physical capital rather than people (Akao & Sakamoto 2018). However, the long-term economic consequences for damaged areas depend on the type and severity of the disaster, on how postdisaster investments and decisions are made, and on predisaster conditions (Noy & duPont 2018), with disasters creating poverty traps when damage exceeds the capacity of an area to rebuild (Hallegatte & Dumas 2009).

Curtis & Schneider (2011) show that natural disasters have spillover (or indirect) effects in counties unaffected by disasters because of the migration patterns that connect affected to unaffected places, thus complicating how scholars should draw the boundaries of disaster impacts. This finding suggests that disaster studies should consider changes that occur in adjacent contexts, places where survivors have strong social ties, and contexts of reception (e.g., Asad 2015, Raker & Elliott 2018). Hori et al. (2009) analyze the social—specifically housing, economics, and health—costs of displacement after Hurricanes Katrina and Rita by conducting a rapid response survey, documenting a negative association between displacement and homeownership, pre- and posthurricane income maintenance, and access to health care facilities. They find that these consequences were similar for residents displaced within a county and across counties. Howell & Elliott (2019) analyze the relationship between natural disasters and wealth inequality, using data from the Panel Study of Income Dynamics, and show that damage from natural hazards results in increases in wealth inequality at the county level. This is a welcome step in disaster research that links individual-level data with local data. Future research would benefit from more certainty that

sampled respondents incurred damage from the natural disaster to isolate direct effects from the effect on simply living in a place where a disaster occurred (an indirect effect on wealth).

More studies should also focus on the people who live in these impacted places to ask the fundamental question—what happens to survivors? Abramson et al. (2010) develop a useful multidimensional conceptual framework for individual recovery, the socioecological model of recovery, outlining five key measures: housing stability, economic stability, physical health, mental health, and social role adaptation. Much research is specialized, focusing only on one or two of these dimensions at a time, namely health and socioeconomic outcomes (Lowe & Rhodes 2013, Karbownik & Wray 2019). We review research on some of these individual dimensions below, but we believe that future studies should look at all of the aspects of recovery together.

Although some studies find that postdisaster adverse mental and physical health problems are often comorbid (Bourque et al. 2006, Polusny et al. 2008), much of the literature on disasters and health focuses on mental health alone. A robust body of research suggests that disasters increase the risk of adverse mental health outcomes such as posttraumatic stress disorder (PTSD) (for reviews, see Norris et al. 2002, Goldmann & Galea 2014), although it is important to note that most survivors appear to be resistant to serious adverse effects (Norris et al. 2009). Norris et al. (2002) found evidence of PTSD in 109 (68%) of 160 samples that were included in their review. Socially vulnerable groups, including racial minorities, low-socioeconomic groups, and persons with pre-existing health conditions, are at an increased risk of developing adverse mental health outcomes (Neria et al. 2008). Some findings differ by disaster, with a warning from leading researchers that with respect to hurricanes “each storm has a unique hazard profile and generates a singular trauma signature,” but nevertheless, the increasing severity of Atlantic hurricanes will produce increased mental health problems (Espinel et al. 2019, p. 1165). Evidence on the physical health effects of disasters beyond the events’ immediate aftermath is relatively scant, but evidence from Hurricane Katrina suggests that experiencing a disaster can affect self-rated health (Rhodes et al. 2010), headache and migraine symptoms (Lowe et al. 2014), and problems such as asthma, at least in the first several years following disaster (Arcaya et al. 2014b). Disasters may also affect physical health outcomes, such as BMI, by changing survivors’ neighborhood environments (Arcaya et al. 2014a).

Natural disasters also affect educational performance and attainment through a variety of pathways. Kousky (2016) suggests that disasters affect schooling in three ways: damaging or closing schools themselves, impacting students’ home lives, and causing long-term absence or even dropout. Although natural disasters have adverse impacts on test scores and school attendance in the short term (Cas et al. 2014), the long-term effects on education vary considerably. For example, Hurricane Katrina caused sharp declines in test scores for displaced students in the year following the storm, but in the long term, the same students experienced an improvement in test scores in comparison to nondisplaced students, highlighting the potential role of school context (Sacerdote 2012). Qualitative studies have demonstrated that despite postdisaster changes, schoolchildren are particularly resilient (Fothergill & Peek 2017) and that college students still express real desires to return to school (Deterding 2015).

Recent studies in the economics literature provide insight into individual-level economic recovery using large-scale administrative data (for an assessment of the use of administrative data in the postdisaster context, see Plyer et al. 2010). The bulk of this literature focuses (albeit not exclusively) on Hurricane Katrina. Groen & Polivka (2008) find that Katrina reduced the labor market participation of evacuees by 3.5% and raised the unemployment rate by 6.3%, and that this effect decreased over time. Using individual tax return data, Deryugina et al. (2018) find that in the long term Hurricane Katrina survivors demonstrated strong economic performance compared with similar controls in unaffected cities. Those who evacuated and never returned had higher long-term earnings. Furthermore, Hurricane Katrina had a particularly large effect on

residential location. In a study of post-Katrina Medicare beneficiaries, Deryugina & Molitor (2018) find that moving to a lower-mortality area causally reduced mortality, but it did not reduce health care spending.

THE TEMPORAL DIMENSIONS OF POSTDISASTER CONSEQUENCES

Some research, including several of the studies cited above, has tested the effects of disasters at different time points, providing evidence that short-term trends cannot reliably be extrapolated over the long run. In addition, there is enduring interest in understanding the temporal dimensions of disaster more holistically. Researchers have long conceptualized disasters' consequences as processes that unfold over time rather than as static outcomes (Quarantelli & Dynes 1977). Some of the earliest sociological research on disasters developed the idea that the social change enacted by disasters followed specific patterns (Carr 1932). However, current research has moved away from conceptualizing disaster recovery timelines as comprising discrete stages and instead urges a focus on predisaster conditions for understanding how disaster recovery unfolds over time; explores how disaster effects appear and persist over time; and asks, using high-quality longitudinal data, whether short-term effects can be extrapolated over the long run.

For example, studies emphasize that the state's role in postdisaster change occurs with predisaster government-supported efforts, such as historic giveaways of swamplands, US Army Corps of Engineers' mitigation efforts, and promotion of residential development in floodplains with a federal insurance program (Tierney 2014, Elliott 2018). In demographic terms, neighborhoods that experienced a predisaster decline in population and housing units tend to experience heightened decline postdisaster (Tierney & Oliver-Smith 2012, Peacock et al. 2014). Relatedly, individual-level studies show that predisaster controls are powerful predictors of postdisaster outcomes, highlighting the need for more studies that extend pre- and postdisaster (Paxson et al. 2012).

Studies show that surviving a disaster may heighten the risk of experiencing subsequent stressors or traumas, such as interpersonal relationship, family, and work conflicts, over the short term (Weitzman & Behrman 2016). Population health also suffers in the short term, with first-order immediate impacts on mortality (Kahn 2005, Sharkey 2007, Frankenberg et al. 2011). Mental health problems, such as symptoms of PTSD, typically begin soon after the event but can persist in the long term and co-occur with depression (Fergusson et al. 2014). Other studies have shown that PTSD persists in a nonnegligible proportion of disaster survivors up to 5 to 10 years after the event (Raker et al. 2019). Paxson et al. (2012) show that posttraumatic stress symptoms persisted in approximately one in three of their sample of low-income mothers, and document the various trajectories of mental health after a disaster. Some survivors even exhibit a pattern of delayed onset, meaning that they may not have shown symptoms in the immediate aftermath but developed symptoms later, exacerbated by reminders, exposure to later disasters, or other stressors (Norris et al. 2004).

However, disaster-related symptoms tend to decline, with most longitudinal disaster studies detecting nonlinear effects of disasters on health including delayed-onset symptoms and long-lasting effects for a minority of the population (Wang et al. 2000, Morren et al. 2007). For example, Wang et al. (2000) found that rates of PTSD were higher 9 months versus only 3 months after the earthquake in Northern China. Mental health outcomes are particularly long lasting for children. Shaw et al. (1996) found that even 2 years after Hurricane Andrew, 70% of children had moderate to severe symptoms of PTSD. Maclean et al. (2016) detected an association between experiencing a disaster before 5 years of age and the risk of developing mental health disorders in adults aged 21–65, but they found no effect on the risk of substance abuse problems. Examples of nonlinear change also exist at the community level. For example, return migration and delayed departure confound

a linear understanding of population change (Fussell et al. 2010), especially in considering racial differences in return migration (Groen & Polivka 2008).

Gaining a clear understanding of how the effects of disaster on individuals change over the long run requires high-quality longitudinal disaster studies. A few exceptional panel studies on individuals exist, including the Study of the Tsunami Aftermath and Recovery (STAR), the Resilience in Survivors of Katrina (RISK) study, and the Christchurch Health and Development Study. These studies not only follow people for years after the disaster but also have predisaster measures of physical and mental health, social support, and socioeconomic status. From STAR we have learned a great deal about the demographic consequences at the individual level, including on mental health, housing, fertility, and children's outcomes, particularly in a developing-country context (Gray et al. 2014). The STAR project shows that household composition and kinship ties matter for mortality, that fertility increased in the wake of considerable child mortality, and that children exposed in utero were shorter on average but later caught up to their peers. From the RISK study, we know more about disasters' consequences for urban Americans, particularly vulnerable ones, along axes of education, health, and neighborhood attainment (Arcaya et al. 2014b, Graif 2016, Waters 2016). The RISK study demonstrates that predisaster health functioning is a critical predictor of postdisaster mental health; that residential displacement has contradictory and complex effects over time, including a reduction in neighborhood poverty; and that important measures of physical health decrease. The Christchurch study examined 952 respondents who had been followed since childhood as part of a health survey and who experienced the earthquake at approximately 35 years of age. The authors of this study contrasted the 57% of the sample who experienced the earthquake with the remainder who did not. Two years postdisaster, those exposed had mental disorders such as PTSD, major depression, and anxiety at rates 1.4 times higher than those who were not exposed (Fergusson et al. 2014).

In the socioeconomic recovery research, recent evidence suggests disasters can confer short-run economic risks but potential long-term economic benefits on individuals. In Indonesia, for example, large earthquakes that initially impose economic costs on rural households spur welfare gains among those same affected households within 6–12 years of the disaster, which are attributable, in part, to an influx in recovery aid, investments in infrastructure, and improvements in supply chains (Gignoux & Menéndez 2016). In the United States, postdisaster displacement appears to act as a particularly costly short-term consequence but also as a long-term and intergenerational boon to some socioeconomic outcomes (Nakamura et al. 2016, Deryugina et al. 2018). A study of individual tax returns shows that 8 years postdisaster, those affected by Hurricane Katrina actually earned more than a panel of unaffected controls, with labor income highest for those who left and never returned to New Orleans after the storm (Deryugina et al. 2018). Lower-income younger survivors experienced smaller income gains post-Katrina, but still showed higher earnings in the long run, particularly if they left New Orleans. Surprisingly, Medicaid data demonstrated that those who managed to survive the immediate aftermath of Katrina may have also gained a longevity boost (Deryugina & Molitor 2018). Increases in earnings and life expectancy post-Katrina are largely attributable to postdisaster moves to more advantageous areas. One caution regarding these conclusions is that New Orleans was a city with high poverty and a declining population before the disaster. The benefits of leaving New Orleans may be much higher than leaving a more affluent city.

However, not all individuals are equally well positioned to “bounce forward” after disasters, and the social costs of economic recovery are unclear. Tax records suggest that Hurricane Katrina survivors had lower long-run probabilities of being married, although differences in final models were not statistically significant (Deryugina et al. 2018), and analyses of consumer credit panel data show that Katrina lowered household size by 0.16 adults or 6% on average immediately after the

storm, although the mechanism and welfare effect of having fewer adults in the home are not clear (Bleemer & van der Klaauw 2019). The effect appeared to be driven by “emancipation of nuclear households” or slower rates of joining/forming a multiadult household. “Partner households,” which were defined as exactly two adults, did not decline.

Administrative data sources are not able to determine whether measures such as higher earnings or even longevity indicate global recovery from the storm, in particular because they cannot account for the trade-offs survivors make when moving forward after a disaster. These administrative studies cannot answer important questions, such as: Are people who are living longer because they are in low-mortality areas suffering more because they are cut off from large kin and neighborhood networks of social support? Have they created new ties? Qualitative studies of what Weber & Peek (2012) call the “Katrina diaspora” describe the discrimination many survivors faced in new locations, their longing for home, the loss of their kin and friendship networks, and the psychological burden of being far from home. These qualitative studies follow people in the first few months and years after the disaster, but questions remain about the long-run trade-offs survivors experience.

We are aware of only one study that attempted to test the effects of postdisaster economic recovery on diverse markers of well-being. This study showed that economic adaptation was not associated with people being better off (Yang et al. 2018). In particular, rural Chinese disaster survivors who moved to find work after surviving a disaster did so at a cost to their mental health, with researchers noting that these migrants lacked a sense of belonging in their new places (Yang et al. 2018). However, not all disasters spur significant changes in how households get by. For example, research in the Nicaraguan context after Hurricane Mitch found no persistent effects of the disaster on household income strategies but did show that the disaster dampened economic prospects for survivors across a range of livelihoods (van den Berg 2010). The questions of whether and when disasters act as poverty traps, versus shocks that push people into better economic trajectories than they would have otherwise had, are unsettled.

Long-term studies of places are also needed because as time passes, places respond and adapt to disasters. These adaptations can take multiple forms, from updating and improving infrastructure to implementing disaster mitigation policies. There are several considerations for scholars studying the short- versus long-term consequences of disasters for places. First, there is little agreement in the literature on what constitutes the short term versus the long term. What temporal span delineates long versus short is a decision for analysts. In our read of extant literature, scholars typically operationalize short term as some time period within 1 year of impact and long term as the time period between 1 year and more than 10 years afterward. Second, because of the vast heterogeneity in studies, the findings of some may not be generalizable to others, especially depending on the temporal span, unit of analysis, and context. Third, time should be conceived to incorporate the predisaster period, as change occurring before the disaster tends to be accelerated and as predisaster information at the individual level is important for predicting postdisaster outcomes in both the short and the long term (La Greca et al. 1996).

NATURAL AND SOCIAL RESPONSES TO DISASTERS AS FEEDBACK LOOPS

As climate change increases the frequency and intensity of weather-related disasters, long-run adaptation and change can create feedback loops that make locations more or less vulnerable to future disasters. Although natural disasters have been historically thought of as random occurrences, first as “acts of god” and later as “acts of nature” (Furedi 2007), we now know that environmental degradation, social conditions, and urban policy and planning decisions shape the

likelihood and severity of natural hazards and contribute to the chances that natural hazards will produce natural disasters. A growing body of literature investigates how disasters themselves may act as important sources of greenhouse gas emissions—effectively loading the dice toward more extreme weather events in the future—and as determinants of the political, demographic, economic, social, and built-environment conditions that intersect with natural hazards to produce natural disaster. In addition, the way the government responds to disasters and the programs to help people after a disaster can increase inequality and favor the powerful. We describe three feedback loops by which disasters affect the occurrence and impacts of subsequent disasters in the long run.

First, disasters can contribute to climate change by generating greenhouse gas emissions. Climate change contributes to stronger and more frequent storms, which can destroy forests and other ecosystems that act as carbon sinks. For example, Hurricane Katrina seriously damaged or destroyed an estimated 320 million large trees, which collectively stored 105 teragrams of carbon (Chambers et al. 2007). Put in context, this is the equivalent of between 50% and 140% of all the carbon sequestered by US forest trees on a net annual basis (Chambers et al. 2007). Wildfires have also become larger and more widespread due to climate change (Abatzoglou & Williams 2016), and they directly contribute to carbon dioxide and other greenhouse gas emissions (Sommers et al. 2014). For example, the 2009 Kilmore East fire in Victoria, Australia, is thought to have accounted for 8.3% of Victoria's greenhouse gas emissions that year (Surawski et al. 2016), and wildfires produced an estimated 15% of California's total carbon dioxide emissions in 2018 (US Dep. Inter. 2018). Even disasters that do not directly emit greenhouse gases can indirectly contribute to emissions by increasing demand for electricity, for example, when air-conditioning use spikes during heat waves (Miller et al. 2008). Greenhouse gases emitted directly by, or generated in order to cope with, climate-related hazards represent a positive feedback loop whereby present-day disasters could make future disasters more likely. Also at work are local processes by which greenhouse gas-emitting disasters make future climate-related disasters more likely by degrading ecosystems; wildfires, for example, threaten local water supplies through erosion and sedimentation (Sankey et al. 2017). Natural hazard regulation, a service provided by healthy ecosystems (Malinga et al. 2015), can also be jeopardized by disasters that have no direct greenhouse house emissions, such as earthquakes and tsunamis (Barbier 2006, Wang et al. 2012).

Second, disasters can change the probability of urban development and value of real estate in affected areas, with far-reaching implications for the future losses that would be incurred were the same areas hit by natural hazards again. Researchers have investigated both positive and negative feedback mechanisms by which disasters, and floods in particular, affect development in environmentally sensitive areas. On one hand, flooding may actually encourage real estate investments in flood-prone areas as developers take advantage of depressed land costs postdisaster with confidence that they can develop and resell that property at a price that does not accurately reflect future flood risk, thanks in part to the National Flood Insurance Program (Holway & Burby 1990, Bagstad et al. 2007). The National Flood Insurance Program has historically contributed to reinvestment in damage-prone areas after disasters by obscuring the true financial risks associated with insuring properties in flood zones. The program has provided what amounts to an average of more than \$1 million in subsidies per resident of Louisiana's Grand Isle, for example, even though this barrier island has been hit by more than 60 major storms in the past 150 years (Bagstad et al. 2007; see <https://www.nhc.noaa.gov>). However, real estate market dynamics can also act to limit reinvestment in disaster-prone areas as the public is reminded of the environmental risks associated with flood zones. Superstorm Sandy was responsible for an 8% price penalty for undamaged properties in Sandy flood zones, for example, although other similar postdisaster penalties have been short-lived, lasting no more than 5 years before disappearing (Ortega & Taşpınar 2018).

Postdisaster climate adaptation efforts can also change the value of real estate, in the case of either home buyback programs or changes to building codes. These and other postdisaster planning decisions have led some scholars to observe that disaster recovery and retreat are the processes by which the United States has been adapting to climate change (Olshansky 2018, Siders et al. 2019). To the extent that postdisaster recovery policy is climate adaptation policy, understanding the real estate dynamics of postdisaster contexts will be crucial.

Third, disasters can help entrench the political and economic regimes in which they take place, reproducing inequalities inherent in those systems and affecting future vulnerability to natural hazards. Politically, disasters focus voters' attention on the performance of elected officials in the immediate aftermath of the events, biasing government spending toward postdisaster relief and against less politically visible preparation efforts. In fact, disaster aid spending gives incumbent parties an electoral reward; disaster preparedness spending confers no such political advantage, despite the fact that disaster preparedness more than pays for itself in avoided costs (Healy & Malhotra 2009, Bechtel & Hainmueller 2011). Electorally competitive states are more likely to receive disaster declarations, making them eligible for aid, even after accounting for disaster damage (Reeves 2011). One study of this phenomenon suggests that half of all US disaster relief may be allocated on the basis of political considerations rather than true need (Garrett & Sobel 2003). A system under which voters reward elected officials for disaster relief but not preparedness, and elected officials disproportionately allocate aid in order to seek these electoral rewards, prevents rational investments to prepare disaster-prone areas to face future hazards. Disasters not only represent moments that trigger large infusions of relief and recovery funding from public sources but also create opportunities for private-sector actors to invest in and profit from disaster-stricken areas (Pais & Elliott 2008).

As such, disaster response both is shaped by and helps to reinforce dominant economic and political systems. Market-oriented recovery efforts in response to Hurricane Katrina, for example, in the form of the Gulf Opportunity (GO) Zone Act and the Road Home Program, have been critiqued as large-scale, inefficient transfers of public funds to private corporations that sidelined fair housing and other social equity objectives (Adams 2012; Gotham 2014a, 2016; Gotham & Greenberg 2014). After Hurricane Katrina alone, the GO Zone Act allocated approximately \$23 billion in bonds, tax exemptions, and tax credits in the Gulf Coast region (Gotham 2014b). GO Zone bonds disproportionately benefited large corporations and lightly damaged areas. Petrochemical and environmental technology projects received the largest GO Zone bond investments, and more than 80% went to areas that suffered less than 10% losses of housing stock (Gotham 2014a, 2015), for example. The implementation of the Road Home Program post-Katrina also operated in a racially discriminatory manner by violating the Fair Housing Act and in a class-discriminatory manner by violating income rules associated with Community Development Block Grant spending (Gotham 2014a). As disasters have increased in severity, the federal government has been providing a great deal of funding through disaster relief grants and insurance payouts through the National Flood Insurance Program. Funds to disaster survivors are therefore now a very large government transfer, although the bulk of funds goes to local governments in the form of public assistance (Howell & Elliott 2019). Still, because most disaster funds are available only in states and counties after a federal disaster declaration, the amount of aid from grant programs to individuals can rival that of other government programs, such as TANF (Temporary Assistance for Needy Families, or welfare). For example, the budget for TANF in Louisiana in the fiscal year before Hurricane Katrina was \$117 million (State of Louisiana 2004), which pales in comparison to the more than \$1 billion distributed to households from FEMA's Individuals and Households Program (GAO 2014). Howell & Elliott (2019) have found that since 2000, nearly all counties in the United States had some damage that qualified for FEMA aid. In

counties that received more FEMA aid, wealth inequality increased at a steeper rate, in contrast to counties with similar levels of damage but less FEMA aid. As climate change causes greater damage across the United States, the amount paid by the government to victims will rise, and since it is allocated unequally on the basis of property values and previous wealth, it will increase inequality.

As these examples show, disasters give those in power new tools, discretion, and resources to implement recovery processes that benefit existing systems, exacerbating inequalities inherent in those systems. It should come as no surprise, therefore, that inequitable and privatized disaster responses may thereby leave some areas and populations more vulnerable to future disasters.

SUMMARY

We have reviewed the aftermath of disasters and trajectories of recovery in terms of three themes: (a) the differences between recovery of places and of people, (b) the need to differentiate between short- and long-term recovery trajectories, and (c) the changing role of government and how it has exacerbated inequality in recovery and created feedback loops that create greater vulnerability. In terms of the first theme, sociologists' concern with community and the problems of following individuals over time has resulted in a large number of studies of the recovery of places—cities, communities, and neighborhoods. These studies have stressed the role of community cohesion, social capital, and economic investment in helping places bounce back or setting them on a path to decline. Social scientists have concluded that disasters remake places but also provide a window of opportunity for powerful interests to shape disaster recovery processes to their benefit, increasing social and racial inequalities.

We caution against conflating the recovery of places with the recovery of the people who had lived in those places at the time of the disaster. Disasters cause migration, and while it is difficult to study, it is necessary to know how individual people recover from disaster. Increasingly available administrative data have allowed some studies to follow people over time, even when they have moved. Longitudinal cohort studies that follow people out of the area have also contributed to insights into individual-level recovery. Going forward, administrative data such as health care claims, tax returns, credit reports, and the like will produce knowledge not only about places but also about people who experienced disasters.

The second theme reviewed above is the need to differentiate between short- and long-term recovery. We argue that social scientists should not extrapolate from the short to the long term. It is tempting to do so because there is more research on short-term outcomes. Sparse literature around long-run postdisaster outcomes, especially at the individual level, prevents us from drawing strong substantive conclusions about how people recover after the immediate aftermath of disasters. However, the few long-term longitudinal studies that have been conducted suggest that recovery is not linear at either the individual or the community level. Longitudinal outcomes are not pegged to the condition of people or places in the short term.

Similarly, we caution scholars against viewing mental health outcomes as a global proxy for postdisaster recovery, despite the fact that most disaster studies focus on mental health and most analysts therefore tend to think of it as the primary indicator. Postdisaster mental health is important, and it is correlated with other outcomes, but crucially it is not wholly determinative. There is a slippage in the literature because of the focus on short-term outcomes and mental health outcomes such that we tend to think of mental health as the major consequence of a disaster.

In addition, studies of mental health would benefit from more of a sociological perspective. Almost all research on the effects of disasters over time is based on individuals, abstracted from their communities. Sociologists should address these trajectories of mental health by integrating

community-, governmental-, and societal-level analyses. Do PTSD and other mental health conditions appear more among those who are isolated or those who are relocated with other survivors? Does the government response in the first few weeks of disaster recovery make a difference in shortening or reducing mental and physical health consequences? How do culture and subjective understandings of the meaning of the disaster and the sense of societal response affect health over the life course following disaster? Since sociologists have argued that community is important in recovery, is there any evidence of reduced harm among people who are able to relocate together with extended family and neighbors, or does that add to the burden people feel as they put their lives back together? Future research on psychological health trajectories should include measures of social networks and community embeddedness.

Finally, the role of government aid and programs that shape recovery from disaster has begun to be studied, but we still have much to learn. The privatization of emergency assistance, the skewed availability of aid to businesses and local governments rather than to individuals, and the unequal distribution of aid that does go to people (providing more aid to property owners, for instance) create greater inequality across individuals and places. The system of public and private insurance, government emergency loans, and aid can not only increase inequality and reward the powerful but also sow the seeds of the next disaster by undermining community resilience, distorting real estate development costs, and even contributing to further climate change.

CLIMATE CHANGE AND QUESTIONS FOR THE FUTURE OF DISASTER STUDIES

Earlier *Annual Review of Sociology* articles on disaster research were concerned with defining the subfield, its terminology, and its scope of study (Quarantelli & Dynes 1977, Kreps 1984). In the most recent review, Tierney (2007) summarized her advice for the field in her title, “From the Margins to the Mainstream? Disaster Research at the Crossroads.” She argued that the subfield had become isolated from mainstream sociology and should focus on more of the core areas of sociological research, such as social inequality and social change. In our view, the field of disaster studies has evolved in the ways Tierney had advised, addressing much more fundamental sociological questions about the contributions of disasters and their aftermath to social stratification, social change, and social inequality.

Disasters pose strong methodological challenges, and as disasters become more frequent and more severe, they will affect all the areas that sociologists study. Life-course researchers will need to study disasters as turning points. Political sociologists and social movements scholars will need to incorporate disasters into their understandings of political life and social movements. Urban and rural sociologists will need to study how places change and adjust to disasters over time. Sociologists who study human–animal interaction have already taken up the question of disasters, not only with respect to pets and companion animals but also with regard to livestock and farm animals (Irvine 2009). All of the different subareas of sociology will find their research affected by climate change and disasters and their aftermath, and the divisions between disaster researchers and others will be lessened.

From this position of greater strength and connectedness, we advocate for the field an interdisciplinary perspective, since disasters are inherently interdisciplinary in their origins and their effects. In the studies reviewed above, economists tend to look at average effects, and sociologists are much more attuned to inequalities in race, class, and gender. Psychologists study individual trajectories, and sociologists and anthropologists study impacts on communities and localities. These disciplinary silos prevent researchers from understanding interactions across units of analysis and across domains of social life (for more detail and insightful reviews from other disciplines,

we direct readers to Barrios 2017 for anthropology, Kellenberg & Mobarak 2011 and Botzen et al. 2019 for economics, and Goldmann & Galea 2014 for epidemiology). We believe there is a strong need for a sociological perspective alongside these other social science disciplines. We also believe that climate change will fundamentally affect all human societies in ways we have only begun to measure and can only imagine in scope. This unfolding global change will bring more disasters that social scientists will need to study, in turn producing findings that will help guide climate adaptation efforts.

Under conditions of climate change, in which disasters become more intense and more frequent, sociologists should adapt current conceptual categories of vulnerability and resilience and perhaps revisit the concept of catastrophe. In essence, climate change necessitates a whole new way of thinking about what constitutes a hazard and what constitutes vulnerability to hazards. How do we conceptualize and operationalize a hazard when it becomes a frequent occurrence or part of the life course? Who becomes vulnerable under these conditions? Currently our society does not consider as a disaster the 40,000 people dead in car accidents each year, because that is the norm. Heat waves, with their excess deaths, have been considered disasters. Will the bar be lowered going forward? As average and extreme temperatures rise, will we accept a certain number of heat-related deaths as inevitable as we do for car accidents and gun violence?

One area ripe for sociological inquiry is the mental models that people bring to the topic of disasters and how they develop, change, and affect behaviors. This area is developing rapidly as social scientists study decision making with respect to risk (for a good introduction to the field, see Morgan et al. 2001). As the disasters increase in severity and frequency, will this change the way people experience or prepare for disasters? We know it is different to lose your house in a fire than to have your entire town destroyed in a wildfire. Will floods and fires be experienced differently when they are much more commonplace?

Decades of research on disasters have shown that the models people have in their heads about what happens during a disaster are often wrong. One of the most destructive misconceptions is the myth that people act selfishly and lawlessly in the aftermath of disaster. As Clarke & Chess (2008) argue, the erroneous assumption on the part of policy makers and emergency planners that panic and violence will result from disaster pervades the planning of elites and their behaviors during disasters. When elites act in this way, they may create a self-fulfilling prophecy in which society does begin to break down.

Finally, do we need another term, perhaps catastrophe, as a way of conceptualizing megadisasters as climate change changes the scale of what humans experience? Quarantelli (2000) differentiated between a disaster and a catastrophe. He defined a catastrophe as much larger than a disaster, with much longer recoveries requiring more resources. Tierney (2019) identifies the 2004 Indian Ocean tsunami; Hurricane Katrina in 2005; the Haitian earthquake of 2010; and the Japanese earthquake, tsunami, and nuclear meltdown of 2011 as examples of catastrophes. She states that the United States has experienced only four true catastrophes in its history: the 1900 Galveston hurricane, the 1906 San Francisco earthquake, the Great Mississippi Flood of 1927, and Katrina (Tierney 2019, p. 5). Undoubtedly, some scholars would include other events, and there seems to be no established cut point between a big disaster and a catastrophe. Future research should take the scale and impact of disasters into account and develop the new terms and models we will need for the new reality we are facing in an era of climate change.

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LITERATURE CITED

- Abatzoglou JT, Williams AP. 2016. Impact of anthropogenic climate change on wildfire across western US forests. *PNAS* 113(42):11770–75
- Abramson DM, Stehling-Ariza T, Park YS, Walsh L, Culp D. 2010. Measuring individual disaster recovery: a socioecological framework. *Disaster Med. Public Health Prep.* 4(Suppl. 1):S46–54
- Adams V. 2012. The other road to serfdom: recovery by the market and the affect economy in New Orleans. *Public Cult.* 24(1):185–216
- Adger WN. 2000. Social and ecological resilience: Are they related? *Prog. Hum. Geogr.* 24(3):347–64
- Akao K-I, Sakamoto H. 2018. A theory of disasters and long-run growth. *J. Econ. Dyn. Control* 95:89–109
- Aldrich DP, Meyer MA. 2015. Social capital and community resilience. *Am. Behav. Sci.* 59(2):254–69
- Arcaya MC, James P, Rhodes JE, Waters MC, Subramanian SV. 2014a. Urban sprawl and body mass index among displaced Hurricane Katrina survivors. *Prev. Med.* 65:40–46
- Arcaya MC, Lowe SR, Rhodes JE, Waters MC, Subramanian SV. 2014b. Association of PTSD symptoms with asthma attacks among Hurricane Katrina survivors. *J. Trauma Stress* 27(6):725–29
- Asad AL. 2015. Contexts of reception, post-disaster migration, and socioeconomic mobility. *Popul. Environ.* 36(3):279–310
- Bagstad KJ, Stapleton K, D’Agostino JR. 2007. Taxes, subsidies, and insurance as drivers of United States coastal development. *Ecol. Econ.* 63(2):285–98
- Barbier EB. 2006. Natural barriers to natural disasters: replanting mangroves after the tsunami. *Front. Ecol. Environ.* 4(3):124–31
- Barrios RE. 2017. What does catastrophe reveal for whom? The anthropology of crises and disasters at the onset of the Anthropocene. *Annu. Rev. Anthropol.* 46:151–66
- Bechtel MM, Hainmueller J. 2011. How lasting is voter gratitude? An analysis of the short- and long-term electoral returns to beneficial policy. *Am. J. Political Sci.* 55(4):852–68
- Beck U. 1992. *Risk Society: Towards a New Modernity*. London: Sage
- Bernstein A, Gustafson MT, Lewis R. 2019. Disaster on the horizon: the price effect of sea level rise. *J. Financ. Econ.* 134(2):253–72
- Blaikie P, Cannon T, Davis I, Wisner B. 2005. *At Risk: Natural Hazards, People’s Vulnerability and Disasters*. New York: Routledge
- Bleemer Z, van der Klaauw W. 2019. Long-run net distributionary effects of federal disaster insurance: the case of Hurricane Katrina. *J. Urban Econ.* 110:70–88
- Bolin B. 2007. Race, class, ethnicity, and disaster vulnerability. In *Handbook of Disaster Research*, ed. H Rodríguez, EL Quarantelli, RR Dynes, pp. 113–29. New York: Springer
- Botzen WJW, Deschenes O, Sanders M. 2019. The economic impacts of natural disasters: a review of models and empirical studies. *Rev. Environ. Econ. Policy* 13(2):167–88
- Bourque LB, Siegel JM, Kano M, Wood MM. 2006. Weathering the storm: the impact of hurricanes on physical and mental health. *Ann. Am. Acad. Political Soc. Sci.* 604(1):129–51
- Carr LJ. 1932. Disaster and the sequence-pattern concept of social change. *Am. J. Sociol.* 38(2):207–18
- Cas AG, Frankenberg E, Suriastini W, Thomas D. 2014. The impact of parental death on child well-being: evidence from the Indian Ocean tsunami. *Demography* 51(2):437–57
- Chambers JQ, Fisher JI, Zeng H, Chapman EL, Baker DB, Hurtt GC. 2007. Hurricane Katrina’s carbon footprint on U.S. Gulf Coast forests. *Science* 318(5853):1107
- Clarke L, Chess C. 2008. Elites and panic: more to fear than fear itself. *Soc. Forces* 87(2):993–1014

- Comerio MC. 1998. *Disaster Hits Home: New Policy for Urban Housing Recovery*. Berkeley: Univ. Calif. Press
- Curtis KJ, Schneider A. 2011. Understanding the demographic implications of climate change: estimates of localized population predictions under future scenarios of sea-level rise. *Popul. Environ.* 33(1):28–54
- Cutter SL, Mitchell JT, Scott MS. 2000. Revealing the vulnerability of people and places: a case study of Georgetown County, South Carolina. *Ann. Assoc. Am. Geogr.* 90(4):713–37
- Deryugina T, Kawano L, Levitt S. 2018. The economic impact of Hurricane Katrina on its victims: evidence from individual tax returns. *Am. Econ. J. Appl. Econ.* 10(2):202–33
- Deryugina T, Molitor D. 2018. *Does when you die depend on where you live? Evidence from Hurricane Katrina*. NBER Work. Pap. 24822
- Deterding NM. 2015. Instrumental and expressive education: college planning in the face of poverty. *Sociol. Educ.* 88(4):284–301
- DeWaard J, Johnson JE, Whitaker SD. 2020. Out-migration from and return migration to Puerto Rico after Hurricane Maria: evidence from the consumer credit panel. *Popul. Environ.* <https://doi.org/10.1007/s11111-020-00339-5>
- Donner W, Rodriguez H. 2008. Population composition, migration and inequality: the influence of demographic changes on disaster risk and vulnerability. *Soc. Forces* 87(2):1089–114
- Elliott JR, Clement MT. 2017. Natural hazards and local development: the successive nature of landscape transformation in the United States. *Soc. Forces* 96(2):851–76
- Elliott R. 2018. The sociology of climate change as a sociology of loss. *Eur. J. Sociol./Arch. Eur. Sociol.* 59(3):301–37
- Enarson E. 2012. *Women Confronting Natural Disaster: From Vulnerability to Resilience*. Boulder, CO: Lynne Rienner
- Erikson KT. 1976. *Everything in Its Path: Destruction of Community in the Buffalo Creek Flood*. New York: Simon & Schuster
- Espinell Z, Kossin JP, Galea S, Richardson AS, Shultz JM. 2019. Forecast: increasing mental health consequences from Atlantic hurricanes throughout the 21st century. *Psychiatry Online* 70(12):1165–67
- Fergusson DM, Horwood LJ, Boden JM, Mulder RT. 2014. Impact of a major disaster on the mental health of a well-studied cohort. *JAMA Psychiatry* 71(9):1025–31
- Fothergill A, Peek L. 2015. *Children of Katrina*. Austin: Univ. Tex. Press
- Fothergill A, Peek L. 2017. Kids, creativity, and Katrina. *Contexts* 16(2):65–67
- Frankenberg E, Gillespie T, Preston S, Sikoki B, Thomas D. 2011. Mortality, the family and the Indian Ocean tsunami. *Econ. J.* 121(554):F162–82
- Friesema HP, Caporaso J, Goldstein G, Linbery R, McCleary R. 1979. *Aftermath: Communities After Natural Disasters*. Beverly Hills, CA: Sage
- Furedi F. 2007. The changing meaning of disaster. *Area* 39(4):482–89
- Fussell E. 2015. The long-term recovery of New Orleans' population after Hurricane Katrina. *Am. Behav. Sci.* 59(10):1231–45
- Fussell E, Curran SR, Dunbar MD, Babb MA, Thompson L, Meijer-Irons J. 2017. Weather-related hazards and population change: a study of hurricanes and tropical storms in the United States, 1980–2012. *Ann. Am. Acad. Political Soc. Sci.* 669(1):146–67
- Fussell E, Sastry N, VanLandingham M. 2010. Race, socioeconomic status, and return migration to New Orleans after Hurricane Katrina. *Popul. Environ.* 31(1–3):20–42
- GAO (Gov. Account. Off.). 2014. *Hurricane Sandy: FEMA has improved disaster aid verification but could act to further limit improper assistance*. Rep. 15–15, GAO, Washington, DC
- Garrett TA, Sobel RS. 2003. The political economy of FEMA disaster payments. *Econ. Inq.* 41(3):496–509
- Gignoux J, Menéndez M. 2016. Benefit in the wake of disaster: long-run effects of earthquakes on welfare in rural Indonesia. *J. Dev. Econ.* 118:26–44
- Goldmann E, Galea S. 2014. Mental health consequences of disasters. *Annu. Rev. Public Health* 35:169–83
- Gotham KF. 2014a. Reinforcing inequalities: the impact of the CDBG program on post-Katrina rebuilding. *Hous. Policy Debate* 24(1):192–212
- Gotham KF. 2014b. Mechanisms of mutation: policy mobilities and the Gulf Opportunity (GO) Zone. *Urban Geogr.* 35(8):1171–95

- Gotham KF. 2015. Limitations, legacies, and lessons: post-Katrina rebuilding in retrospect and prospect. *Am. Behav. Sci.* 59(10):1314–26
- Gotham KF. 2016. Re-anchoring capital in disaster-devastated spaces: financialisation and the Gulf Opportunity (GO) Zone programme. *Urban Stud.* 53(7):1362–83
- Gotham KF, Greenberg M. 2014. *Crisis Cities: Disaster and Redevelopment in New York and New Orleans*. Oxford, UK: Oxford Univ. Press
- Graif C. 2016. (Un)natural disaster: vulnerability, long-distance displacement, and the extended geography of neighborhood distress and attainment after Katrina. *Popul. Environ.* 37(3):288–318
- Gray C, Frankenberg E, Gillespie T, Sumantri C, Thomas D. 2014. Studying displacement after a disaster using large scale survey methods: Sumatra after the 2004 tsunami. *Ann. Assoc. Am. Geogr.* 104(3):594–612
- Groen JA, Polivka AE. 2008. The effect of Hurricane Katrina on the labor market outcomes of evacuees. *Am. Econ. Rev.* 98(2):43–48
- Hallegatte S, Dumas P. 2009. Can natural disasters have positive consequences? Investigating the role of embodied technical change. *Ecol. Econ.* 68(3):777–86
- Healy A, Malhotra N. 2009. Myopic voters and natural disaster policy. *Am. Political Sci. Rev.* 103(3):387–406
- Hoffman JS, Shandas V, Pendleton N. 2020. The effects of historical housing policies on resident exposure to intra-urban heat: a study of 108 US urban areas. *Climate* 8(1):12
- Holway JM, Burby RJ. 1990. The effects of floodplain development controls on residential land values. *Land Econ.* 66(3):259–71
- Hori M, Schafer MJ, Bowman DJ. 2009. Displacement dynamics in southern Louisiana after Hurricanes Katrina and Rita. *Popul. Res. Policy Rev.* 28(1):45–65
- Howell J, Elliott JR. 2019. Damages done: the longitudinal impacts of natural hazards on wealth inequality in the United States. *Soc. Probl.* 66(3):448–67
- Hunter LM, Luna JK, Norton RM. 2015. The environmental dimensions of migration. *Annu. Rev. Sociol.* 41:377–97
- IPCC (Intergov. Panel Clim. Change). 2012. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, ed. CB Field, V Barros, TF Stocker, D Qin, DJ Dokken, et al. Cambridge, UK: Cambridge Univ. Press
- IPCC (Intergov. Panel Clim. Change). 2018. *Global Warming of 1.5°C*. Geneva: IPCC
- Irvine L. 2009. *Filling the Ark*. Philadelphia: Temple Univ. Press
- Kahn ME. 2005. The death toll from natural disasters: the role of income, geography, and institutions. *Rev. Econ. Stat.* 87(2):271–84
- Karbownik K, Wray A. 2019. Long-run consequences of exposure to natural disasters. *J. Labor Econ.* 37(3):949–1007
- Kellenberg D, Mobarak AM. 2011. The economics of natural disasters. *Annu. Rev. Resour. Econ.* 3:297–312
- Kirk DS. 2009. A natural experiment on residential change and recidivism: lessons from Hurricane Katrina. *Am. Sociol. Rev.* 74(3):484–505
- Kirk DS. 2020. *Home Free: Prisoner Reentry and Residential Change After Katrina*. Oxford, UK: Oxford Univ. Press
- Klinenberg E. 2002. *Heat Wave: A Social Autopsy of Disaster in Chicago*. Chicago: Univ. Chicago Press
- Kousky C. 2016. Impacts of natural disasters on children. *Future Child.* 26(1):73–92
- Kousky C. 2019. The role of natural disaster insurance in recovery and risk reduction. *Annu. Rev. Resour. Econ.* 11:399–418
- Kreps GA. 1984. Sociological inquiry and disaster research. *Annu. Rev. Sociol.* 10:309–30
- La Greca A, Silverman WK, Vernberg EM, Prinstein MJ. 1996. Symptoms of posttraumatic stress in children after Hurricane Andrew: a prospective study. *J. Consult. Clin. Psychol.* 64(4):712–23
- Lin T-H. 2015. Governing natural disasters: state capacity, democracy, and human vulnerability. *Soc. Forces* 93(3):1267–300
- Logan JR, Issar S, Xu Z. 2016. Trapped in place? Segmented resilience to hurricanes in the Gulf Coast, 1970–2005. *Demography* 53(5):1511–34
- Lowe SR, Rhodes JE. 2013. Trajectories of psychological distress among low-income, female survivors of Hurricane Katrina. *Am. J. Orthopsychiatry* 83(2):398–412

- Lowe SR, Willis M, Rhodes JE. 2014. Health problems among low-income parents in the aftermath of Hurricane Katrina. *Health Psychol.* 33(8):774–82
- Maclean JC, Popovici I, French MT. 2016. Are natural disasters in early childhood associated with mental health and substance use disorders as an adult? *Soc. Sci. Med.* 151:78–91
- Malinga R, Gordon LJ, Jewitt G, Lindborg R. 2015. Mapping ecosystem services across scales and continents—a review. *Ecosyst. Serv.* 13:57–63
- Manyena B, Machingura F, O’Keefe P. 2019. Disaster Resilience Integrated Framework for Transformation (DRIFT): a new approach to theorising and operationalising resilience. *World Dev.* 123:104587
- McLaughlin P, Dietz T. 2008. Structure, agency and environment: toward an integrated perspective on vulnerability. *Glob. Environ. Change* 18(1):99–111
- Miller NL, Hayhoe K, Jin J, Auffhammer M. 2008. Climate, extreme heat, and electricity demand in California. *J. Appl. Meteor. Climatol.* 47(6):1834–44
- Mitchell B, Franco J. 2018. *HOLC “redlining” maps: the persistent structure of segregation and economic inequality*. Exec. Summ., Natl. Community Reinvest. Coalit., Washington, DC
- Morgan MG, Fischhoff B, Bostrom A, Atman CJ. 2001. *Risk Communication: A Mental Models Approach*. Cambridge, UK: Cambridge Univ. Press
- Morren M, Dirkzwager AJE, Kessels FJM, Yzermans CJ. 2007. The influence of a disaster on the health of rescue workers: a longitudinal study. *Can. Med. Assoc. J.* 176(9):1279–83
- Nakamura E, Sigurdsson J, Steinsson J. 2016. *The gift of moving: intergenerational consequences of a mobility shock*. NBER Work. Pap. 22392
- Neria Y, Nandi A, Galea S. 2008. Post-traumatic stress disorder following disasters: a systematic review. *Psychol. Med.* 38(4):467–80
- Norgaard KM. 2019. *Salmon and Acorns Feed Our People: Colonialism, Nature, and Social Action*. New Brunswick, NJ: Rutgers Univ. Press
- Norris FH, Friedman MJ, Watson PJ, Byrne CM, Diaz E, Kaniasty K. 2002. 60,000 disaster victims speak. Part I. An empirical review of the empirical literature, 1981–2001. *Psychiatry* 65(3):207–39
- Norris FH, Murphy AD, Baker CK, Perilla JL. 2004. Postdisaster PTSD over four waves of a panel study of Mexico’s 1999 flood. *J. Trauma Stress* 17(4):283–92
- Norris FH, Tracy M, Galea S. 2009. Looking for resilience: understanding the longitudinal trajectories of responses to stress. *Soc. Sci. Med.* 68(12):2190–98
- Noy I, duPont W IV. 2018. The long-term consequences of disasters: what do we know, and what we still don’t. *Int. Rev. Environ. Resour. Econ.* 12(4):325–54
- Olshansky RB. 2018. Recovery after disasters: how adaptation to climate change will occur. In *Climate Change and Its Impacts: Risks and Inequalities*, ed. C Murphy, P Gardoni, R McKim, pp. 195–207. Cham, Switz.: Springer
- Olsson L, Jerneck A, Thoren H, Persson J, O’Byrne D. 2015. Why resilience is unappealing to social science: theoretical and empirical investigations of the scientific use of resilience. *Sci. Adv.* 1(4):e1400217
- Ortega F, Taşpınar S. 2018. Rising sea levels and sinking property values: Hurricane Sandy and New York’s housing market. *J. Urban Econ.* 106:81–100
- Pais JF, Elliott JR. 2008. Places as recovery machines: vulnerability and neighborhood change after major hurricanes. *Soc. Forces* 86(4):1415–53
- Paxson C, Fussell E, Rhodes J, Waters M. 2012. Five years later: recovery from post traumatic stress and psychological distress among low-income mothers affected by Hurricane Katrina. *Soc. Sci. Med.* 74(2):150–57
- Peacock WG, Morrow B, Gladwin H. 1997. *Hurricane Andrew: Ethnicity, Gender and the Sociology of Disasters*. London: Routledge
- Peacock WG, Zandt SV, Zhang Y, Highfield WE. 2014. Inequities in long-term housing recovery after disasters. *J. Am. Plan. Assoc.* 80(4):356–71
- Picou JS. 2009. Katrina as a natech disaster: toxic contamination and long-term risks for residents of New Orleans. *J. Appl. Soc. Sci.* 3(2):39–55
- Plyer A, Bonaguro J, Hodges K. 2010. Using administrative data to estimate population displacement and resettlement following a catastrophic U.S. disaster. *Popul. Environ.* 31(1):150–75

- Polusny MA, Ries BJ, Schultz JR, Calhoun P, Clemensen L, Johnsen IR. 2008. PTSD symptom clusters associated with physical health and health care utilization in rural primary care patients exposed to natural disaster. *J. Trauma Stress* 21(1):75–82
- Quarantelli EL. 2000. *Emergencies, disasters and catastrophes are different phenomena*. Prelim. Pap. 304, Disaster Res. Cent., Univ. Del., Newark
- Quarantelli EL, Dynes RR. 1977. Response to social crisis and disaster. *Annu. Rev. Sociol.* 3:23–49
- Raker EJ. 2020. Natural hazards, disasters, and demographic change: the case of severe tornadoes in the United States, 1980–2010. *Demography* 57:653–74
- Raker EJ, Elliott JR. 2018. Attitudes toward mass arrivals: variations by racial, spatial, and temporal distances to incoming disaster evacuees. *Soc. Sci. Q.* 99(3):1200–13
- Raker EJ, Lowe SR, Arcaya MC, Johnson ST, Rhodes J, Waters MC. 2019. Twelve years later: the long-term mental health consequences of Hurricane Katrina. *Soc. Sci. Med.* 242:112610
- Reeves A. 2011. Political disaster: unilateral powers, electoral incentives, and presidential disaster declarations. *J. Politics* 73(4):1142–51
- Rhodes J, Chan C, Paxson C, Rouse CE, Waters M, Fussell E. 2010. The impact of Hurricane Katrina on the mental and physical health of low-income parents in New Orleans. *Am. J. Orthopsychiatry* 80(2):237–47
- Robinson WS. 1950. Ecological correlations and the behavior of individuals. *Am. Sociol. Rev.* 15(3):351–57
- Rosa E, McCright A, Renn O. 2013. *The Risk Society Revisited: Social Theory and Risk Governance*. Philadelphia: Temple Univ. Press
- Rothstein R. 2017. *The Color of Law: A Forgotten History of How Our Government Segregated America*. New York: Liveright
- Sacerdote B. 2012. When the saints go marching out: long-term outcomes for student evacuees from Hurricanes Katrina and Rita. *Am. Econ. J. Appl. Econ.* 4(1):109–35
- Sankey JB, Kreitler J, Hawbaker TJ, McVay JL, Miller ME, et al. 2017. Climate, wildfire, and erosion ensemble foretells more sediment in Western USA watersheds. *Geophys. Res. Lett.* 44(17):8884–92
- Seltzer N, Nobles J. 2017. Post-disaster fertility: Hurricane Katrina and the changing racial composition of New Orleans. *Popul. Environ.* 38:465–90
- Sharkey P. 2007. Survival and death in New Orleans: an empirical look at the human impact of Katrina. *J. Black Stud.* 37(4):482–501
- Shaw JA, Applegate B, Schorr C. 1996. Twenty-one-month follow-up study of school-age children exposed to Hurricane Andrew. *J. Am. Acad. Child Adolesc. Psychiatry* 35(3):359–64
- Siders AR, Hino M, Mach KJ. 2019. The case for strategic and managed climate retreat. *Science* 365(6455):761–63
- Smiley KT, Howell J, Elliott JR. 2018. Disasters, local organizations, and poverty in the USA, 1998 to 2015. *Popul. Environ.* 40(2):115–35
- Smith SK, McCarty C. 1996. Demographic effects of natural disasters: a case study of Hurricane Andrew. *Demography* 33(2):265–75
- Sommers WT, Loehman RA, Hardy CC. 2014. Wildland fire emissions, carbon, and climate: science overview and knowledge needs. *Forest Ecol. Manag.* 317:1–8
- State of Louisiana. 2004. *Overview of the Fiscal Year 2005 Budget*. Baton Rouge: Senate Fisc. Serv.
- Surawski NC, Sullivan AL, Roxburgh SH, Polglase PJ. 2016. Estimates of greenhouse gas and black carbon emissions from a major Australian wildfire with high spatiotemporal resolution. *J. Geophys. Res. Atmos.* 121(16):9892–907
- Tierney KJ. 2007. From the margins to the mainstream? Disaster research at the crossroads. *Annu. Rev. Sociol.* 33:503–25
- Tierney KJ. 2014. *The Social Roots of Risk: Producing Disasters, Promoting Resilience*. Stanford, CA: Stanford Univ. Press
- Tierney KJ. 2019. *Disasters: A Sociological Approach*. New York: Wiley
- Tierney KJ, Oliver-Smith A. 2012. Social dimensions of disaster recovery. *Int. J. Mass Emerg. Disasters* 30(2):24
- Torche F. 2018. Prenatal exposure to an acute stressor and children’s cognitive outcomes. *Demography* 55(5):1611–39

- US Dep. Inter. 2018. *New analysis shows 2018 California wildfires emitted as much carbon dioxide as an entire year's worth of electricity*. Press Release, Novemb. 30
- van den Berg M. 2010. Household income strategies and natural disasters: dynamic livelihoods in rural Nicaragua. *Ecol. Econ.* 69(3):592–602
- VanLandingham MJ. 2017. *Weathering Katrina: Culture and Recovery Among Vietnamese Americans*. New York: Russell Sage Found.
- Vigdor J. 2008. The economic aftermath of Hurricane Katrina. *J. Econ. Perspect.* 22(4):135–54
- Wang X, Gao L, Shinfuku N, Zhang H, Zhao C, Shen Y. 2000. Longitudinal study of earthquake-related PTSD in a randomly selected community sample in north China. *Am. J. Psychiatry* 157(8):1260–66
- Wang YK, Fu B, Xu P. 2012. Evaluation the impact of earthquake on ecosystem services. *Proc. Environ. Sci.* 13:954–66
- Waters MC. 2016. Life after Hurricane Katrina: the Resilience in Survivors of Katrina (RISK) project. *Sociol. Forum* 31(Suppl. 1):750–69
- Weber L, Peek L. 2012. *Displaced: Life in the Katrina Diaspora*. Austin: Univ. Tex. Press
- Weitzman A, Behrman J. 2016. Disaster, disruption to family life, and intimate partner violence: the case of the 2010 earthquake in Haiti. *Sociol. Sci.* 3:167–89
- Whyte KP, Brewer JP, Johnson JT. 2016. Weaving Indigenous science, protocols and sustainability science. *Sustain. Sci.* 11(1):25–32
- Wooten T. 2012. *We Shall Not Be Moved: Rebuilding Home in the Wake of Katrina*. Boston: Beacon
- Wright JD, Rossi PH, Wright SR, Weber-Burdin E. 1979. *After the Clean-Up: Long-Range Effects of Natural Disasters*. Beverly Hills, CA: Sage
- Yang H, Dietz T, Yang W, Zhang J, Liu J. 2018. Changes in human well-being and rural livelihoods under natural disasters. *Ecol. Econ.* 151:184–94