A consideration of research designs for the study of disaster-related displacement and migration

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A growing body of empirical research examines the relationship between environmental disasters and displacement or migration (Hunter, Luna, and Norton 2015). However, it is relatively rare that data are available that combine measures of exposure to a disaster event and subsequent migration. Furthermore, when data does exist, it may not meet scientific standards that are expected to draw strong conclusions about when, where, and for whom a disaster results in displacement or migration. The objective of this paper is to review research designs for establishing a causal relationship between an event and an outcome, and use this as a framework for considering how we evaluate existing research and design future research on disaster-related displacement and migration.

Research design to establish causal relationships

Disaster research is a specialized field of sociology that has provided both practical knowledge for managing disaster response and mitigating hazardous impacts, as well as theoretical insights into social relations during normal and non-normal times (Wisner, Blaikie, Cannon, and Davis 2004). Disaster research frequently involves going into the field soon after a disaster strikes and employing qualitative and quantitative research case study designs based on convenience samples (Philips 2014). This approach is depicted in Panel A of Table 1. A great deal can be learned from this practical approach, and it is often the only approach available given the unpredictable nature of disasters. However, it falls short of what is needed to establish causal relationships (internal validity) and make generalizations about the affected population (external validity). The gold standard for establishing a causal relationship in population research is an experimental design that employs population representative longitudinal data on individuals or households. Panel B of Table 1 characterizes this approach.

The experimental design has four desirable elements. First, it involves pre- and post-disaster measures, ideally with observations at multiple time points after the disaster to measure disaster recovery trajectories. This feature limits the extent to which change in the outcome is affected by factors other than the disaster, especially when time 1 follows soon after the disaster. Second, it includes a measure of disaster exposure, ideally with subjective and objective measures of the extent of exposure. Having variables in exposure measures improves on the simple exposed-unexposed dichotomy by allowing for the possibility of a dose-response effect. Third, a comparison group of unexposed but observationally similar individuals provides a measure of what might have happened in the absence of the disaster. Finally, a population representative sample allows findings to be generalizable to the affected

population and, if the sample is sufficiently large, allows for comparisons between sub-groups in the population (race, ethnicity, age, gender, etc…). Most disaster research lacks one or more of these elements, limiting our ability to make strong inferences about the effects of a disaster on individuals or households, to make generalizations about disaster effects, and to discern differences in disaster effects within the population.

Table 1. Research design in disaster-related research				
	Pre-disaster measure	Disaster exposure	Post-disaster measure	
Assignment	**Time 0**		**Time 1**	**Time 2**
Panel A. Case studies				
Exposed	0	Treatment	X	X
Unexposed	0	0	0	0
Panel B. Experiments				
Exposed	X	Treatment	X	X
Unexposed	X	Control	X	X
Note: X indicates the measure is observed; 0 indicates the measure is missing.				

Until recently, few researchers used experimental approaches to study disaster exposure and migration, but a longer tradition of this research exists in the field of psychology. Fran Norris (2006), a leading expert on disasters and mental health, reviewed the methods used in 225 research publications in her field. She found that cross-sectional, after-only designs, convenience sampling, and small samples were the modal design. Disaster effects on mental health were typically larger in these case study designs than in those employing longitudinal methods or those with larger samples. But even in studies that include controls for baseline mental health or that have greater statistical power and, perhaps, more representative samples, other elements may be lacking, whether it is a nuanced exposure measure or an appropriate control group. The need for more rigorous epidemiological or demographic research on disaster impacts on population is now more widely appreciated (Galea, et al 2008), although still challenging to achieve.

Examples of repurposing existing panel data for disaster research

Disaster research has been advanced by leveraging pre-existing population-based surveys to follow respondents after a disaster. When the Indian Ocean tsunami struck Indonesia, Elizabeth Frankenberg, Cecep Sumantri, and Duncan Thomas (ND) collaborated with Statistics Indonesia to adapt the 2004 wave of a large-scale annual cross-sectional survey conducted by Statistics Indonesia that included the tsunami-affected areas of Aceh and North Sumatra to construct the longitudinal Study of the Tsunami Aftermath and Recovery (STAR). In 2005, when Hurricane Katrina struck the Gulf Coast, two on-going studies in New Orleans were repurposed to examine the long-term recovery of selected populations. Mark VanLandingham's (ND) population representative study of the Vietnamese population of New Orleans became Katrina Impacts on the Vietnamese American Population of New Orleans (KATIVA-NOLA). Mary Waters, Jean Rhodes, Elizabeth Fussell (ND) and others revised a study of a low-income parents enrolled in a New Orleans community college to become the Resilience in Survivors of Katrina (RISK) study. Similarly, the Japan Gerontological Evaluation Study (JAGES), a panel study of the elderly in

Japan that began data collection in 2003, was used to study of disaster recovery after the 2011 tsunami affected one of the study sites (JAGES ND). The design features of these studies are summarized in Table 2.

Studies like these cannot be planned, and when they occur one of the four key elements of the quasi-experimental research design is often missing. For example, STAR, KATIVA-NOLA, and JAGES are representative of known pre-disaster populations because of their original study designs, but RISK is not since the community college students self-selected into school and into the study. Two of these studies have control groups, but two do not. For both STAR and JAGES, the control group was formed by households living in communities that were at risk of being hit by a tsunami but were not hit by the wave in those disasters. In contrast, KATIVA-NOLA and RISK do not have control groups since the hurricane affected everyone in the sampled population. Even though all of these studies include pre-disaster measures of household and individual-level social, economic, and demographic characteristics, some desirable baseline measures may not exist, such as mental or physical health measures that would have been affected by disaster-related trauma. What all the studies have in common is post-disaster measures of a wide range of disaster-related outcomes, as well as retrospective respondent-reported and objective measures of disaster exposure. Even with these shortcomings these studies have provided original scientific about disaster impacts on populations, especially on their health and residential mobility (e.g., Frankenberg et al. 2008; Fussell and Lowe 2014; Gray et al. 2014; Hikichi, et al. 2016; Hikichi et al. 2017; Rhodes et al. 2010; Vu and VanLandingham 2012; Vu et al. 2009)

Table 2. Design elements of longitudinal studies of disaster-affected populations or groups

Study	Population representative	Treatment & control groups	Pre-disaster measures	Disaster exposure measure	Post-disaster measures
STAR	X	X	X	X	X
KATIVA-NOLA	X (ethnic group)		X	X	X
RISK			X	X	X
JAGES	X (elderly)	X	X	X	X

Note: X indicates the design element exists.

Limitations of existing longitudinal data for disaster research

There are many issues to be considered before deciding whether it is feasible to repurpose a longitudinal survey for disaster research, but two are key. The first is whether the number of affected individuals is large enough to support statistical analyses. If the answer to this is affirmative, the next questions have to do with whether the baseline measures are of scientific interest to disaster researchers, such as physical and mental health measures, as well as other aspects of social and economic wellbeing. Other issues are also important, such as whether study participants have agreed to have the data used in this way and whether contextual, environmental, or administrative data can be linked to the survey data to supplement or validate survey measures.

Considering the first question about sample size, it is important to consider the geography of the sampled population. Many studies use two-stage cluster sampling designs intended to efficiently study national populations. Typically, this involves randomly sampling geographically defined areas, known as primary sampling units (PSUs), from different regions of the country, and then randomly sampling

households within those areas, known as secondary sampling units (SSUs). In some PSUs, the SSUs may be densely concentrated or more dispersed. In a few rare cases, geographically defined populations may not use random sampling without clustering and have large sample sizes, allowing for a greater chance that many sample participants would be affected by a disaster. Since disasters vary in scale, it is more likely that the latter will generate a sufficient number of exposed households and individuals to support a statistical analysis.

Two examples illustrate this point. Hurricane Katrina, a large-scale disaster event, affected about 500 families in the Panel Study of Income Dynamics (PSID) sample of 10,000 families (PSID ND). The PSID is a fifty-year long panel study that follows families and split-off families over multiple generations regardless of geography. As the sample matured, it was refreshed to make it representative of the national population, particularly of immigrants. When Hurricane Katrina struck the Gulf Coast, PSID took extra measures to retain the 500 affected families in Mississippi, Louisiana, and Alabama and also administered a supplement focused on mental and behavioral health (Cerdá, Tracy, and Galea 2011). While it was important to retain these sample members, the number of affected individuals and families was too low to support a wide range of analyses and, furthermore, it may not be representative of the affected region.

A much larger national federal survey, the Current Population Survey, run by the Census Bureau on behalf of the Bureau of Labor Statistics, added questions to the survey for the first year after Hurricane Katrina to identify the geographic locations and living conditions of the Katrina-affected population. Jeff Groen and Anne Polivka, BLS employees who had access to this restricted data, published several articles from this data on the labor market outcomes and residential mobility of the Katrina-affected population in the year after the disaster (Groen and Polivka 2008; 2010). A limitation of this data is its restricted nature due to the need to protect respondents' personal information. Since household and individual demographic information combined with geographic identifiers introduced by a specific disaster increases the risk of deductive disclosure of personally identifying information, these papers combined geographic areas into more and less damaged areas. The CPS response to Hurricane Katrina was possible for a large scale event but may not be in the case of smaller scale events that would be more likely to compromise respondents' information.

The next question is whether the baseline data include measures that are susceptible to the effects of a disaster and, therefore, will contribute high priority scientific research. Most disaster research focuses on health outcomes, particularly mental health and to a lesser extent physical and behavioral health. However, there are many other outcomes of interest, including change in housing, employment, earnings and wealth, consumption, school attendance and educational attainment of children, fertility and family change, criminal behavior and recidivism, and spirituality. While it is not possible to study change in a given outcomes without a baseline measure, residential mobility can be studied by adding new measures since the baseline is implicit in the residential composition of the sample household.

Summing up, if a disaster-affected study sample has a sufficient statistical power and valuable baseline measures, then it may be feasible to repurpose an existing survey to study disaster impacts, whether these are mental health, residential mobility, or something else. The next steps involve developing self-reported and objective measures of disaster exposure and loss that are sufficiently nuanced to capture the range of experiences and are specific to the disaster and affected location and identifying whether an unexposed comparison group is available. Finally, but of utmost important, is whether respondents'

consent to participate in the original study allows for this use. This is but a short list of considerations to be made when evaluating whether repurposing an existing study is feasible and likely to produce valuable scientific knowledge.

Aggregating disasters for generalizable conclusions

Another approach to studying disaster impacts on populations is to combine data on multiple disaster events, small or large, with longitudinal data to find the general effects of disasters on specific household or individual outcomes. Some scholars have used data from the Spatial Hazards Events and Losses Database for the US (SHELDUS ND) to relate events and losses from multiple disaster events to the US Census data (Elliott 2015; Fussell, et al 2017; Schultz and Elliott 2013; Pais and Elliott 2008) and the PSID (Elliott and Howell 2017). In Bangladesh, Gray and Mueller (2012a) used a panel study of rural households to study the effects of flooding and non-flooding related crop failure on individual-level migration over a 16 year period. These studies, and others that measure temperature and precipitation instead of disasters (e.g. Gray and Mueller 2012b; Gray and Bilsborrow 2013; Henry et al. 2004), provide more generalizable results since they include a greater variability in the phenomenon of interest, such as the type of hazard, the hazards' destructive potential, and characteristics of exposed built and natural environment and the population. Indeed, these studies come closer to achieving the quasi-experimental design described in Panel B of Table 1.

Discussion

This methodological review of previous research on disasters is an important preliminary exercise for evaluating and/or designing research on disaster-related displacement. Considering the body of research on disasters and human mobility, one conclusion is that there is no consistent relationship between the two phenomena (Hunter et al 2015). While there is a great deal of fear that climate change will produce future waves of "climate migrants" from vulnerable coastlines, the empirical record to date does not support this. It is possible that we have not hit that tipping point yet, at least not in a way that has made this type of migration visible. A more plausible explanation for the lack of consistent findings that is grounded in migration theory and research is that all migration is multi-causal and the environment is but one factor, and often not the most direct factor, driving migration decision-making. Furthermore, any of these factors, labelled by Black et al. (2011) as demographic, economic, environmental, political, and social, may drive households and their members to *stay or leave* their community of origin. Therefore, it may be unrealistic to expect social science to converge around a simple uniform causal relationship between environment and migration.

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