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Examining the shifting role of the human in disaster studies

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ABSTRACT

This review essay considers the development of the field of disaster studies and specifically, examines the myriad ways in which the role of the human has shifted during this development. The essay focuses on four major periods of development within disaster studies, including: the hazard-risk paradigm, the bounded rationality paradigm, the concept of social vulnerability and critiques of social vulnerability.

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Research on natural hazards is becoming increasingly important as these hazards become more common and damaging in the face of climate change (Banholzer et al. 2014). Geography is an important consideration in studying natural hazards given that the role of space is of the utmost importance in understanding the impacts of these disasters when they occur, and time and space are considered the unifying factors within examinations of natural hazards (Alexander 1991). Geographers, and geographical thought, have had significant contributions to the trajectory of disaster studies, especially considering the increasing influence of humans and human society within disaster studies. This paper traces the some of the development of concepts of the human within disaster studies and examines four major periods of this development: the early days of the risk/hazard paradigm developed by White, the focus on a "bounded rationality paradigm", the development of concepts of social vulnerability, and current critiques of social vulnerability.

Social geographer Gilbert F. White stimulated major conversations about risk to natural hazards beginning with his PhD thesis in 1942 and continuing throughout his entire career, and is considered by many to be the "father of floodplain management" (Turner 2014). White's work was crucial to developing a more multifaceted approach to understanding geophysical hazards that ultimately resulted in the development of the Natural Hazards Center at University of Colorado, which continues to be one of the premier research institutions for hazards research.

Beginning, largely with White and his students, was a growing concern with the human aspects of hazard zones, specifically the role that humans play in both producing risk, and managing risk (White 1942, White and Haas 1975). Many historians and researchers situate White's revolutionary thinking within the political and social aspects of American life at the time of his academic upbringing. Not only did White begin his studies within a very tenuous time in the US hazards landscape (the 1920's and 30's are infamous for a number of extreme floods and droughts), but also a time of extreme social hardship with the Great Depression (Macdonald et al. 2012). Some scholars argue that this social hardship, and the resulting New Deal, fundamentally shifted the way many scientists and government workers viewed their responsibility to the general public, especially

in how knowledge could be applied to the greater good (Reisner 1993), and this was evident in White's interest in integrating human society into disaster planning and disaster mitigation.

Before White's work, natural hazards research was found almost exclusively in the natural sciences and engineering (Hufschmidt et al. 2005). Because of this, there was largely a singular focus on physical modeling of extreme events and developing engineering and technical solutions to reduce risk from these events. White's dissertation, *Human adjustment to floods*, challenged this focus by introducing the concept of human adjustment, meaning how can humans lower their risk to hazards, and argues that human development should be a main consideration in flood management (White 1942). He writes "floods are acts of God, but flood losses are largely acts of man. Human encroachment upon floodplains of rivers accounts for the high annual total of flood losses" (White 1942, 2) which recenters the role of humans within natural processes. Throughout his chapters, he introduces the concept of adjustments and argues that, while a technocratic paradigm and a focus on structural solutions dominated flood management discourse, alternative adjustments based on human society could be more effective (White 1942). These adjustments included land management, emergency measures, land-use changes, and public relief and insurance (White 1942).

White's and his students' research continued to develop and resulted in the publishing of *Assessment of Research on Natural Hazards* in 1975 (White and Haas 1975), which was a major aggregation of existing research on Natural Hazards and White's interventions within this field. The interventions of this book were focused on two major avenues. One, that researchers publishing on natural hazards have been, and remained, largely physical scientists whose focus was understanding physical processes and developing physical models, largely lacking a human perspective (White and Haas 1975). The outcome of this singular focus in modeling and developing technical solutions was an extra-human focus, which led to his second major point throughout the book—that only a small amount of hazards research was available to the general public (White and Haas 1975). White questioned the trajectory of hazards research and reinforced the importance of integrating assessments of human society within hazards research, which has importance in both preventing damage from these hazards and recovering from them when they did occur.

White's research was much more readily accepted by geography, and other social science disciplines, than it was by the natural science disciplines involved in hazard research at the time (Hufschmidt et al. 2005). This moment in geographical thought also involved a shifting role of human in other aspects of natural life, which was likely a contributing factor to the broader acceptance of the human turn in hazards research (Castree 2011). While White's influence in this turn focused largely on how humans are involved in producing risk, by developing in the floodplain, and how they could contribute to managing this risk, by human adjustment, his research developments paved the way for an increasing focus on the human in disasters more broadly. This led to an increasing question of how this floodplain development happens, or more broadly, how humans come to live in areas at high risk for damage from natural disasters. This question became the basis of decades of research about risk, risk perception, and vulnerability— largely examined in social science disciplines like geography, which also led to increasing separation between these social scientific explorations of disasters, and continuing earth science explorations of disaster risk (Hufschmidt et al. 2005).

Following White's exploration of human adjustment, the concept of "bounded rationality" emerged to explain both the creation of human risk to natural hazards, and the utilization or non-utilization of human adjustment techniques (Cutter et al. 2009). The bounded rationality paradigm in disaster research posited that a mismatching human perception of risk existed in areas at high risk to damage from natural hazards. Because people incorrectly assess their risk and subsequently make risky decisions—whether it be moving to a risky area or failing to appropriately utilize human adjustments—this formulates their risk for damage (Burton, Kates, and White 1978; Kates 1971). Researchers believed that if the public could appropriately assess risk to natural hazards, this risk could be lowered, which led to significant research on public risk assessment and how people determine what an acceptable level of risk could be (Burton et al. 1978). This increasing focus on the human in disaster research came along with an increasing focus on disaster planning and emergency preparedness, which was also missing from pre-White disaster research (Hufschmidt et al. 2005).

Developing around the same time as the bounded rationality paradigm was a separate understanding of how people come to be at risk to natural hazards. O'Keefe et al.'s (O'Keefe et al. 1976) "Taking the Naturalness out of Natural Disasters", critiqued the very conception of "natural disasters" to explore the political and social drivers of human risk to extreme events.

Following from this examination was the development of concepts of vulnerability within disaster studies. Vulnerability literature began with the rejection of the idea that "disasters" in the manner that they are typically conceptualized, are simply a result of natural causes and are a normal geophysical process or, in other words, result strictly from biophysical risk (Ernel and Peet 1989). Instead, a disaster is driven by vulnerability—both in terms of exposure to risk, and recovery from risk when it occurs. Scholars such as Wisner and Luce (Wisner and Luce 1993), Hewitt (Hewitt 1983), Fothergill et al. (Fothergill et al. 1999), and many others began to explore concepts surrounding social vulnerability such as marginalization, in which "under certain circumstances the conflict of interests in society creates groups pushed to the limits" (Wisner and Luce 1993). In this, relegation to high-risk areas is not the result of inappropriate risk assessment, but is the result of political, social, or economic forces that relegate vulnerable populations to a metaphorical and physical edge.

Perhaps the largest influence on present day understandings of social vulnerability in a geographical context came with Cutter's (Cutter 1996) hazard-of-place approach to vulnerability, which developed out of these explorations of vulnerability, and re-emphasized the geographical role of place in disaster studies. While social science research developments around vulnerability to extreme events had become increasingly abstract, and also had dislodged the important intersection between biophysical risk (exposure) and social risk (vulnerability), Cutter's hazards- of-place approach re-emphasizes the importance of biophysical vulnerability by describing the place-based interaction between biophysical vulnerability and social vulnerability (Cutter 1996). For instance, her examination of flood risk in Georgetown County, South Carolina explored the importance of the interaction of biophysical and non-biophysical factors in assessing flood risk, in which "the interplay of social, political and economic factors—interacting separately, in combination with one another, and with the physical environment—creates a mosaic of risks and hazards that affect people and the places they inhabit (riskscapes or hazardscapes)" (Cutter et al. 2000). The development of these concepts of riskscapes or hazardscapes acts as an important bounding mechanism to recenter the role of place and landscape within disaster studies, reemphasizing the role that geography as a discipline can play in disaster studies. Cutter's general case study approach recognizes that drivers of both biophysical risk and vulnerability can differ across diverse landscapes.

Cutter's hazards-of-place model was further developed by Cutter's social vulnerability index (SoVI). This index is a quantitative

measure of social vulnerability across the United States and is commonly utilized within geospatial analyses of risk to natural disasters. In its original development, Cutter et. al (Cutter et al. 2003) included over 250 variables that had been cited in literature as impacting social vulnerability, which was reduced to 85 variables after testing for multicollinearity among the variables. The current SoVI synthesizes 29 socioeconomic variables, and after z-score standardization performs principle component analysis using a varimax rotation and Kaiser criterion for component selection (Cutter 2016).

The resulting factors are named after variables with significant factor loadings, and the components are combined into a single SoVI score for a place (Cutter 2016). While Cutter's hazards-of-place model and subsequent SoVI are still very commonly utilized within disasters studies, critiques to these models, and to social vulnerability models more generally, have developed over time as well. Two of these critiques will be examined here—the critique that social vulnerability frameworks normalize inequality and the critique that the quantitative methodologies developed to spatially measure social vulnerability are ineffective.

While the concept of social vulnerability was, and remains, an important development within hazards research, an uncritical understanding of social vulnerability also has the potential to naturalize inequalities. The concept of social vulnerability, as executed in disaster studies, is typically associated with the outcomes of this vulnerability, rather than the processes that create and perpetuate vulnerability (Faas 2016). Critiques offer an alternative to this outcome-focused research by suggesting that analyses of social vulnerability in disaster studies should not recognize vulnerability as an inherent characteristic in some communities, but instead should focus on the institutional processes that generate this vulnerability. For instance, instead of solely looking at the geographical distribution of vulnerable communities, a holistic understanding of social vulnerability recognizes that this geographical distribution, in which socially vulnerable populations often live in riskier areas, is a result of discriminatory housing policies (Peacock, Gladwin, and Morrow 2012; Van Zandt 2007 Oliver and Shapiro 2018; Flippen 2004). Because of this geographical distribution, these communities are thus more likely to suffer damages during extreme events, but at the same time are more likely to be adversely effected by the exclusionary structuring of recovery programs, such as head of household policies (Morrow and Enarson 1996). These policies help produce and reproduce social vulnerability, and examining them illuminates the importance of not naturalizing drivers of social vulnerability, but recognizing them within the institutional contexts in which they are formulated.

Other critiques analyze specifically the effectiveness of the quantitative methodologies associated with social vulnerability frameworks—namely social vulnerability indices. Two of the most of the most widely used quantitative measures are Cutter's Social Vulnerability Index, and the Center for Disease Control's Social Vulnerability Index (SVI) (Flanagan et al. 2011). Both of these indices attempt to quantify social characteristics that influence social vulnerability and create a numeric index system that allows for broad scale comparisons and analyses across different geographies. The development of these quantitative measures of social vulnerability has introduced the necessity of efforts to validate the usefulness and effectiveness of these indices.

There have been various attempts to internally and externally validate these indices by a variety of means, and critiques generally center around the varying levels of success of validation of these indices.

In terms of internal validation, global sensitivity analysis is a common approach to internally validate both deductive, hierarchical indices (like CDC's SVI) and inductive measures (like Cutter's SoVI). Tate (2012) attempted global sensitivity analysis to internally validate both of these methodologies, and found that while inductive methodologies were found to be most precise, the inductive index configuration based on Cutter's SoVI algorithm was an outlier and generally lacked precision. This global sensitivity analysis also found that methodological choices, such as transformation, normalization, weighting, and factor retention were also found to be highly influential in index outcome, and Tate argued that increased methodological transparency should be implemented in index design (Tate, 2012). Spielman et al's (2020) attempt at internal validation found that SoVI can lack theoretical and internal consistency. They found instances where a positively coded variable was contributing negatively to SoVI, which contributed to a lack of theoretical consistency (Spielman et al. 2020). These, largely unsuccessful, attempts at validating internal consistency casts doubt on the effectiveness of social vulnerability indices and led to general critiques about their formulation.

Other critiques of social vulnerability indices center around scale, and scale is a continued issue in vulnerability index construction and validation. Cutter developed the SoVI to be a comparative index, originally at the entire US level, so SoVI outcomes are intuitively sensitive to the geographical inputs and SoVI outputs are meaningless except in a comparative environment (Cutter et al. 2003). While it is theoretically valid to understand vulnerability as geographically contextual, in that some variables may be more or less powerful in some geographies (Birkmann, 2007), SoVI has, at times, been found to be perhaps excessively sensitive to scale (Spielman et al. 2020), and much more sensitive than hierarchical indexes like CDC's SVI (Tate, 2012). However, at other points, SoVI has been found to be relatively stable at different scales, indicating a lack of scholarly consensus on the role of scale in SoVI validity (Schmidtlein et al. 2008). While SoVI was originally developed for use on a national scale, SoVI has frequently been applied at different geographical scales (state, county, sub-county) and enumeration units (census block, census tract) as well as in an international context (Borden et al. 2007, Wood et al. 2010, Maharani et al. 2016, Andersen and Sugg 2019) which have led to differing results.

Attempts at external validation of social vulnerability indices often utilize existing disaster data or modeled impacts of disasters. Like efforts to establish the internal consistency of social vulnerability indices, these attempts have established contradictory evidence of these indices' validity and have led to additional critique. Schmidtlein et al. (2011) used FEMA's natural hazard modeling software package HAZUS to connections between social vulnerability and modeled earthquake loss in Charleston SC. They found that while physical vulnerability was the most significant predictor of loss, social vulnerability was an appropriate predictor of relative loss after accounting for wealth (Schmidtlein et al. 2011). Rufat et. al (Rufat et al. 2019), in studying Hurricane Sandy outcomes found that the SoVI had slightly more explanatory power than the CDC's SVI (which was poor) but that both of these models were overall poor predictors for outcomes, and that alternatives to SoVI and SVI, including the weighted index based on expert knowledge had higher validity. Tellman et. al (2020) found that the SoVI was a better predictor of variation in death and damage than flood intensity alone when looking at variation in outcomes from 11,629 flood events in the United States. Burton (2010) found that SoVI was significant only at hurricanes that reached extensive and catastrophic levels.

Social vulnerability indices are designed to be generalizable across diverse instances of hazards (Cutter et al. 2003, Flanagan et al. 2011). However, recent studies of vulnerability have indicated that vulnerability is extremely hazard specific and different hazards may be more sensitive than others to particular social variables. In Rufat

et al.'s (2015) study on social vulnerability to flood risk, they found that the influence of social vulnerability drivers to flooding varied considerably by disaster stage and national setting, highlighting the importance of both geographical and hazard context in understanding social vulnerability. In addition, many studies have emphasized the importance of hazard specific social vulnerability metrics given the differential impact of different social factors depending on disaster type, including to wildfire (Davies et al. 2018), flooding (Fekete 2009), coastal hazards (Bjarnadottir et al. 2011), hurricanes (Rygel et al. 2006), and a number of other hazards.

Understandings of the role of humans in disaster studies have developed significantly since White's original interventions in the 40's. While disaster studies began as a physical science modeling physical impact of extreme weather events, it has developed to highly consider the role of humans and how they come to be at risk to these extreme events. White, his students, and his immediate predecessors took human choice to be a major consideration in risk to damage, and argued that a misjudgment of risk ultimately allowed individuals and communities to make risky choices and expose themselves to potential damage. However, following this examination of choice came the development of conceptions of social vulnerability have developed to understand how people come to be vulnerable outside of their individual choice. The concept of social vulnerability has become a very important mainstay of disaster studies, but is not without critique. In particular, the potential for concepts of social vulnerability to normalize inequality, and the true effectiveness of indices developed to track social vulnerability on a large geographical scale have been explored in the last few decades.

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