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Family Structures, Relationships, and Housing Recovery Decisions after Hurricane Sandy

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Abstract: Understanding of the recovery phase of a disaster cycle is still in its infancy. Recent major disasters such as Hurricane Sandy have revealed the inability of existing policies and planning to promptly restore infrastructure, residential properties, and commercial activities in affected communities. In this setting, a thorough grasp of housing recovery decisions can lead to effective post-disaster planning by policyholders and public officials. The objective of this research is to integrate vignette and survey design to study how family bonds affected rebuilding/relocating decisions after Hurricane Sandy. Multinomial logistic regression was used to investigate respondents' family structures before Sandy and explore whether their relationships with family members changed after Sandy. The study also explores the effect of the aforementioned relationship and its changes on households' plans to either rebuild/repair their homes or relocate. These results were compared to another multinomial logistic regression which was applied to examine the impact of familial bonds on respondents' suggestions to a vignette family concerning rebuilding and relocating after a hurricane similar to Sandy. Results indicate that respondents who lived with family members before Sandy were less likely to plan for relocating than those who lived alone. A more detailed examination shows that this effect was driven by those who improved their relationships with family members; those who did not improve their family relationships were not significantly different from those who lived alone, when it came to rebuilding/relocation planning. Those who improved their relationships with family members were also less likely to suggest that the vignette family relocate. This study supports the general hypothesis that family bonds reduce the desire to relocate, and provides empirical evidence that family mechanisms are important for the rebuilding/relocating decision-making process.

Keywords: Hurricane Sandy; relocation; family structures; family relationships; vignette

1. Introduction

Understanding of the recovery phase of the disaster cycle is still in its infancy [1,2]. A thorough grasp of recovery can lead to effective post-disaster planning, which is essential to enable communities to recover from natural and man-made catastrophes in a timely fashion. Severe hurricanes cause considerable damage to houses and properties, in addition to causing casualties. In 2012 Hurricane Sandy damaged more than a quarter-million residences and was responsible for around 150 direct deaths and $50 billion in losses [3]. After hurricanes, many people will be displaced; some will return to rebuild or repair their residences, and some will have no plan to return [4,5].

Whether to relocate or stay in the community and rebuild after a hurricane is an important decision for families to make. This decision could affect their wellbeing in the long run and would

collectively affect the community's recovery [6]. Thus, the decision-making process of rebuilding or relocating has been an important topic that attracts wide attention from policymakers at different levels as well as the general public [7]. Furthermore, current studies have highly signified the role of social capital and highlighted the need to emphasize social infrastructure rather than pure physical infrastructure [8,9].

Additionally, disasters are perceived as collective stress situations [10] and disaster recovery is known to be a complex social process [11]. Studies on post-disaster recovery have shown its significant reliance on social networks and the psychological wellbeing of the affected households [12]. Social networks have been shown to empower such collective action in two ways: (1) they greatly influence the psychological wellbeing of the affected families [12], helping them reduce the psychological effects of the traumatic event and preventing families from abandoning their residences; and (2) they promote housing recovery of the families, as the studies have highlighted the tendency of families to relocate or to go back to their own homes [10,13] accompanied by family or friends [12]. The familial bonds at the center of households' social networks can have a significant role on driving housing recovery decisions. In addition, in [14], social capital is described in terms of three actions-recognize, preserve/conserve and invest—which leads to collective and mutually beneficial thinking and actions in communities, in the context of disaster recovery. Finally, in [5,15], place attachment was denoted as being a key driver of community collective engagement in disaster recovery.

Existing recovery modeling literature has focused either on analyzing this issue at the household level, such as how the level of damages in a neighborhood and broader community affect decision-making [16], at the community level [17], or at the individual level, such as how individuals' demographic factors, including their age, gender, income, and ethnicity, affect their relocating/rebuilding decisions [4,18]. Few studies have examined how family mechanisms, such as family structures and relationships among family members, may affect rebuilding/relocating. Ignoring family mechanisms is a serious research gap in this area; after all, these decisions are made within the network of constraints and opportunities provided by families [19]. For example, it is known that families are the first responders who helped each other [20–22], and concerns of families were the primary reason for disaster survivors to experience negative psychological consequences [23]. This study directs attention to how family mechanisms affect individuals' beliefs and strategies concerning rebuilding/relocating decisions by incorporating a vignette into a face-to-face survey and investigating peoples' housing recovery responses to Hurricane Sandy. In the vignette, the respondents were asked for their recommendation to a hypothetical family affected by disaster. The vignette uses experimental design to increase internal validity and at the same time makes it possible to examine situations that are rare or hard to measure in reality [24,25], which is favorable for examining the decision-making process. Apart from the vignette study and its hypothetical family structure, this study also examines how individuals' actual decisions are affected by their family structures and relationships with family members. The general hypothesis is that family bonds reduce the endorsement for relocating relative to rebuilding. This section is succeeded by a literature review and is then followed by descriptions of the study area, data collection, research methodology, and analysis. Finally, the conclusion section will wrap up the paper.

2. Literature Review

Effective post-disaster planning is essential to enable communities to recover from natural catastrophes such as hurricanes, earthquakes, and tsunamis, as well as human-induced events like acts of terrorism or accidents. In anticipation of these high-impact, low-probability events, at-risk communities need policies, contingency plans, procedures, guidelines and budgets that can enable them to implement recovery actions. However, recent major disasters in the U.S., including Hurricane Sandy, reveal the inability of existing policies and practices to promptly restore infrastructure, residential properties, and commercial activities in affected communities. The exponential increase in future extreme events [26] coupled with a growing population in disaster-prone regions, has created an

urgent need for a better understanding of the process of disaster recovery and more effective strategies to enhance it. These enhancements can in turn lead to fewer casualties and significant savings of federal resources, which according to U.S. Department of Housing and Urban Development [27] amounted to $19.7 billion for grants in Louisiana, Mississippi, and Texas in 2005 alone. There is ample literature on the determinants of post-disaster housing recovery, each highlighting a specific aspect of the process. For example, demographic, socioeconomic, psychological, and social control variables such as age, gender, ethnicity, income, employment, and assets, are cited as internal factors affecting recovery [12,28–36]. Private insurance, a restored economy, and spatial externalities are other crucial external control factors [37–40]. Additionally, Peacock *et al.* [41] highlighted the long-term aspect of housing recovery through a longitudinal study in Miami-Dade and Galveston after Hurricanes Andrew and Ike. In this study, income, race, and ethnicity were shown to be the critical determinants of losses and recovery in Miami, *vs.* income alone in Galveston. Functionality of businesses and transportation and utility infrastructure, as well as availability of schools, health-care, and social services are other requirements to achieve normalcy after disasters [42]. Henry [43] performed an inductive analysis of recovery decisions in the aftermath of Hurricanes Katrina and Rita in August and September 2005, and found that for those who planned to return to damaged areas, housing circumstances, and to a lesser degree family and work circumstances, play significant roles in their decision. Additionally, for those who chose to relocate, their decisions were based on three equally-weighted and interconnected parameters: family, risk, and work. Finally, for those who remained undecided, housing and work seemed to be the main decision-making drivers. Place attachment and social networks are two other important factors that affect recovery decisions and are briefly discussed below.

Place attachment has also been the subject of numerous research studies as a potential factor in influencing recovery decisions [43–47]. Place attachment is generally defined as having two major constituents: place identity, which refers to residents' self-perception of their identity relative to their surrounding physical environment, and place dependence, which refers to residents' self-perception of the community's potential to address their needs [45,48,49].

Recovery is not only the act of individuals but also a collective action largely based on extensive interactions within the members of households and their social networks. The collective aspect of recovery decisions surfaced in the aftermath of Katrina, when a significant portion of the affected population eventually relocated for multiple reasons [7,50–53]. The role of social capital as a facilitator of post-crisis recovery was also reflected in the work of Aldrich [54], in which it was proven to be the strongest predictor of recovery in the aftermath of the 1995 Kobe earthquake in Japan. Moreover, in [55,56], the author focused on the importance of social capital as the engine for recovery and the reason behind the display of resilience in some neighborhoods and stagnation in others. Also, in [14], social capital is described in terms of three actions: recognize, preserve/conserve, and invest, which in the context of disaster recovery, leads to collective and mutually beneficial thinking and actions in communities. Furthermore, in [5], the authors highlighted the collective narrative associated with social capital and its impact on post-disaster recovery. Also, in [57], the author studied the role of social capital in the context of post-disaster recovery in 11 provinces in Western China, in which trust was shown to have a positive role and socially vulnerable groups were denoted to be more dependent on their strong-ties networks, which might have negative impacts on their overall recovery. More specifically, in [58], the reconstruction decisions of affected households were significantly linked to the decisions of neighbors. While the existing literature has encompassed a wide range of parameters affecting housing recovery, there are still gaps in fully understanding the recovery decisions of households in the aftermath of disasters and how these decisions affect the overall recovery of the community. This is partially due to the need for a more detailed approach capable of integrating micro-level parameters such as familial bonds. We report on our research effort to bridge the existing gap by integrating this understudied aspect of disaster recovery in our data collection and analysis, and by supplementing the face-to-face survey with a vignette study in which rarer scenarios can be included in the analysis.

The findings can ultimately inform our understanding of households' recovery decisions, Vignettes, simulations of real events portraying hypothetical scenarios [59], have a long history of application in studying norms, perceptions, and beliefs [60]. In other words, vignettes within video material and cartoons [61,62] are elicitation tools intended to facilitate the investigation of responses to hypothetical scenarios. Vignette studies help with counterbalancing the weaknesses associated with classical experiments and survey methodology by combining ideas from both [63]. This combination provides a high internal validity through the features of classical experiments due to their active mode of measurement, and high external validity through characteristics of traditional surveys and their multivalent measurements. This has led to the fact that in the field of designing public opinion surveys, vignettes were cited as a key innovational breakthrough [64]. Vignettes have the flexibility to be used both in quantitative and qualitative design. In quantitative design, a series of predetermined responses will be made available to the respondents [59]. Although quantitative vignette studies have been used in various fields of application, including psychology [65–67] and sociology [68–70] and many others [63], to the best of the authors' knowledge there are no similar design and studies within the context of post-disaster housing recovery. Typically in vignette studies, subjects are confronted with the whole population of vignettes to elicit their behavior with regard to the presented vignette scenarios [63]. In this research study, the vignette design had four factors, each comprised of two factor levels, leading to a total of 16 vignettes. The description of these factors and their associated levels is elaborated in the following sections.

Apart from the vignette design and study, several factors deemed to be influential on housing recovery decisions were included in the face-to-face survey. These factors encompassed internal attributes such as family structure, location bonds, socioeconomic status, as well as external factors such as reconstruction of neighboring households. In this study, Staten Island, NY, severely impacted by Hurricane Sandy, was used as the case study area, given its wide range of demographic and socioeconomic attributes such as age, race, and income. Household recovery decisions-reconstruct/repair, wait or relocate—were assumed to be based on a confluence of the aforementioned internal and external factors. The data was mainly collected through face-to-face surveys. The survey was designed to elicit the factors that directly affected the household's decision to rebuild/repair, wait, or relocate, as opposed to the vignette study, wherein the respondents were asked to provide their recommendations given a hypothetical scenario; that is, a particular combination of four predictors, discussed in more detail in a later section.

Although several distinctions have been made about the types and quality of existing social capital including bonding, bridging, and linking [71,72], the focus of this paper is merely on bonding social capital, which according to Putnam [73], refers to relationships amongst the members of a network with similarities. More specifically, the emphasis is on the familial bonds between the members of a family.

3. Study Area

For the purpose of this study, two severely affected neighborhoods in Staten Island, namely Midland Beach and New Dorp Beach, were selected for data collection. Staten Island, was one of the major areas severely impacted by Hurricane Sandy in October 2012. The total death count associated with Hurricane Sandy was 43, of which 23 occurred in Staten Island including 10 just in the neighborhood of Midland Beach [74], one of the two targeted neighborhoods in this study. The damage caused by Sandy to the economy, homes, and businesses was estimated to be more than $19 billion. Among the hundreds of homes destroyed by Sandy or determined to be structurally compromised, 30% were located in Staten Island. The storm surge devastated south beach neighborhoods including Midland Beach and New Dorp Beach. Overall, Staten Island had higher rates of yellow- (significant nonstructural damage) and red-tagged (structural damage) buildings, and a lower rate of damaged buildings compared to the rest of the city. The yellow and red-tagged buildings were clustered in the east shore neighborhoods of South Beach, Midland Beach, New Dorp Beach and Oakwood Beach.

According to the most thorough assessment of building damage by the New York City Department of Buildings, 23% were located on the east and south shores [74]. Additionally, about 120,000 customers lost power due to the impact of Sandy on Staten Island's utilities. The storm also affected the Staten Island Ferry, the East River Ferry and private ferries, stranding 80,000 normal weekday passengers [74]. In the aftermath of Hurricane Sandy, several initiatives were developed under the City's five-borough building resiliency plan in order to protect structures on the east and south shores against several risks, including climate risks, which in turn incorporate flooding, high winds, and other extreme events. According to [75], the mayor's Build It Back program was able to reimburse homeowners with over $100 million dollars, making 1837 construction projects viable. More specifically, 9.8 miles of dunes across the Rockaway Peninsula were among the short-term measures that were put in place to ensure the safety of the five boroughs. Additionally, in Staten Island, 68 acres of degraded wetlands are being restored.

4. Data Collection

4.1. Face-to-Face Survey

A face-to-face survey was administered to the residents of highly affected areas in Staten Island, NY, USA, in December 2012, approximately 35 days after Hurricane Sandy. Two faculty members and three trained students from an interdisciplinary research team at Texas Tech University were deployed in the area and conducted recruitment and face-to-face surveys. Participants were recruited through two sampling methods. The first was door-to-door surveying, which targeted the heavily damaged coastal areas, particularly New Dorp Beach and Midland Beach. The second was surveying at designated shelters for those whose residences were inhabitable. The door-to-door surveying adhered to the following process: a single address was selected randomly by each of the members of the data collection group within the targeted locations. Using this address as a benchmark, other houses neighboring this address were approached and asked to participate in the survey, if the house was approachable and if the person answering the door was over 18 years old. If a home was not approachable, the adjacent home was approached and the same pattern was repeated by each of the data collection group members. The unapproachable home at the time of surveying was labeled for a maximum of two subsequent follow-ups. Procedures similar to this have been previously employed for data collection purposes in the aftermath of disasters in which the starting point of door-to-door surveying was randomly selected, and the rest of the addresses were selected using the randomly selected address as the starting point [44]. The basis behind selection of the targeted neighborhoods was the availability of subjects that were deemed to be more relevant to the subject of the research, as the majority of them experienced severe damages to their residences [76]. This was accompanied by a snow-ball sampling [77,78] technique to integrate the experience of: (1) other survivors who lost their homes in the area and were residing in a major shelter (Bayley Seton Hospital); and (2) the people who were applying for assistance from FEMA in their temporary centers throughout the city and other food banks, suggested by the first recruitment method. More specifically these centers were: (1) the FEMA disaster recovery center on Hylan Blvd. (Manfredi Auto); and (2) the FEMA-State disaster recovery center at New Dorp High School, together with the food bank at the intersection of Midland Avenue and Patterson Avenue. The rationale behind selecting these sampling methods was the limited availability of households in the area, and consequently a relatively small sample size due the nature of the event. Although there were certain biases associated with both of these sampling methods, each is believed to be appropriate for the research. Survey participants were compensated for their participation though on-site cash payments.

Altogether, 126 completed surveys resulted from spending five days on data collection, including 150 h of face-to-face surveys. The survey focused on the post-hurricane experience and household decision making concerning relocating and reconstructing. The face-to-face survey aimed at collecting data from the affected households and was comprised of five parts. The first part included questions on

households' demographic, socioeconomic, and personal attributes (age, race, education, employment, annual income, and religion). The second part encompassed questions on residence status before the hurricane (ownership, type, tenure, insurance, and residence value before impact). The third focused on residence status after the hurricane. It incorporated questions such as level of damage and household housing recovery decisions in the aftermath of Sandy. The housing recovery decision had three alternatives: (1) rebuild or repair; (2) wait and stay in temporary housing; and (3) relocate. Each of these alternatives was associated with follow-up questions on parameters believed to be influential in making that decision. For example, the decision to rebuild/repair was associated with the following influencing parameters: restoration of affected infrastructure, reconstruction by neighbors, availability of mental health services, reimbursement from insurance, availability of grants, loans, temporary housing, and finally, accessibility to family and relatives. The decision to wait was associated with the same parameters, to determine which would encourage rebuilding/repairing among those who decided to wait and seek temporary housing. Finally, for those who decided to relocate, the location of the new residence was included in the questions. The fourth part collected information on the amount of loss and compensation received through different entities such as federal, state, and local governments, charities, and the fifth part covered psychological impacts. The main survey was accompanied by two additional surveys on household members before and after the storm, and the intensity of the different types of support, including emotional, instrumental, and financial, exchanged among them. This was incorporated into the survey to track changes in familial ties within each household and to explore the significance of internal and external attributes on these changes. Power analysis with STATA© indicated that this sample size would provide adequate power for multiple regression, assuming a medium effect size [79]. The selected sample reflected fairly closely the racial breakdown of the area when compared to census data, with Caucasians being the dominant group [80]. However there was a gap between the values recorded under age, income, and gender distributions. This is shown in Table 1 below.

Table 1. Sample *vs.* population.

Variables	Sample	Population
Age (median)	45.52	35.9
Gender (male)	0.64	0.48
Gender (female)	0.36	0.52
Race (Caucasian)	0.81	0.78
Race (African American)	0.07	0.12
Race (Asian)	0.02	0.08
Race (Other)	0.1	0.02
Income (median)	52,278	73,496

4.2. Vignette Survey

For the purpose of this research's vignette, the following scenarios were developed to examine factors that would possibly influence household recovery decisions after disasters. The text in italics highlights the portions with changing values, each creating a separate scenario.

"A *(a) single-mother family with two kids/(b) family with two-parents and two kids* has been living in the area for *(a) around 10 years/(b) less than 1 year*; they own their own houses with a mortgage. Hurricane Sandy severely damaged their house, and they have to make a decision about whether to relocate or reconstruct the house. *(a) The insurance the family has is enough to reconstruct the house/(b) not enough to build the house. (a) Most neighbors have started reconstructing/(b) most neighbors choose to relocate*."

After presenting the scenarios, the respondents were asked the following question: "What do you think the family should do?" The respondents had three choices: (a) reconstruct or repair; (b) wait and see, in temporary housing; and (c) relocate. As the vignette had four factors each with two factor levels, it resulted in 16 ($2 \times 2 \times 2 \times 2$) combinations. Each respondent was randomly assigned a unique combination. Assigning random combinations of the dimensions to the respondents

provides the ability to establish internal validity and argue for the causality of each dimension's influences on the outcome of interest. In other words, as Vignette is in essence an experimental design we can establish internal validity or causal inference by actively manipulating levels (dimensions) of independent variables, and choose a randomly selected version of the vignette story for each respondent, keeping almost everything the same and varying the key elements. When combined with a survey with a carefully-designed sampling strategy, the vignette design also exhibits external validity of generalizability [25,81,82]. Even though the aforementioned dimensions are believed to be prevalent individually throughout the community, there are a few vignette combinations that might not be as widespread. The vignette was approved by Texas Tech University office of Human Research Protection Program in early December 2012, following the completion of design and prior to performing the data collection.

4.3. Dependent Variables

As previously mentioned, two logistic regressions were performed in this study to analyze responses to (a) a vignette (hypothetical case); and (b) an actual scenario (Hurricane Sandy). For both of these regressions the dependent variable was set to households' preferred choice among the following options: (1) reconstruct/repair; (2) wait; and (3) relocate.

4.4. Independent Variables

Vignette Dimensions: As shown in Table 2, there were four dimensions associated with the vignette. The first was to examine the influence of family structure for which a "single-mother (SM) family" was coded as 1, and a "two-parent family" was coded as 0. The second was to account for the role of place attachments (TY) for which "around ten years" was coded as 1 and "less than a year" was coded as 0. The third was to capture the influence of insurance (EI) on households' decisions for which "sufficient insurance to reconstruct the house" was coded as 1 and "insufficient insurance" was coded as 0. Finally, the fourth dimension was to incorporate the impact of neighbors' actions (NR) on individuals' recovery decisions, for which "most neighbors have started reconstructing" was coded as 1 and "most neighbors choose to relocate" was coded as 0. Neighbor interactions were factored in the vignette to examine the collective nature of recovery decisions in the affected area in post-disaster settings. The distribution of vignettes among respondents had a decent coverage of all factor-levels associated with each factor, as the percentages are all close to fifty. In other words, each factor level of a given factor was included in half of the vignettes.

Family Structure: Additionally, as seen in Table 2, family structures were classified into two different categories. The first distinguished those who lived alone from those who lived with family members before Sandy. The second further distinguished those who reported the presence of children younger than 18 in the household but not that of a spouse or partner (*i.e.*, single parents) from other respondents living with family members before Sandy (*i.e.*, other families).

Familial Ties/Bonds: We asked respondents about their relationships with each of the family members who lived with them before the Hurricane: "How much did the hurricane bring you closer or less close to this person?" The answers included: a lot closer, somewhat closer, only a little closer, about the same, only a little less close, somewhat less close, and a lot less close. Then we took the highest level of improved closeness among all family members and categorized respondents into those who had improved closeness with at least one family member (closer), who did not improve on family relationships but maintained similar relationships with at least one family member (about same), and who experienced less close relationships with family members (less close). These three groups were compared to those respondents who lived alone before Hurricane.

Control Variables: Other included variables were respondents' age, gender, homeownership, and recruiting place, as explained in Table 2. Notably, those who were recruited from shelters (=1) were differentiated from the rest including those who were recruited from door-to-door visits, as the latter represented the population who remained in the community.

Table 2. Descriptives.

Variables	NO# of Obs.	Percentage	Coding
Suggestions for the vignette family	**128**		
Rebuild or repair (reference)		48.44	0, 1
Wait and see		16.41	0, 1
Relocate		35.16	0, 1
Respondents' plan	**126**		
Rebuild or repair (reference)		57.14	0, 1
Wait and see		9.52	0, 1
Relocate		33.33	0, 1
Vignette dimensions	**128**		
Single mother		56.25	0 (two parents family), 1 (single mother family)
Residence tenure		48.44	0 (1 year), 1 (10 years)
Enough insurance		52.34	0 (not enough insurance to rebuild), 1 (enough insurance to rebuild)
Neighbors' response		48.44	0 (most neighbors relocate), 1 (most neighbors rebuild)
Respondents' characteristics			
Female	129	36.43	0 (male), 1(female)
Age	129		
19–29 (reference)		10.08	0, 1
30–49		53.49	0, 1
50 and older		36.43	0, 1
Homeownership	129	46.51	0 (did not own home), 1 (own home)
Recruiting place	129	48.06	0 (community), 1 (shelters)
Model 1: Family structure 1	**129**		
Lived alone (reference)		25.58	0, 1
Lived with family members		74.42	0, 1
Model 2: Family structure 2	**129**		
Lived alone (reference)		25.58	0, 1
Single parents		8.53	0, 1
Other families		65.89	0, 1
Model 3: Family relationships [a]	**119**		
Lived alone (reference)		27.73	
Less close		10.08	0, 1
Same close		18.49	0, 1
Closer		43.70	0, 1

[a] 10 respondents reported living with family members before Sandy but did not report whether their relationships improved after Sandy.

5. Research Methodology

The completed surveys were used to build a housing recovery decision-making model. To form the model, logistic regression was used as the statistical modeling technique. Logistic regression is a form of statistical modeling which relates a set of explanatory variables to a categorical response variable. Response variables can either have two or more than two categories and are called dichotomous or polytomous respectively. In this research, the response variable could take three categories of responses and as such was polytomous. Depending on the type of the response variable, there are two ways to approach logistic regression. If the response variable is ordinal, cumulative logits are used [83]. On the other hand, when the response variable is nominal, a model can be fitted to generalized logits instead of cumulative logits. In this survey, due to the nature of housing recovery options as the response

variable, generalized logits were pursued to perform logistic regression. Generalized logit models are an extended form of binary logit models in which, instead of having a single logit model, multiple logits are modeled.

5.1. Generalized Logit Model

Binary logit models can be extended to multinomial logistic models as follows. If response variable Y can take on categories 1, 2, . . . , n, choosing, k as the reference category will result in:

$$\log\left(\frac{\pi_j}{\pi_K}\right) = \log\left(\frac{P(Y=j)}{P(Y=k)}\right) = x'\beta_j \tag{1}$$

In which $\pi(x)$ is the response probability, k is the fixed category and j can take on values between 0 and n. In addition x' is the vector of covariates and β_j is the vector of regression coefficients for j^{th} logit. By assuming that the last response category is the same as the reference category, the response probabilities (π_1, . . . , π_n) can be shown as below [84]:

$$\pi_n = \frac{1}{1+\sum_{i=1}^{n-1} e^{x'\beta_i}} \tag{2}$$

$$\pi_j = \pi_n e^{x'\beta_j} \tag{3}$$

In other words, in generalized logits, the log odds of being in one category to being in the reference category are computed. In the context of this research, the aforementioned description can be interpreted as modeling the log odds of choosing a recovery strategy other than "*reconstruct/repair*" to the recovery strategy of "*reconstruct/repair*". The vector of explanatory variables consists of: NR (neighbor recovery), SM (single mother), EI (enough insurance), and TY (ten years of residence in the same location). Finally, SG (suggestion) is the response (dependent) variable.

5.2. Parameter Estimation

Assuming N independent observations of the dependent variable, and multiple observations for each fixed x_i value, it can be concluded that $E(Y_i) = n_i\pi(x_i)$ where $i = \{1, \ldots, I\}$, and $n_1 + \ldots + n_I = N$. Given that the joint probability mass function of Y_1 to Y_I would be proportional to the product of I binomial functions or simply the joint conditional probability of the observations, therefore [85]:

$$\prod_{i=1}^{I} \pi(x_i)^{y_i}[1-\pi(x_i)]^{n_i-y_i} = \left\{\prod_{i=1}^{I}[1-\pi(x_i)]^{n_i}\right\} \exp\left[\sum y_i \log\left(\frac{\pi(x_i)}{1-\pi(x_i)}\right)\right] \tag{4}$$

and as a result, the log-likelihood will be defined as:

$$L(\beta) = \sum_j \left(\sum_i y_i x_{ij}\right)\beta_j - \sum_i n_i \log\left[1+\exp\left(\sum_j \beta_j x_{ij}\right)\right] \tag{5}$$

The next step is to differentiate the log-likelihoods with respect to the vector of β and equal the results to zero. This results in the following equations:

$$\frac{\partial L}{\partial \beta_a} = \sum_i y_i x_{ia} - \sum_i n_i x_{ia}\left[\frac{\exp\left(\sum_j \beta_j x_{ij}\right)}{1+\exp\left(\sum_j \beta_j x_{ij}\right)}\right] \tag{6}$$

which can be solved using Newton-Raphson method. There are several commercial programs to perform these procedures among which SPSS v. 21 was used for the purpose of this study.

6. Analysis

Multinomial logistic regressions were used to examine predictors for respondents' actual plans and their suggestions to the vignette family. The relative risk ratios of choosing "wait and see in temporary housing" and "relocate" against "rebuild or repair" (reference) were estimated. As in generalized logit models the log odds of being in one category *vs.* being in the reference category are computed, in the context of this research, the objective was to compute the log odds of choosing a recovery strategy other than "reconstruct/repair" to the recovery strategy of "reconstruct/repair" as the reference category. Table 2 displayed the coding and descriptives for analytic variables. Table 3 below shows that although respondents' actual family structures alone did not predict their suggestions to the vignette family (Models 1 & 2), those who improved on family relationships were less likely to suggest relocating relative to rebuilding, than those who lived alone (Model 3). In contrast, respondents who maintained similar relationships or experienced less close relationships were not significantly different from those who lived alone, concerning their suggestions to the vignette family. All four dimensions of the vignette affected respondents' suggestions to the vignette family to some degree. More specifically, in Model 3, results indicated that a single-mother family is more likely to choose wait-and-see than reconstruct-or-repair. Furthermore, in all three models (Models 1, 2, and 3), sufficient insurance was shown to be highly significant in choosing the reconstruct-repair strategy over relocate or wait-and-see. Additionally, the results highlighted the significance of residence tenure (TY)/location attachment in choosing wait-and-see over reconstruct-repair.

Furthermore, neighbor response (NR) was shown to be influential in choosing reconstruct/repair over relocate, implying that in the presence of neighboring recovering activities, the residents are more likely to repair-reconstruct instead of relocate. Finally, none of the control variables were shown to be significant in predicting respondents' suggestions to the hypothetical vignette family. Among the statistics shown in the table, McFadden Pseudo *R*-squared (Pseudo-R^2) is an alternative to the *R*-squared in OLS regression as logistic regressions do not have a similar equivalent [86]. Also, the Likelihood Ratio Chi-Square test (LR-chi^2) investigates whether at least one of the predictors in the model has a non-zero regression coefficient and is proportional to the difference between the log likelihood of the null and fitted model [86]. Finally, DF is the degree of freedom.

In Table 4, Model 1 showed that those who lived with family members were less likely to plan to wait-and-see or relocate relative to rebuilding/repairing than those who lived alone. Model 2 showed that respondents who were single parents were less likely to plan for relocating; other families were less likely to relocate or wait-and-see than respondents who lived alone. But additional tests did not show significant differences between single parents and other families. Model 3 showed that only those who had improved family relationships after Sandy were less likely to favor wait-and-see and relocate; those who had similar or alienated family relationships were not significantly different from those who lived alone concerning the rebuilding or relocating decision. A supplementary analysis using "less close" as the reference group shows similar results: that those who were closer to their family members were significantly less likely to relocate than those who were less close to their family (not shown in the table, RRR = 0.26, $p < 0.01$). Among control variables, respondents who were aged 50 and above were substantially less likely to wait and see than those who were aged between 19 and 29. Homeowners were less likely to wait and see or relocate. Respondents recruited from shelters were more likely to relocate than those recruited from the community.

Listwise deletion of variables resulted in a slight reduction in the working sample size for each analysis.

Table 3. Multinomial logistic regression predicting respondents' suggestion to vignette families (reference: rebuild or repair).

Vignette Responses	Model 1 (N = 128)				Model 2 (N = 128)				Model 3 (N = 118)			
	Wait and See		Relocate		Wait and See		Relocate		Wait and See		Relocate	
	B	RRR [a]	B	RRR	B	RRR	B	RRR	B	RRR	B	RRR
Vignette dimensions												
Single mother (SM)	1.22	3.40	0.22	1.24	1.23	3.42	0.20	1.22	1.24 *	3.46	0.20	1.22
Residence tenure (TY)	1.19	3.30 *	0.35	1.42	1.09	2.96	0.29	1.34	1.08	2.95	0.12	1.13
Enough insurance (EI)	−1.73	0.18 **	−1.06	0.35 *	−1.51	0.22 *	−0.96	0.38 *	−1.66 **	0.19 **	−0.98	0.38 *
Neighbor response (NR)	−0.56	0.57	−0.86	0.42	−0.49	0.61	−0.82	0.44	−0.60	0.55	−0.99	0.37 *
Controls												
Female	0.80	2.22	0.24	1.27	0.89	2.44	0.30	1.35	0.91	2.47	0.02	1.02
Age (ref: 19–29)												
30–49	−1.02	0.36	−0.21	0.81	−1.06	0.35	−0.20	0.82	−0.97	0.38	0.47	1.60
50 and older	−1.16	0.31	−0.70	0.50	−1.24	0.29	−0.70	0.50	−0.88	0.41	−0.03	0.97
Homeownership	−0.06	0.94	−0.77	0.46	−0.14	0.87	−0.84	0.43	−0.12	0.89	−0.83	0.44
Recruiting place	0.97	2.63	0.74	2.09	0.90	2.47	0.67	1.96	1.01	2.75	0.48	1.61
Model 1: Family structure 1 (ref: lived alone)												
Lived with family	−0.75	0.47	−0.87	0.42								
Model 2: Family structure 2 (ref: lived alone)												
Single parents					−15.35	0.00	−1.49	0.23				
Other families					−0.59	0.56	−0.77	0.46				
Model 3: Family relationships (ref: lived alone)												
Less close									−0.01	0.99	0.82	2.28
About same									−1.33	0.27	−0.83	0.43
Closer									−0.35	0.71	−1.32	0.27 *
Constant	−0.58	0.56	1.30	3.68	−0.59	0.56	1.29	3.65	−0.84	0.43	1.08	2.96
Statistics												
LR chi^2	41.31				44.11				44.70			
DF	20				22				24			
Pseudo R^2	0.16				0.17				0.18			

[a] RRR is the abbreviation for relative risk ratio and equals e^B. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 4. Multinomial logistic regression predicting respondents' plan to rebuild, wait and see, and relocate (reference: rebuild or repair).

Actual Responses	Model 1 (*N* = 126)				Model 2 (*N* = 126)				Model 3 (*N* = 116)			
	Wait and See		Relocate		Wait and See		Relocate		Wait and See		Relocate	
	B	RRR [a]	B	RRR	B	RRR	B	RRR	B	RRR	B	RRR
Female	0.77	2.16	−0.01	0.99	0.67	1.95	−0.04	0.97	0.57	1.77	−0.54	0.58
Age (ref: 19–29)												
30–49	−2.75	0.06	−1.17	0.31	−2.71	0.07	−1.23	0.29	−2.41	0.09	−0.37	0.69
50 and older	−4.86	0.01 *	−2.53	0.08	−4.83	0.01 *	−2.58	0.08	−4.43	0.01	−1.54	0.22
Homeownership	−2.13	0.12 *	−3.16	0.04 ***	−2.07	0.13+	−3.26	0.04 ***	−2.06	0.13	−4.31	0.01 ***
Recruiting place	1.12	3.06	2.40	11.01 **	1.18	3.24	2.35	10.51 **	0.80	2.23	3.43	31.00 **
Model 1: Family structure 1 (ref: lived alone)												
Lived with family	−2.96	0.05 **	−2.09	0.12 *								
Model 2: Family structure 2 (ref: lived alone)												
Single parents					−2.38	0.09+	−3.55	0.03 *				
Other families					−3.12	0.04 **	−1.94	0.14 *				
Model 3: Family relationships (ref: lived alone)												
Less close									−1.79	0.17	0.77	2.16
About same									−16.55	0.00	−0.84	0.43
Closer									−3.18	0.04 *	−2.88	0.06 *
Constant	3.66	38.96	2.35	10.52	3.62	37.40	2.46	11.72	3.60	36.55	0.87	2.39
Statistics												
LR chi^2	108.49				111.60				114.90			
DF	12				14				16			
Pseudo R^2	0.47				0.49				0.55			

[a] RRR is the abbreviation for relative risk ratio and equals e^B. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

7. Conclusions

This study supports the general hypothesis that family bonds reduce the preference for relocating and provides empirical evidence that family mechanisms are important for the rebuilding or relocating decision-making process. Respondents with improved family relationships were less likely to plan for their own relocation or suggest the vignette family relocate than those who lived alone; in contrast, those who had similar or less close family relationships were not. Because of that, we suspect that it is the relationship quality, rather than the mere presence of family, that actually influences respondents' plans for rebuilding or relocating. The results of this research provide invaluable insights on behavioral patterns of people in the aftermath of disasters. Parameters including availability of sufficient insurance, family structures, neighbors' activities, and location attachment are statistically shown to be significant predictors for households' suggestions to the vignette family. Although control variables such as home-ownership, recruiting location, and age were shown to be significant in predicting the actual housing recovery decisions, the key finding of this research emerged from the facts that: (1) family mechanisms are a key player in the context of post-disaster housing recovery; and (2) respondents' own decision-making processes are very similar to their impersonal analysis of a situation in the case of a vignette when there is an improvement in family relationships. These results can have significant applications in pre- and post-disaster housing recovery planning by providing guidance to policyholders and public officials.

This study has a relatively small sample size which limits the statistical power of the analysis and the potential to include more controlling variables. In addition, because this is a cross-sectional study, causal relationships between the independent variables and the dependent variables could not be assumed without caution. Nevertheless, the findings indicate the important association between family mechanisms and the decision to rebuild or relocate. Additionally, care should be taken in generalizing these results to other events due to the constraints associated with our sampling.

Finally, it has been well-documented that people respond to disasters as families, e.g., they usually evacuate together and most of the time continue their after-disaster life together and recover together [19]. But how families constitute contexts for people's responses and recovery has rarely been examined [87]. This study shows that family structure and the relationship quality among family members are related to relocating decisions, which are consequential for the wellbeing of individuals, families, and the community. It is important for mitigation and recovery policies to consider the roles of families in examining individuals' and communities' responses to and recovery from disasters. An integrated part of recovery policy-making should be providing support, such as temporary housing and counseling services, to reduce stresses within the family and promote family cohesion.

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