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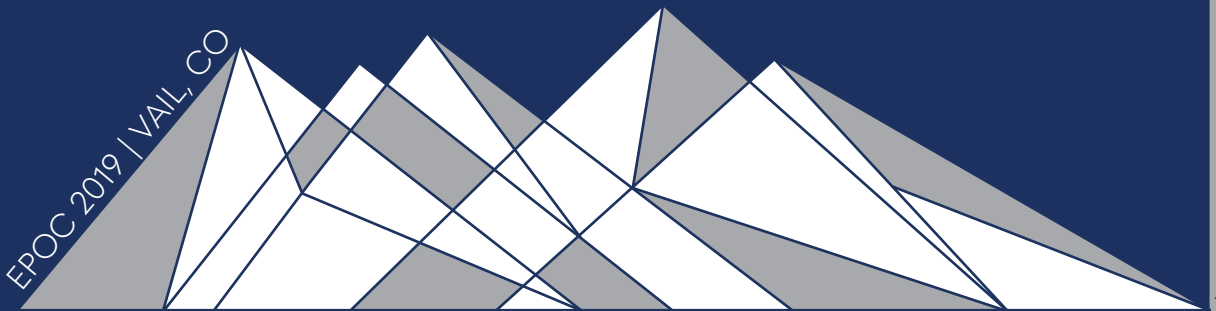

HOUSING RECOVERY THROUGH SOCIAL CAPITAL: PUERTO RICO AFTER HURRICANE MARIA

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ABSTRACT

Puerto Rico was devastated by Hurricane Maria on September 20, 2017. Due to a delayed and insufficient official response from the local and federal governments and other aid agencies, the effects are still crippling more than a year after the event. When official response networks failed, communities often engaged in informal reconstruction processes to facilitate their recovery. This research seeks to explain why certain communities were effective in reconstructing on their own and uses social capital theory as the theoretical framework. This study was conducted in four municipalities in Puerto Rico (Adjuntas, Barranquitas, Loíza, and Utuado). A mixed methods approach was adopted in this study which included interviews (N=31 with community members, local business owners and stakeholder representatives in Adjuntas, Barranquitas and Yabucoa) and door to door households surveys (N=163 in Loíza). Data analysis included qualitative analysis of the interviews where the researchers coded main social capital themes (e.g. linking, bridging and bonding). Data analysis of surveys included chi squared tests evaluating the frequency of social capital forms and informal reconstruction. The results show a significant relationship between informal reconstruction with bridging and linking social capital. Results will contribute to theory and practice of social capital mobilization in post disaster recovery contexts especially in the context where housing is ineligible for official aid. Understanding informal reconstruction through mobilization of social capital will contribute to identifying how communities can use resources available to them in times of crisis and need.

KEYWORDS

Social capital, post-disaster reconstruction, housing recovery, mixed methods study design

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INTRODUCTION

Puerto Rico was devastated by Hurricane Maria on September 20, 2017. The disaster quickly became a humanitarian crisis as the official reconstruction process became difficult to navigate and inaccessible to many. Strict requirements imposed on housing borne of a process that is historically loosely regulated, and inadequate formal recovery mechanisms have left vulnerable populations without long-term shelter, increasing susceptibility to health and safety risks and growing mental health issues (Acevedo & Pacheco, 2018; Dickerson, 2017). The devastation is extensive and widespread – 400,000 houses were in need of reconstruction and repairs which represents a third of the 1.2 million houses on the island (Brown, 2018). The recovery process has been strained and issues like ambiguous and inadequate funding processes have especially affected many communities where institutional support and resources were more scarce (De La Rosa, 2018). Only 40% of Federal Emergency Management Agency (FEMA) financial assistance applications have been approved (Acevedo & Pacheco, 2018) and 80% of appeal cases are pending or have been denied (Acevedo, 2018). As a result, many households and communities have relied on their own resources and efforts to reconstruct their houses (Portal, 2018; Viglucci, 2018). This kind of self-reliance has widespread precedents in pre-Hurricane Maria informal construction (Viglucci, 2018). Housing units considered 'informal' are more common in rural communities; where residents often sell or inherit properties through informal agreements, subdivide land without completing the title process, occupy government owned land to build homes, or build a house without completing the construction permit process. Housing informal reconstruction is defined in this research as design and construction actions carried out by community members in establishing permanent features of housing (e.g. design decision, physical labor) without following formal construction procedures or codes. This often comes in the form of family providing labor, building without inspections, or reusing scrap material. Estimates of informally built houses present on the island before Hurricane Maria range from 260,000 to 700,000 homes – the latter constitutes 60% of total homes on the island (Brown, 2018; Florido, 2018). These practices illustrate the culture of informality, particularly in regards to construction. Motivations for partaking in informal reconstruction include the challenges of formal disaster recovery programs which often include strict regulations on housing aid eligibility. Therefore many of these residents were unable to receive necessary resources for repair and reconstruction even though the resources may have been available. As a result, communities, particularly those with historically vulnerable demographics, rely on their own resources and efforts to initiate and maintain reconstruction processes, often through the use of their community and family relationships, or social capital.

Social capital represents the features of social organizations such as relationships, networks and trust which bring a wide range of benefits including coordination and cooperation (Portes, 1995; 2000). These resources are essential in the immediate aftermath of a disaster as it allows communities to mobilize which ultimately facilitates survival, improves access, and creates empowerment in a community (Aldrich, 2015; Nakagawa and Shaw, 2004). Previous studies suggest that social capital increased access to resources and reconstruction process (Aldrich, 2012), yet there is still more to learn from a scenario such as Puerto Rico with widespread

devastation and a historical lack of construction regulation enforcement. This study examines the social drivers behind informal housing reconstruction from a social capital perspective and asks: "*Which types of social capital were most instrumental in informal housing reconstruction in Puerto Rico after Hurricane Maria?"*

This question was explored through a mixed methods study including interviews with local community members (N=31) in three rural, low income municipalities in Puerto Rico and door to door household surveys (N=163) in one municipality. First, interviews were conducted to collect the narratives of the process of informal housing reconstruction. Data analysis included coding of interviews to find instances and patterns of social capital. Second, survey data captured informal housing reconstruction, social capital and demographic data at the household level. Data analysis of surveys included frequency matrixes evaluating the relationship between bonding, bridging and linking capital and informal housing reconstruction.

This research contributes to explaining the informal housing reconstruction in the aftermath of Hurricane Maria. Specifically, the findings will contribute to identifying which forms of social capital are critical for communities to rebuild on their own. The study contributes to a holistic perspective regarding practical difficulties and solutions during housing reconstruction especially when formal response and recovery resources become inaccessible. This has the potential to elevate the conversation of the housing recovery process; recognizing collective actions that drive communities to build informally. Identifying drivers to housing recovery does not only influence reconstruction but also helps authorities to acknowledge and understand the level of informality throughout these scenarios. Overall, the study can improve formal disaster recovery policies and action sequences to better align with those in disaster recovery scenarios.

RESEARCH RATIONALE

POST-DISASTER RECONSTRUCTION

Informal reconstruction is rooted in the literature on self-recovery, or 'self-build' and 'self-help', which represents communities organizing to rebuild or repair damaged or destroyed homes using their own resources (Parrack et al, 2014; Flinn, Schofield & Morel, 2017; Hendriks, Basso, Sposini, van Ewijk & Jurkowska, 2017). This often creates access to reconstruction that has become unavailable to many and these unregulated, or 'informal' methods allow vulnerable populations attempt to return to daily life as quickly as possible using the limited resources available to them. These methods have been critical for survival and mitigation of vulnerabilities as they offer a solution when disaster victims do not have the financial resources, time, or physical mobility to use other options and introduces significant control and agency (Flinn et al, 2017). This has been seen in historical and recent disasters, such as in the Philippines after Typhoon Haiyan (Flinn et al, 2017), and Gujarat India after the 2001 earthquake (Ahmed, 2011). These solutions have allowed families to rebuild with a faster timeline, are less financially and resource intensive and allows them to rebuild according to their own needs and preferences (Hendriks et. al, 2017).

Current response practices globally can provide for as low as 10% of the shelter needs within the first year, therefore it is 'inevitable' that communities build back on their own especially in developing contexts where resources are scarce (Parrack et. al,

2014). Previous work on self-recovery has primarily discussed its importance for community response and the related safety concerns (Flinn et al, 2017). However, there is still a lack of understanding of what drives self-recovery and why certain communities manage to effectively mobilize resources on their own. Identifying the drivers behind housing informal reconstruction expands post disaster recovery literature by specifying the social resources that are effectively used after a natural disaster. This view will aid in gaining a holistic perspective of informal reconstruction that extends further than the technical, financial and political components and includes the essential yet oft overlooked social and cultural perspectives.

SOCIAL CAPITAL

The research is based in social capital theory to explain how social relationships can facilitate or impede information sharing, participation and collaboration between community members (Coleman, 1988; Aldrich, 2012; Portes, 2000). These community features are essential especially in post-disaster contexts where people need to mobilize resources (Bolin & Stanford, 1998; Shaw & Goda, 2004). A comprehensive framework describing the different features of social capital includes bonding, bridging and linking social capital (Aldrich, 2012). *Bonding social capital* is characterized by horizontal connections between individuals within a similar community, such as ethnic, identity, language, family or neighborhood groups. *Bridging social capital* is characterized by horizontal links between communities of similar characteristics such as ethnic, religious, language, and community proximity. *Linking social capital* is characterized by primarily vertical links with formal or otherwise established organizations in power (Aldrich, 2012). These forms of capital affect post disaster recovery as they limit or facilitate access to resources and information. For example, linking capital facilitated grass-roots efforts with distant, larger organizations following Hurricane Katrina in New Orleans (Hawkins & Maurer, 2010) while bonding and bridging capital allowed residents in multiple communities in the Philippines to maintain mutually beneficial agreements, collective action and other forms of security (e.g. collective community building of dams to protect from flooding) (Bankoff, 2007). This past work has especially emphasized the importance of resource mobilization during post-disaster recovery. This research posits that bonding and bridging social capital contributes to housing informal reconstruction since it expands reach for non-redundant resource. Linking is not expected to play a role in housing informal reconstruction since authority figures can increase their oversight and influence in decision-making, likely reducing illegal or otherwise unwelcome behavior.

METHODS

Research Context

This research study uses a mixed methods approach to identify which forms of social capital contributed to informal reconstruction. Phase one consisted of 31 interviews with local community members in three communities (Adjuntas, Barranquitas, and Utuado) to identify social capital forms used for housing informal reconstruction. These locations were chosen as they were impacted significantly by Hurricane Maria and over 50% of residents in all three municipalities live under the official poverty

line (64.1% in Adjuntas, 60.7% in Barranquitas and 53% in Utuado) (US Census Bureau). The social capital and housing informal reconstruction themes identified in phase one informed phase two. Phase two consisted of 163 door-to-door household surveys in one community (Loíza).

PHASE ONE: QUALITATIVE DATA

Interview Data Collection

All interviews were conducted during May – June 2018 and were in Spanish or English or a combination, depending on the preference of the interviewee. The first author who speaks English and Spanish conducted all interviews, including an additional interpreter for some of the interviews. Interview participants were recruited through convenience sampling by local contacts and organizations. Each participant was contacted by meeting in person, describing the research study and inquiring if they were interested and had stories relevant to the research goals. Interviews lasted approximately 45 minutes to two hours, with total length of interviews approximately 24 hours and 40 minutes. Interviews were semi-structured and included questions regarding sources of reconstruction resources and key individuals or groups that helped in their reconstruction process such as "Where were you able to acquire materials for reconstruction?" and questions about community dynamics such as "Did your community become closer during this event?".

Table 1: Interviews conducted with Puerto Rico residents, business owners and stakeholder representatives

Municipality	Interview participants
Adjuntas	6
Barranquitas	13
Utuado	12
Total interview participants	31

Data Analysis

Interviews were transcribed verbatim and coded using Nvivo software for the intersection of social capital and reconstruction. Macrocodes include bonding, bridging and linking social capital. Microcodes represent specific bonding, bridging and linking relationships. The coding framework contained the macrocodes of bonding, bridging, and linking social capital, further split into microcodes; seven each within bonding and bridging, and four within linking. Many of those codes have further subcodes within them to further specify groups and subgroups identified as significant connections. These microcodes further specified the sources of social capital, for example family and neighbors within bonding, local organizations and the diaspora within bridging, and government and community leaders within linking. Groups were categorized within these macrocodes based on levels of closeness, existence of power dynamics, and according to previous literature updated for cultural considerations.

Reliability

Reliability was incorporated into data collection through community engagement and gaining an insider's perspective. In Adjuntas, the in-field researcher (first author), partnered with a local sustainability-focused organization that held a significant role in Hurricane Maria recovery. The researcher assisted in household assessments with the organization to improve community understanding and recruit participants. In Barranquitas, insider's perspective was pursued by volunteering for three weeks with a volunteer reconstruction organization to understand the methods, networks, and difficulties in the reconstruction process, understand community context and recruit participants. In Utuado, the insider's perspective was pursued through working with a local civil engineering student to understand the technical aspects of the reconstruction process, community context and recruit participants.

To increase reliability in the analysis phase, transcriptions were coded by two researchers (Munoz & Bangdiwala, 1997; Zerio, Opdyke, & Javernick-Will, 2016), including one undergraduate political science student from Puerto Rico. The participation of the Puerto Rican student assists in accounting for any cultural sensitivities and local knowledge, as well as political theory considerations. These considerations were important to understand the roles and responsibilities of stakeholders, specifically in linking capital, which relies heavily on agencies, organizations, policy decisions, and political actors. Interrater reliability scores are being calculated and will be included in the next draft of this paper. The transcripts were coded by the researchers individually and inter-rater reliability scores in the form of Cohen's Kappa coefficient using NVivo software will be reported. The reliability tests sameness of coding by each of the researchers. A value of 0.6 (60% agreement) will be used as the threshold for achieving substantial coding agreement (Munoz and Bangdiwala 2012).

PHASE 2: QUANTITATIVE DATA – HOUSEHOLD SURVEYS

Research Context

Surveys were conducted in the rural municipality of Loíza in Northeastern Puerto Rico just over one year after Hurricane Maria. This municipality was chosen because it had a significant presence of informal construction before Hurricane Maria which reduced the ability of the community to receive official assistance. Additionally, the housing stock in the municipality was significantly destroyed by Hurricane Maria and required major reconstruction. Furthermore, Loiza is considered lower income area (average annual income is $17,273 (US Census Bureau)) which affected the capacity of the households to find the necessary resources to reconstruct.

The municipality of Loíza has a population of roughly 26,000 people with an unemployment rate of 7.9%. The average annual income is $17,273 which is below the average annual income in Puerto Rico (US Census Bureau). Also, 51.9% of the Loíza population live below the poverty line (US Census Bureau). Loíza is situated in the northeastern side of the island, bordering the main airport and in close proximity to the capital city and main metropolitan area of San Juan.

Data Collection

Door to door surveys (N=163) were gathered from households within the municipality during December 2018 – January 2019. The first author spent one week collecting data and was assisted by seven paid local residents. Surveys were written

and administered in Spanish. Surveys were mainly administered verbally however at times the surveys were left at houses and collected later in the day to accommodate the respondent. The municipality is officially split into six neighborhoods ("barrios") and surveys were collected from each neighborhood first based on proportion of population living in each barrio, that is, we attempted to approach neighborhoods according to the proportion of the total population of Loiza that lives in each neighborhood. Second, case selection was based on convenience sampling, allowing us to survey people who were around and willing to participate as our sampling plan required door to door communication thus there were considerable constraints due to who was home, housing density and issues of safety for areas to collect data. Individuals that responded to door to door communication or who were met in public places were screened by meeting the requirement of being the owner of a household within the study area that had sustained significant damage.

Table 2. Percentage of survey respondents in each barrio

Barrio	**Percentage of Loíza population**	**Survey respondents**	**Percentage of total respondents**
Canóvanas	23.22	18	11.04
Loíza pueblo	12.89	10	6.14
Medianía Alta	26.68	74	45.40
Medianía Baja	29.21	47	28.83
Torrecilla Alta	0	0	0
Torrecilla Baja	8.00	13	7.98

*Note: barrio of one respondent was unclear

First, the survey asked for demographic data, including gender, age, religious affiliation, highest level of education, approximate household annual income, number of adults (specified for employed or unemployed), number of children that lived in the house, and place of birth. Second, the survey asked for indicators about the informality of the house before Hurricane Maria including a question asking if the house was built with permits or if they had ever added on to the house without using building codes. Third, the survey asked respondents to assess the level of damage to their house and where they received different types of resources (physical labor, construction materials, technical expertise, etc.). Fourth, the survey asked for the respondent to give a percentage of how much of their necessary reconstruction has been completed, and percentage of the reconstruction actions that could be considered informal. Finally, the survey asked questions regarding their household social capital. These items were adapted from phase 1 qualitative data in this study and previous literature (Villalonga-Olives, Adams & Kawachi, 2016; Grootaert, Narayan, Jones & Woolcock, 2004; Rodríguez-Rey, Alonso-Tapia, & Hernansaiz-Garrido, 2016; Aldrich, 2012; Aldrich, 2019) to fit the specific context. Bonding, bridging and linking social capital were measured through multiple variables. Bonding indicators measured the frequency and strength of connections within a community to which they belong (neighborhood, religion, etc.) and included questions such as "How would you rate this community as a place to live?" and "How often do you attend community events?" Bridging indicators measured the frequency and strength of connections with people outside of their main communities that they do not

necessarily identify with and local organizations and included rankings of how often they interact with people from different communities, or people with a different religion, ethnicity, etc. Linking indicators measured the frequency and strength of connections with authority groups and included such questions as “Do you know anybody personally who works for the local government?” and “Do you know anybody personally that volunteers with a reconstruction organization?”

Data Analysis

Survey data was examined with descriptive statistics to identify the relationship between social capital and informal reconstruction. Frequency tables showing high/low reconstruction and high/low of each of the types of social capital were created to view relationships with chi squared tests.

Reliability

Reliability in data collection was considered through hiring local students to assist with administering surveys. This added a consideration of cultural sensitivities, improved understanding of the local context, language proficiency in the survey language and discussions about improving analysis of the results amongst the different perspectives of the survey administrators.

RESULTS

Phase one data was used to inform materials for phase two data collection. The dominant narratives regarding the process of reconstruction and relevant resources, sources of help, barriers to reconstruction and points of conflict were gathered to create survey questions and structure the survey process. Phase two presents descriptive statistics related to the use of informal processes for reconstruction and social capital. Preliminary relationships are presented quantifying the relationship between the test variables. The following results are broken down into phase one and phase two main findings.

PHASE ONE RESULTS: SOCIAL CAPITAL AS NARRATIVES REGARDING INFORMAL RECONSTRUCTION

Interview analysis identified main themes for social capital as a driver for informal reconstruction, organized according to the coding framework.

Bonding Capital

Bonding social capital was essential for the recovery process in the communities observed. Interviewees who lacked financial resources relied on their families and neighbors to obtain help during the reconstruction. As one respondent mentioned: “*I wanted to hire someone, but the money was not enough, you know*”. Family help often included labor offered by family members, who provided the possibility to reconstruct. Another respondent mentioned: “*Money was not enough to do the bedroom and fix upstairs. At least my son has a little bit of knowledge, and my brother had helped him with whatever he did not understand, and that is how we have been doing, almost, almost, almost there*”. Furthermore, this type of self-performance reflects how bonding capital has been a tool for informal housing reconstruction; specifically, the capability to circumnavigate challenges without any formal procedures. The factors of why families engage on informal reconstruction is

articulated by our interviews, explaining the improvised and largely uncertified labor resources.

Second, interviews uncovered that there was a strong sense of the Puerto Rican identity that encouraged assistance amongst people responding together as they felt tied to each other and they had a larger duty to help Puerto Rico recover through helping individuals. For example, a local hardware store manager discussed his financial ability to leave the island but the pull he felt to stay and help where he could.

Bridging Capital

Bridging social networks were the principal actor in communities like Adjuntas, where community-based organizations had strong ties in their communities; connecting, organizing and mobilizing resources in the reconstruction process. For example, the organizations knew and had connections to key individuals that could help in the community, such as engineers or community leaders. This helped for distributing resources as well as gathering the appropriate people to further the reconstruction process. However, many organizations that usually fill other needs besides construction and are responding to a crisis rather than extending their work to the disaster context often limit themselves to response rather than reconstruction. Therefore only select organizations were instrumental in the actual reconstruction phase, even though their response activities such as distributing food and water helped support efficient and early reconstruction.

On the other hand, the study found that bridging capital in the form of local businesses was essential for moving reconstruction materials around the island; using the bridging connection of hardware stores as mentioned by one respondent: "*…with another National "ferreteria" (hardware store) maybe in another town, they would complement with each other. Like, I do not have this, go there…*". Besides the connections for restocking materials, the bridging capital within hardware stores made for a more effective flow of information around these communities. "*If I do not have something, I can call another hardware store, and if this store has extra merchandise, we make business and supply the merchandise needed, until I get my own for my business*". This is reflected also in local organizations that have the networks within and between communities to bring together the right minds and stakeholders to be of assistance in this process *"Casa Pueblo (Adjuntas) directed a board involving: engineers, experts, and ordinary people within the community to respond to the urgent problems of the recovery"*.

A specific area in which bridging capital intersected with informal practices was by lending credit to the surrounding community, increasing ability to reconstruct and move towards recovery. Furthermore, giving informal consultation for materials and methods to reconstruct. A hardware store manager noted *"In our store, some clients do not have financial resources; however, we lend materials, and they would pay us later."* In this manner the hardware stores had built an informal credit system, helping individuals to access resources and expertise, even though formal procedures or experts did not necessarily accompany them.

Linking Capital

Interviews uncovered that people who were close somewhat to any elected official or any actor from the local or federal government did not show any benefit from those

relationships. Consequently, governmental authorities had a pressure of the legality of the reconstruction processes, where the absence of legal title of the house significantly decreased their ability to approve resources, regardless of their personal connection to or sympathy for the applicant. *"FEMA disqualified me because… the little house that the grandmother left many years ago, but it was with an affidavit, but I did not have the official deed"*. FEMA had primary jurisdiction in distributing funds for housing reconstruction, however the FEMA system of law confronts the cultural approaches of the Puerto Rico system of law, where generations could transfer land with an affidavit. Moreover, FEMA did not recognize this as a legal document, denying services to the majority of the interviewees. Moreover, we found that our interviewees did not have any relationships whatsoever with FEMA workers or significant help in reconstruction from their relationships with local officials. This gap exposed the lack of linking social capital in the housing recovery process of Puerto Rico in the aftermath of Hurricane Maria.

PHASE TWO RESULTS: QUANTIFYING THE RELATIONSHIP BETWEEN SOCIAL CAPITAL AND INFORMAL RECONSTRUCTION

The above narratives informed survey questions used to quantify the relationship between bonding, bridging and linking capital, and informal reconstruction. Specifically the main struggles in the accessing resources, such as strict legal requirements, damage to transportation networks and the subsequent unjust distribution of resources throughout the island due to inaccessibility. Survey data verified results discovered in interviews and follows similar relationships between the variables.

Community Demographics

The sample included a diverse sample in terms of gender (31.3% males and 68.7% females), employment status (55.8% unemployed and 44.2% unemployed). In terms of ethnicity, 94% of the sample included Puerto Ricans and the rest included mainland USA, Dominican Republic places of birth. Respondents were between the ages of 18 and 95 with a mean age of 59.

Reconstruction Actions

85% of respondents reported they had begun their process of reconstruction, and 25% had begun within a month of Hurricane Maria. 68.9% have completed 50% or less of the reconstruction needed on their house, only 7.9% had completed 100% of their reconstruction and 15.2% had not started reconstruction or did not plan to reconstruct. When presented with the definition of 'informal reconstruction' as defined in this research, 20.7% of respondents reported 0% of use of informal actions, 43.6% reported using more than 50% informal reconstruction methods and 27.9% reported 100% use of informal methods. Over 50% did not have an official inspection during reconstruction and roughly 35% of those who did not report working with a contractor reported they did not refer to any building codes during their reconstruction process.

Social Capital and Informal Reconstruction

This section presents preliminary descriptive statistics quantifying the relationship between the independent (social capital) and dependent (informal reconstruction) variables. The indicator used for reconstruction practices was a question asking the

respondent to give a percentage of how much of their reconstruction actions could be considered 'informal', after presenting them with the definition used in this study. High use of informal was categorized by an answer greater than 50% marked on the percentage scale supplied on the survey. Of the 142 respondents, 45% were categorized as high informal users.

Table 3. Frequencies and chi square results

		High informal reconstruction	Low informal reconstruction	Chi square	P value
BONDING	High social capital	18	15	1.5125	0.219
	Low social capital	37	51		
BRIDGING	High social capital	44	42	3.9074	0.048*
	Low social capital	11	24		
LINKING: Local government	High social capital	30	17	8.4186	0.004*
	Low social capital	34	56		
LINKING: Federal government	High social capital	9	6	1.346	0.246
	Low social capital	53	67		

* Statistically significant at $p < 0.05$

The indicator used for bonding social capital was a self-identified frequency of how often they attend community events. A frequency above once a month was categorized as high social capital, anything less was categorized as low social capital. Of the 130 that responded to the question, 28% were categorized as high social capital.

The indicator used for bridging social capital was a self identified frequency of how often they interact with people from a different community. A frequency above once a month was categorized as high social capital, anything less was categorized as low social capital. Of the 132 that responded to the question, 71% were categorized as high social capital.

The indicator used for linking social capital (local government) was how many people they know personally who work in the local government. Knowing more than two people was categorized as high social capital, anything less was categorized as low social capital. Of the 152 people that responded to the question, 35% were categorized as high social capital.

The indicator used for linking social capital (federal government) was how many people they know personally who work in the federal government. Knowing more than two people was categorized as high social capital, anything less was categorized as low social capital; an even split of the four possible responses given in the survey.

Of the 146 people that responded to the question, 10% were categorized as high social capital.

DISCUSSION

PHASES 1 AND 2: QUALITATIVE DATA

Survey results take the identified issues from the surveys and turns it into quantifiable relationships. Interviews generally found bonding social capital to be the most successful at mobilizing resources to reconstruct households when formal processes such as FEMA assistance were accessible. A very close second was bridging capital in the form of local organizations as they had the pre established networks within and between communities to find and distribute the appropriate resources. Linking was not discussed at length in interviews and when they were mostly took the form of inaccessible processes with FEMA. These results are echoed and furthered in the quantitative analysis where results show statistically significant relationships between bridging social capital and use of informal reconstruction practices, and linking social capital in the form of ties with local government, and use of informal reconstruction practices. Perhaps these results can be explained through bridging social capital increasing the reach of resources from other communities, allowing households to reconstruct when their immediate community does not have access to the necessary resources. Loíza is a low income area of Puerto Rico reinforcing the hypothesis that bonding capital may not be an important factor if there are already limited resources within the community. This aligns with a previous study that found bonding capital has significant limitations in the long term recovery phase as the immediate community is limited by the same damages from the disaster and state of poverty, and there is often potential for residents within the same community to begin competing for the same scarce resources (Islam and Walkerden, 2014). Furthermore, Aldrich (2010) specifically notes the importance of bonding capital in post-disaster reconstruction because of its role in information sharing such as neighbors sharing learned information about reconstruction procedures and deadlines. However, infied observations confirmed there was a widespread lack of communication throughout the island in the aftermath of the disaster, reducing the effect of bonding social capital in this aspect. The Islam and Walkerden study (2014) also stated that at the same time, bridging capital was helpful in receiving resources from organizations that did not have enough to supply the entire community as organizations assisted in the situations they knew about (Islam and Walkerden, 2014).

The result regarding local government linking social capital may be a false positive and explained by local government involvement in response activities prior to reconstruction. Response is vital for reconstruction as it supplies resources that communities need to stay healthy and stay in the area to rebuild. Disaster recovery literature suggests that local governments in past disasters have been overwhelmed by the sheer amount of need and the roles they must play in recovery (Smith & Wenger, 2007). Furthermore, the large number of groups and agencies the government must organize leads to either poor communication and misaligned efforts, or too much time in meetings coordinating stakeholders (Félix, Monteiro, Branco, Bologna, & Feio, 2015). However, many survey respondents noted that the local government such as the mayor and town hall were present and influential during the immediate response,

distributing food and water and checking on community members. Response activities are vital to eventual reconstruction as they allow for immediate survival and resistance to migration to stay and rebuild their homes, however is not the focus of this study.

THEORETICAL CONTRIBUTIONS

The overall theoretical contribution from this research is that social relationships are key to enlarging capacity to reconstruct within systems that can be difficult to access and navigate. Particularly, bridging relationships to other neighborhoods, religious groups, ethnic groups, local organizations, etc. are important in determining levels of informal reconstruction used. Furthermore, these results confirm the hypothesis that social resources are vital for recovery for a much longer timeline in Puerto Rico beyond initial response actions and endure throughout rebuilding permanent housing, as previously seen in other developing contexts (Aldrich, 2012). This is a contribution to recovery theory in understanding how ingrained social resources improve accessibility to rebuilding in a context where many face barriers against recovery. This is expanded in this study to a context where residents have faced significant setbacks when attempting to use official processes, such as traditional construction methods misaligned with FEMA requirements and resource scarcity, than seen in previous studies (Aldrich, 2012; Bankoff, 2007). However, this study cannot comment on the quality of the informally constructed houses or ability to mitigate for future events.

PRACTICAL CONTRIBUTIONS

This study helps inform who are the important individuals or groups in a post-disaster context and how/when they are naturally mobilized after a disaster. In this way, policymakers and organizations can focus on getting resources to the ideal locations that facilitate recovery most effectively. Specifically, the results show that organizations that bridge communities and local government are effective at mobilizing capital that facilitate recovery thus post-disaster networks can prioritize distributing resources to these organizations and supporting their efforts.
These results also inform stakeholders of the importance of finding ways to make communities redundant or plan for contingencies so there are resources available within the community in times of vulnerability, reducing the need to rely on outside sources.

CONNECTION TO THE GRAND CHALLENGES

This project addresses the grand challenges of the new project manager and project networks as construction considerations are expanded to incorporate social aspects. Networks and those who work in them, specifically in a post-disaster context must be holistic to capture the whole picture of what is happening and considerations for viable solutions. Single factors cannot be understood in isolation, thus the social drivers to informal reconstruction are equally as important as traditionally considered drivers such as economic or political. It is vital that new project managers are equipped to consider diverse factors and holistic projects. Nothing can be understood in pieces, current networks and project managers are incomplete without allowing for alternate truths.

LIMITATIONS

In both phases small sample size limits generalizability, thus more collection would need to be conducted to improve robustness and generalizability of results.

In phase one collection, semi-structured interviews did not ensure uniformity among participants, thus there is a chance for interviewer bias as they had the power to decide follow up questions based on their opinion of what was important to pursue. In phase two, limitations in survey design include limitations in face to face surveys with the surveyor asking questions and documenting answers. A variety of the questions included illegal or unsavory options for answers, such as admitting to building without permits or rating your community as a terrible place to live. There is potential for bias being reflected in the answers as some respondents may have felt uncomfortable stating that to another person or felt they may have been reprimanded or reported. Furthermore, working in lower income areas administering the survey door to door limited data collection to daylight hours creating a response bias capturing more of the population who were elderly or disabled as they were most likely to be at home. Data was also collected on the weekend to attempt to capture households with only working members to mitigate this issue as much as possible. Furthermore, there is significant response bias in administering door to door surveys as we were only able to survey people who were home at the times we came by and wished to participate.

CONCLUSION

This study investigated the relationship between bonding, bridging, and linking social capital and informal reconstruction. Preliminary analysis found significant relationships between percentage of informal reconstruction used and bridging, and linking social capital in the form of ties with the local government. These results have implications for theory and policy in how we view and mobilize established and emerging groups in the aftermath of a disaster. Future analysis for the next draft of the paper will include combining social capital indicators for a holistic score of social capital for each respondent. Future studies will further the investigation of informal reconstruction with a focus on institutional drivers. This includes government agencies, organizations and emergent institutions in the aftermath of a disaster.

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