**Household Awareness of What to Do in a Disaster:
A Social Capital Approach**

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*This article investigates the utility of a social capital approach for explaining household awareness of what to do in a disaster in the context of long-term threats. Using data from a household survey in Dominica, it assesses how the concepts and measures for two variants of social capita—relational and community—can be used to explain three separate awareness outcomes. Results demonstrate the relevance of both relational and community social capital tools for disaster research. Each type of social capital was found to be significantly related to a different awareness outcome. Further, although there was no evidence of a different effect of relational social capital across outcomes, there were significant differences between the effects of community social capital on awareness of protective measures, knowledge of what to take to a shelter, and familiarity with disaster committee responsibilities.*

**Key words:** Social capital, awareness, social networks, community preparedness

## Introduction

Social capital broadly refers to aspects of social relations that yield benefits to actors, and this aspect has gained considerable popularity among sociologists and political scientists over the past two decades. Social capital can be understood in two different ways: as broad social cohesion within groups or individual access to social resources (Esser 2008; Kawachi, Subramanian, and Kim 2007). Empirical studies have already highlighted the role of social networks and community integration in disasters, and social capital can thus provide a useful addition to disaster theories (Dynes 2002, 2005; Koh and Kadigan 2007). A growing body of literature has (more or less explicitly) considered the role of social capital in explaining individuals and communities' differential ability to respond and recover from disasters (Berke, Kartez, and Wenger 1993; Buckland and Rahman 1999; Comfort 1999; Hawkins and Maurer 2009; Hurlbert, Haines, and Beggs 2000; Jessamy and Turner 2003; Kartez 1984; Murphy 2007; Nagakawa and Shaw 2004;

Zhao and Dalen 2006), and there is abundant evidence that informal and community networks shape access, receptivity and reaction to risk information (Aguirre 1991; Drabek and Stephenson 1971; Kirschenbaum 2004; Lindell and Perry 2004; Turner, Nigg, and Heller Paz 1986). Nonetheless, constructs and measured variables vary considerably and few studies have given a comprehensive overview of how social capital concepts and measures could be applied to disaster contexts. Using data from six communities in the Caribbean island of Dominica, this article sets out to address this gap and explores the applicability of a social capital approach in advancing our understanding of household awareness of what to do in a disaster in the absence of near-term threats.

## Linking Social Capital to Awareness of Appropriate Disaster Response

### Awareness of Appropriate Disaster Response in Normal Times

Communities and households are the first (and sometimes only) line of response in emergencies (ADPC 2003; Delaney, Avtar, and Miller 2004; IFRCS 2002; Kokawa 2003; Perwaiz, Balaka, Trebucq, Padmanabhan, Stephan, Mohapatra, Sengupta, and Chaudhary n.d.). At the household level, households must be ready to take self-protective actions and to act to obtain the resources needed to support effective response when disasters strike. Awareness of what to do in a disaster is an important first step towards action.

This study specifically examines household awareness of what to do in a disaster in the context of long-term threats. Research has traditionally focused on the role of social and community interactions in disasters. However, as we seek to devise effective long-term strategies to build a culture of safety and prevention and decrease the risk of major disasters, an improved understanding of how social context shapes awareness of suitable actions in the absence of immediate threats becomes critically important.

### Defining Social Capital

The concept of social capital has provided insights into a wide range of political, economic, and social issues. While (or maybe because) social capital is an extremely popular concept across a variety of fields, the specific constructs and variables used have noticeably varied across studies. Although a clear consensus has yet to be reached, there is increasing agreement among scholars that there may be several variants, or types, of social capital, and that a distinction between more individual and more collective forms of social capital should at least be operated (Author 2009; Esser 2008; Foley and Edwards 1999; Hooghe and Stolle 2003; Kawachi et al. 2007; Krishna 2003a; Lin 1999a; Ostrom and Ahn 2001, 2003). The former, referred to as relational social capital in this paper, focuses on the resources (of all kinds) that may become available to a focal

individual as a result of the relationships he or she develops and maintains with others. The latter, community social capital, focuses on the quality of relationships among actors within a well-defined group (often the community), and refers to the features of social organizations (e.g. networks, norms, and social trust) that facilitate coordination and cooperation within that group (Putnam, Leonardi, and Nanetti 1993). Despite its collective quality, it can be useful to identify community social capital at the household level since the ability to cooperate as a group does not presuppose that all households equally share in the networks, norms, and trust that make up community social capital, but only that a critical mass does (Marwell and Oliver 1993).

Social networks and connections have been found to be an important channel for confirming, correcting, and supplementing warning messages (Aguirre 1991; Fitzpatrick and Mileti 1994; Lindell and Perry 2004; NRC 2006; Turner et al. 1986), as well as to provide informal support for individuals to cope and recover, both materially and emotionally, following disasters (Bolin and Klenow 1983; Hurlbert et al. 2000; Kaniasty and Norris 1995; Zhao and Dalen 2006; Zhao n.d). Switching to a collective focus, there is evidence that communities with stronger horizontal associations and ties between individuals that display greater levels of trust and deeply held and widely shared norms and behavioral expectations respond and recover better and faster from disasters (Berke et al. 1993; Buckland and Rahman 1999; Comfort 1999; Jessamy and Turner 2003; Kartez 1984; Murphy 2007; Nagakawa and Shaw 2004). Thus studies have related social networks and social capital (albeit not always explicitly) to a range of disaster behaviors, and it is a logical extension to explore whether relational and community social capital serve as a vehicle for building a culture of shared knowledge and practical experience on what to do in a disaster in normal times.

**Relational Social Capital**

Relational social capital relates to the resources embedded in social networks that are made available to actors. It is determined by the personal resources of network members, as well as by the structure of the network that link actors (Foley and Edwards 1999; Hurlbert et al. 2000; Lin 1999a, 1999b, 2001; Portes 1998; van der Gaag and Webber 2007). Further, relational social capital is goal-specific, which means that specific configurations of network resources and structure have distinct roles in the productivity of relational social capital in different contexts (Flap and Völker 2001; Granovetter 1973; Hurlbert et al. 2000; Lin 1999a; Pescosolido 1992; van der Gaag and Webber 2007; van der Gaag, Snijders, and Flap 2004). Researchers have empirically validated this theory in disaster contexts. Looking at recovery from natural disasters in Western China, Zhao and Dalen (2006) for instance indicated that small, dense "core" networks provided informal support, while larger, less-dense networks improved the circulation of information. Thus research on the productivity of relational social capital should start with specifying what

relational social capital is expected to do (Kawachi et al. 2007; Sobel 2002). Furthermore, it warrants the use of multiple measures, each turned towards specific sub-dimensions, in order to determine which features are relevant in relation to specified outcomes (van der Gaag and Webber 2007).

Facilitating information flows has been repeatedly emphasized as one of the primary functions of social networks in a variety of fields (Burt 1997; Campbell, Marsden, and Hurlbert 1986; Granovetter 1973; Hurlbert et al. 2000; La Due Lake and Huckfeldt 1998; Lin 2001; Marsden 1987; Renzulli and Aldrich 2005). Disaster studies have also reported that social networks are an important information channel before (Aguirre 1988; Fitzpatrick and Mileti 1994; Turner et al. 1986) and after (Erickson, Mostacci, Nosanchuk, and Dalrymple 1975; Richardson, Erickson, and Nosanchuk 1979; Zhao n.d.) disasters, as well as in the absence of specific threats or warnings (Kirschenbaum 2004). In line with these findings, the basic premise of this study's argument is that households equipped with "relevant" relational social capital will be better informed of what to do in a disaster. Looking to define "relevant" relational social capital in this context, this research focuses on two particular aspects of the distribution of social resources within networks: resource quality and diversity. This decision reflects both practical constraints (as related to data collection issues) and theoretical choices guided by the available literature on relational social capital and disaster behaviors, as described below.

**Resource quality.** Resources are valued goods in society. However, the number of possible resources held by network members is very large, and it can be difficult to determine exactly what goods, or combination thereof, may help individuals attain their goals and should thus be considered in relation to relational social capital. To solve this problem, relational social capital theory operates on the assumption that socioeconomic standings provide a single "currency" able to capture various valued social resources in most societies because of their correspondence with wealth, status, and power (Lin 1982; 2001; Lin, Ensel, and Vaughn 1981; van der Gaag and Webber 2007; Weber 1946). In this study, this assumption translates into treating socioeconomic standings as a proxy for the disaster expertise and/or experience of network members, which is somewhat reasonable as positional characteristics are generally assumed to affect information receipt and processing (Kirschenbaum 2004) and because they further correlate with hazard adjustments (Lindell and Perry 2000; Tierney 1993; Tierney, Lindell, and Perry 2001). It is expected that, as the mean expertise within a network (i.e. resource quality) increases, so may the availability of "relevant" relational social capital, thereby resulting in enhanced awareness of what to do in a disaster. Thus it is hypothesized that:

**H1:** Resource quality enhances household awareness of what to do in a disaster.

**Diversity.** Diversity simply reflects whether different resources are represented in the focal individual's social network by at least one instance (van der Gaag and Webber

2007). Again, resources are represented by socioeconomic standings. There is considerable evidence from a varied literature that heterogeneous networks that connect dissimilar individuals and reach diverse parts of social structure are more likely to provide access to new and non-redundant information (Burt 1997; Campbell et al. 1986; Granovetter 1973; La Due Lake and Huckfeldt 1998; Lin 2001; Marsden 1987; Renzulli and Aldrich 2005). Thus results from a study of the Sichuan earthquake area for instance suggests that heterogeneous networks facilitated access to new information following a disaster (Zhao n.d.). Conversely, homophilous networks can limit openness to new information, ideas, and alternative behaviors (Nahapiet and Goshal 1998; Portes and Sensenbrenner 1993). In addition, hazard intrusiveness (defined as the frequency with which people think about and talk about hazards and hazard adjustments) was found to be an important predictor of adjustment adoption (Lindell and Prater 2000). Even if an individual rarely talks about hazards or is not surrounded by others with new information or specific expertise, the proliferation of diverse contacts with different levels of knowledge, experiences, and receptivity to disaster information stochastically increases the chances that informal discussions related to disasters will be held. Therefore it is predicted that:

**H2:** Diversity positively relates to awareness of what to do in a disaster.

## Community Social Capital

Although community networks also lend community social capital an informational potential, typical features of community social capital further include collective bondedness, trust and cohesion, and norm adherence. Disaster studies have documented the importance of geographic proximity in emergencies. Residents of a community share common threats and community networks provide channels whereby individuals develop a perception of risk and can be motivated to take preventive actions (Dynes 2005). In this context, community social capital could prove highly salient in explaining awareness of what to do in a disaster. Of particular relevance is the fact that community social capital provides an orientating attitude that directs actions because actors adhere to a shared system of norms and values (Esser 2008). This feature echoes Palm's suggestion that risk mitigation behaviors may be "more related to socially shared rules or norms than to individual-level assessments" in cultures where one is viewed as interconnected to others (Palm 2005, p. 128). Arguments about the emergence of disaster cultures further lend particular support to the possibility of an effect of community social capital on awareness of what to do, as these postulate that norms of appropriate behaviors are developed and shared in areas experiencing recurrent disasters (Dynes 2005; Mileti and Darlington 1997; Wenger and Weller 1973). Community social capital could, *a priori*, provide support to the development and adoption of appropriate behaviors or, on the other hand,

to the perpetuation of passivity, ignorance, or misinformation. Indeed in keeping with Foley and Edwards' comment on the "paradox of civil society" (1996), it has been noted in the disaster literature that community social capital can be a dual-edged sword and in some occasions be detrimental to the pursuit of certain outcomes (Aldrich and Crook 2008, Buckland and Rahman 1999).

However, empirical considerations related to the effect of variables such as community integration and involvement in the context of risk-information communication and adjustment adoption tend to provide support to a positive effect of community social capital on awareness of what to do in a disaster. Warning research suggests that membership in voluntary associations and community organizations, a commonly-used measure for community social capital, enhances access to information and provides opportunities for message confirmation (Aguirre 1991; Baker 1979; Lindell and Perry 2004; Perry, Lindell, and Greene 1981). Additionally, Turner et al. (1986) found that community bondedness (defined among other things as identification of the neighborhood as one's home and participation in community organizations) encouraged active preparedness more than fear of or concern for disasters. They interpreted community bondedness as a form of community involvement that "invest(s) life with meaning" (p. 185), and thereby encourages individuals to act. Isolation within the community, on the other hand, leads to passivity and the inability to address problems actively. Thus it is hypothesized that:

**H3:** Community social capital elicits increased awareness of what to do in a disaster.

## METHOD

### Data and Sample

Data to test the study's hypotheses were collected from a household survey and key informant interviews conducted in six coastal communities in Dominica. Like other Caribbean islands, Dominica has very high exposure to hurricanes and other climate-related hazards. Between 1986 and 1996, the island experienced 40 tropical storms and 19 Category 1-3 hurricanes, and 13 years witnessed multiple storms (CDERA 2003). Although there had not been a hurricane in Dominica in six years at the time of this research, further severe weather events are virtually unavoidable. Thus Dominica provided an opportunity to study how people respond to the long-term threat of disasters in the absence of recent or imminent events.

Data collection occurred between January and April 2006, outside of the hurricane season. The study communities were purposively selected on the principle that they shared similar levels of disaster exposure and experience. Further, the six communities were divided between two districts to ensure variations in institutional arrangements for

disaster management. A random proportionate sample of 20 percent of households was selected in each community using the 2001 Census as a sampling frame. The smallest community was oversampled. A household survey was administered to 182 households by trained local interviewers and resulted in 179 complete interviews. The minimum cooperation rate was 86.1 percent.[1] The chairs of local disaster committees in each village and district-level officers were also interviewed.

**Measurement**

   **Awareness of Appropriate Disaster Response.** Table 1 displays a list of all variables and measures. Three household-level outcomes were investigated that provide a comprehensive picture of awareness of what to do in a disaster: awareness of appropriate protective actions to take around one's home in the event of a hurricane, knowledge of what to bring to a shelter when evacuating, and familiarity with disaster committee responsibilities. Each aspect was measured directly from respondents' answers to survey questions and corresponds to a slightly different dimension of the disaster event phase: protective actions, evacuation procedures, and organized disaster management activities.

   **Social capital variables.** Measures of the two aspects of relational social capital, resource quality and diversity, were derived from Position Generator data. The Position Generator method, first developed by Lin and Dumin (1986), uses a hierarchically ordered sample of occupations and asks whether the respondent knows anyone in each sampled occupation. It is content-free and can be used across various life domains. Although other measurement methods exist, the Position Generator is the method of choice in relational social capital research emphasizing the productivity of social resources for instrumental use (of which access to information is a common example) (van der Gaag and Webber 2007). As stated earlier, the assumption underlying relational social capital theory is that socioeconomic standings refer to valued resources attached to occupied positions (Lin 1999b). Thus in the Position Generator method, occupations are typically ranked using prestige or occupational status scores. The Position Generator in this study used a sample of 14 occupations selected based on interviews with local people and key informants. Scores were attributed to each occupation using the International Socio-Economic Index of Occupational Status (ISEI) compiled by Ganzeboom and Treiman (1996).[2] In line with the idea of goal-specificity of relational social capital and the hypotheses specified above, resource quality and diversity were taken to represent different theoretical dimensions and their productivity investigated through the use of two separate measures. Resource quality was measured as the average status score of all sampled occupations in which the respondent indicated knowing someone. Diversity was calculated as the number of sampled positions in the respondent's network.

## Table 1. Measurement Of Variables

| | Mean (S.D.) | Measure |
|---|---|---|
| *Dependent variables – Derived from household survey* | | |
| Awareness of protective measures | 1.72 (0.08) | Number of correct and non-redundant actions cited by respondent out of a possible 3. |
| Knowledge of what to take to a shelter | 2.85 (0.03) | Number of correct and non-redundant items cited by respondent out of a possible 3. |
| Familiarity with disaster committee responsibilities | 1.03 (0.09) | Number of correct and non-redundant responsibilities cited by respondent out a possible 3. |
| *Independent variables (household level) – Derived from household survey* | | |
| Resource quality | 49.27 (0.39) | Mean of the status scores of all sampled occupations in which the respondent indicated knowing someone. |
| Diversity | 8.77 (0.20) | Number of sampled positions in which the respondent indicated to know. |
| Community social capital index | -0.06 (0.22) | Average of standardized scores for five items listed below. |
| *Membership in groups* | 0.29 (0.03) | 1=member of a community association, 0=not a member. |
| *Expectations of mutual support* | 3.96 (0.06) | Respondent rating of perceived extent of community-level volunteering to clear debris after a hurricane on a scale of 1 to 5 (1=less than 25%; 2=25–50%; 3=50–75%; 4=more than 75%; 5=100%). |
| *Expectations of solidarity* | 1.50 (0.07) | Respondent rating of perceived levels of community-level assistance in building or repairing homes on a scale of 0 to 3 (0=family, paid help or close relatives; 1=relatives and neighbors/friends; 2=relatives, neighbors/friends and small group of residents; 3=almost everyone). |
| *Lending of personal items* | 1.37 (0.07) | Respondent rating of their willingness to lend personal items to others in the community on a scale of 0 to 3 (0=no one or close relatives; 1=close relatives and neighbors/friends; 2=relatives, neighbors/friends and small group of residents; 3=almost anyone). |
| *Collective action* | 2.17 (0.08) | Respondent rating of extent of koud-mai in the community on a scale of 1 to 4 (1=less than 25%; 2=25–50%; 3=50–75%; 4=more than 75%). Koud-mai is a long-standing tradition of self-help in Dominica whereby residents contribute free labor to projects in their communities. |
| Awareness of district officers' role in disaster management | 0.28 (.03) | 1=disaster preparedness listed as a responsibility of the District Development Officer and Assistant by respondent, 0=not listed. |
| Gender of respondent | 0.39 (0.04) | 1=female, 0=male. |
| Age of respondent | 0.24 (0.03) | 1=over 65 years old, 0=64 or less. |
| Religion | | |
| Catholic | 73.18% | Religion of respondent (1 = Roman Catholic; 2 = Protestant; 3 = none or other). |
| Protestant | 18.99% | |
| Other | 7.82% | |

| | Mean (S.D.) | Measure |
|---|---|---|
| Number of school-age children | 1.12 (0.10) | Number of school-age children. |
| Regular consultation of print media | 0.50 (0.04) | 1=respondent consults newspapers at least once a month for news and information, 0=less than once a month. |
| Education | 0.51 (0.04) | 1=highest level of education in the household is secondary or tertiary, 0=no or only primary education. |
| Fisher or farmer | 0.31 (0.04) | 1=breadwinner is a fisher or farmer, 0=not a fisher or farmer. |
| Home ownership | 0.85 (0.03) | 1=household owns their house, 0=other. |
| Income | | |
| Very low | 68.57% | 2005 Household income category before taxes (1 = very low income; 2 = low income; 3 = medium or high income). |
| Low | 15.00% | |
| Medium/high | 16.43% | |
| *Independent variables (community level) – Derived from key informant interviews and records* | | |
| Disaster committee effectiveness index | 1.60 (0.42) | Average of scores for three items listed below. |
| *Disaster planning* | 0.68 (0.03) | Weighted average of disaster plan (weight=1; 1=incomplete plan; 2=plan is complete but not consulted; 3=plan is complete and consulted) and action teams (weight=0.5; 1=few teams; 2=teams identified for all the responsibilities described in the plan) after each score is converted on a scale of 0 to 1. |
| *Current activity level* | 0.44 (0.09) | Multiplicative index of number of active volunteers (number of volunteers x percentage of volunteers regularly attending meetings) and meeting frequency (1=only during hurricane season; 2=immediately before and during season; 3=throughout the year) after each score is converted on a scale of 0 to 1. |
| *Long-term activity level* | 0.48 (0.15) | Age of disaster committee (years). Scale converted to 0–1. |

Note: The descriptive statistics are computed for the sample of 179 households. Nonresponses vary among items. Percentages are reported for categorical data. Disaster committee effectiveness variables and its components are community-level variables (n = 6). The population mean and standard deviation are provided for these variables, since the six villages constitute the population of interest.

Community social capital was measured at the household level using a locally relevant index reflecting households' perceptions of the community social capital available in their village. Because community social capital entails a cognitive dimension, it primarily exists inside people's heads. As such, it is not directly observable and can only be measured through its manifestations (Krishna 2003b). The World Bank Social Capital Development Tool (SOCAT) offers a standardized methodology to collect locally-relevant data on community social capital (Krishna and Shrader 2002). The method was too comprehensive for the time and budget available for this study so a simplified approach similar to the one used by Krishna and Uphoff (1999) and subsequently revised by Krishna (2002) was adopted. Because the types of activities people regard as appropriate to carry out collectively rather than individually varies contextually, field inquiries were first conducted to identify relevant survey questions considering three types of indicators that offer different perspectives on community social capital: structural (2 indicators) and cognitive features (2), and collective action (1) (Grootaert and van Bastelaer 2002; Krishna 2002). As yet, the social capital literature lacks a unifying and sufficiently refined model to indicate whether the different community social capital dimensions should be treated separately or as an index (Grootaert 2002). Both approaches have been used and have found empirical support (Krishna 2002; Krishna and Uphoff 1999; Grootaert 1999; Grootaert and Narayan 2000; Narayan and Cassidy 2001). Thus, the unidimensionality of community social capital remains an empirical question to be tested in each case (Grootaert 2002). Hence a fourth hypothesis is added:

**H4:** Community social capital is unidimensional, and all five indicators refer to a single underlying construct.

**Additional control variables.** Most communities in Dominica have volunteer disaster management committees charged with informing and educating residents and carrying out appropriate response activities. Moreover, these committees are supervised by district-level officers who generally provide support to communities on a range of development issues. Therefore the analysis controlled for these institutional arrangements. Because aspects of community context and sociodemographic characteristics might be related to the receipt and processing of information and to both relational and community social capital, household and community characteristics were also controlled (Drabek 1986; Howell 2003; Hurlbert et al. 2000; Lin 2001; Tierney 1993; Tierney et al. 2001). All variables in the analysis are summarized in Table 1.

**Analysis Procedures**

The unidimensionality of community social capital (H4) was assessed using confirmatory (CFA) and exploratory (EFA) factor analysis techniques. CFA was implemented based on the raw data and using maximum likelihood estimation as implemented in LISREL. Preliminary analysis of the data for suitability for EFA was assessed with the Kaiser-Meyer-Olkin overall measure of sampling adequacy (Garson 2007). Oblique factor analysis was conducted using promax rotation starting with a principal component analysis as implemented by *proc factor* in SAS. The number of factors extracted was based on the Kaiser-Guttman rule of eigenvalues greater than 1 and a scree plot (Thompson 2004). Factor loadings greater than 0.4 were retained for each factor (Norman and Streiner 2000). Alternative models (the one-factor model and the model emerging from the EFA) are nested, and were compared using a chi-square difference test.

Logistic regression was used to estimate the direct effects of relational and community social capital and control variables on awareness of what to do in a disaster. Several different approaches are available to test the study's hypotheses. A first approach would be to combine the three awareness variables in a scale and fit a single regression model. The three outcome measures, however, are significantly but only moderately correlated with one another with a Cronbach's $\alpha = 0.55$. Further, this approach would not allow for possible variations in the effects of predictor variables from one outcome to another, which is problematic in light of the argument of goal-specificity of social capital. A second approach, which was adopted in this study, consists of using multivariate logistic regression. This approach allows fitting a single regression model for all three outcomes simultaneously, and thus permits estimating outcome-specific regression coefficients while accounting for correlation among multiple awareness measures from the same household. Moreover, differences between outcome-specific predictor effects can be evaluated via tests of marginal effects equaling zero.

Multivariate logistic regression analysis was performed using *proc survey logistic* in SAS. Three records were used for each household, one for each outcome variable.[3] Sample weights were assigned to control for the sampling design. Household ID was included as a cluster variable to control for correlation between outcomes. In addition to predictors, the independent variables for each record included an outcome indicator variable (which differed for the three records associated with each household) and outcome indicator-predictor interactions. Because the number of communities observed (6) was too small to be considered representative and to attempt to generalize the results to a larger population of villages, community was treated as a fixed-effect using a set of five indicator variables. The model-building strategy involved the use of a base multivariate logistic regression model containing only community indicator variables and household characteristics. Household characteristics that proved significant at $p < 0.05$

(for any of the three outcomes) in the base model were entered in the final model, along with key explanatory variables. Because of 22 percent missing data, income variables were excluded from the model-building analyses. However, additional analyses were performed to examine the findings' sensitivity to income. The multivariate model was fitted for the subset of observations for which income data were available and income was added as a predictor. The conclusions did not change (results not shown). Because disaster committee effectiveness was measured at the community level, it could not be included in the list of predictors. Rather a test for linear trend was performed via orthogonal polynomial contrasts.

The Wald statistic served to assess the statistical significance of outcome-specific predictor effects and marginal effects with an alpha value of $p < .05$. The generally accepted recommendation of ten observations per parameter was met (Long 1997). Other assumptions of logistic regression were tested by evaluating nonlinearity and collinearity. The Nagelkerke $R^2$ is reported as a generalized definition of the coefficient of determination (Nagelkerke 1991). The Nagelkerke $R^2$ was obtained for each outcome based on the comparison of the full fitted multivariate model and the intercept-only multivariate model for the corresponding outcome. It was also calculated for the comparison of the full model and the reduced model without social capital variables; this allowed estimating the additional proportion of variance explained when social capital variables are included in the model for each awareness variable.

## RESULTS

### Descriptive Results

**Awareness variables.** What to take to a shelter was the most salient aspect of preparedness with an average household score of 2.8 out of 3. The most popular items were non-perishable food (87.2%) and water (58.1%), followed by a change of clothes (45.8%), light (43.6%), and important documents and/or money (38.0%). Awareness of protective measures and familiarity with the responsibilities of disaster committees were more limited with average scores of 1.3 and 1.0 out of 3 respectively. The two most commonly named protective actions were boarding up the house (79.3%) and trimming trees (40.2%). Regarding disaster committee responsibilities, shelter management (35.8%) and evacuation (34.1%) were the best-known.

## Table 2. Correlation Matrix

|  | X₁ | X₂ | X₃ | X₄ | X₅ | X₆ | X₇ | X₈ | X₉ | X₁₀ | X₁₁ | X₁₂ | X₁₃ | X₁₄ | X₁₅ | X₁₆ | X₁₇ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X₂ | .21** | | | | | | | | | | | | | | | | |
| X₃ | .39** | .26** | | | | | | | | | | | | | | | |
| X₄ | .14* | .06 | .14* | | | | | | | | | | | | | | |
| X₅ | .39** | .13 | .23* | .21* | | | | | | | | | | | | | |
| X₆ | .12 | .11 | .34** | .03 | .10 | | | | | | | | | | | | |
| X₇ | .18* | .20** | .36** | -.02 | .10 | .56** | | | | | | | | | | | |
| X₈ | .07 | -.02 | .09 | -.04 | .05 | .58** | .13* | | | | | | | | | | |
| X₉ | .15 | .02 | .20** | .02 | .08 | .61** | .12 | .18** | | | | | | | | | |
| X₁₀ | .06 | .18** | .14 | .09 | .13 | .48** | .16* | .06 | .12 | | | | | | | | |
| X₁₁ | .13 | -.09 | .11 | .05 | -.04 | .62** | .16* | .24** | .30** | .02 | | | | | | | |
| X₁₂ | -.08 | .02 | -.08 | -.14 | .06 | .22** | .13 | .15 | .11 | .00 | .16* | | | | | | |
| X₁₃ | .33** | .11 | .31** | .16* | .16* | .24** | .24** | .08 | .21** | .04 | .12 | -.03 | | | | | |
| X₁₄ | -.29** | -.16 | -.26** | -.16* | -.42** | -.12 | -.21** | -.05 | -.03 | .07 | -.06 | -.10 | .24** | | | | |
| X₁₅ | -.04 | -.09 | .04 | .09 | -.04 | -.07 | -.12 | -.09 | .05 | -.09 | .11 | -.03 | .00 | .16* | | | |
| X₁₆ | .02 | .07 | .08 | .00 | .04 | .09 | .16** | .01 | -.00 | .11 | -.08 | .04 | .07 | -.11 | .81** | | |
| X₁₇ | .29** | .07 | .29** | -.02 | .31** | -.05 | .16* | -.17* | .06 | -.00 | -.16** | -.11 | .28** | -.23** | .05 | .03 | |
| X₁₈ | .01 | -.02 | -.20** | .11 | -.09 | -.12 | -.15* | -.13 | -.05 | -.01 | .00 | -.10 | -.02 | -.21** | -.21** | .09 | .03 |

X1=Awareness of protective measures, X2=Knowledge of what to take to a shelter, X3=Familiarity with disaster committee responsibilities, X4=Resource quality, X5=Diversity, X6=Community social capital index, X7=Membership in groups, X8=Expectations of mutual support, X9=Expectations of solidarity, X10=Lending of personal items, X11=Collective action, X12=Disaster committee effectiveness (n=6), X13=Awareness of district officers' role in disaster management, X14=Age over 65, X15=Catholic, X16=Protestant, X17=Regular consultation of print media, X18=Fisher or farmer

*p≤.05   **p≤.01

**Social capital.** As shown in Table 2, the two relational social capital variables, resource quality and diversity, are positively and significantly correlated. Neither one is significantly correlated with any of the community social capital indicators. The left-hand panel of Table 3 presents the results of the confirmatory and exploratory factor analyses used to test the unidimensionality of community social capital (H4). CFA of the one-factor model was conducted first. The standardized parameter estimates are reported in the second column of Table 3. The squared multiple correlations for each variable indicate that the model only explains a small amount of variance in some of the observed variables, particularly for membership in groups and lending of personal items, which also have small factor loadings. This is somewhat surprising because membership in groups has historically been one of the core indicators of community social capital across settings. Yet the fit statistics show a good fit of the data.[4]

**Table 3. Completely Standardized Parameter Estimates and Fit Statistics
For the One-Factor and Two-Factor Models (CFA)**

| | One-factor model Factor loadings (*t* value) One factor | $R^2$ | Two-factor model Factor loadings (*t* value) Factor 1 | Factor 2 | $R^2$ |
|---|---|---|---|---|---|
| Membership in groups | .30 (3.07) | .09 | | .60 (1.89) | .37 |
| Expectations of mutual support | .42 (3.54) | .18 | .42 (3.51) | | .18 |
| Expectations of solidarity | .49 (4.47) | .24 | .48 (4.33) | | .23 |
| Lending of personal items | .16 (1.29) | .03 | | .27 (1.64) | .07 |
| Collective action | .59 (5.08) | .34 | .61 (5.04) | | .37 |
| Inter-factor correlation | - | | .45 | | |
| $\chi^2$ (*df*) | 3.87 (*df* = 5) | | | 1.28 (*df* = 4) | |
| RMSEA | 0.00 | | | 0.00 | |

In light of these moderately supportive results, EFA was performed next to determine whether more than one factor would emerge from the set of indicators. Two factors emerged from the analysis, which together explain 55.1% of the variance in the data (results not shown). A CFA of the two-factor model was conducted next to assess the fit of the two-factor model and compare it to the results of the one-factor model. Results are presented in the right-hand panel of Table 3. Both models present a good absolute fit to the data. The chi-square difference statistic equals 2.59, which with a single degree of freedom, is non-significant at the 0.05 level. Thus the fit of the two-factor model is not significantly better than that of the one-factor model so the one-factor model is preferred (Kline 1998). Each item was standardized to zero mean and unit variance and averaged into a household-level community social capital index.[5] Although Cronbach's $\alpha$ was only 0.47, the results of the factor analyses support the unidimensionality hypothesis and thus indicate sufficient consistency to proceed with the index.

**Multivariate Logistic Regression Analysis Results**

The correlations for the variables included in the final model are summarized in Table 2. Table 4 presents the results for the multivariate logistic regression analysis. The estimated regression coefficients and standard errors are shown for each outcome side by side.

**Table 4. Estimated Outcome-Specific Coefficients and Standard Errors**

|  | Protective measures | Shelter items | Disaster committee responsibilities |
|---|---|---|---|
| Resource quality | 0.04 (0.03) | -0.01 (0.05) | 0.01 (0.04) |
| Diversity | 0.23** (0.07) | 0.11 (0.12) | 0.06 (0.09) |
| Community social capital index | 0.05 (0.06) | 0.09 (0.09) | 0.32** (0.07) |
| Awareness of DDO/DDA's role | 0.38 (0.46) | 0.33 (0.96) | 0.54 (0.49) |
| Age (over 65) | -0.39 (0.42) | -0.74 (0.54) | -1.11* (0.54) |
| Catholic | -0.42 (0.64) | -1.10 (1.46) | 2.58* (1.21) |
| Protestant | -0.50 (0.68) | -0.65 (1.56) | 3.33** (1.23) |
| Print media | 0.18 (0.37) | 0.08 (0.55) | 1.17** (0.43) |
| Fisher or farmer | 0.10 (0.36) | -0.36 (0.62) | -1.54** (0.45) |
| Nagelkerke $R^2$ | 0.56 | 0.24 | 0.91 |

*$p \leq .05$ **$p \leq .01$

*Note*: This table only shows estimated coefficients for the main predictor variables. Intercepts and estimated coefficients for village indicator variables are not reported. Standard errors are in parentheses. Results for the tests of marginal effects equaling zero are not shown.

Resource diversity is the only significant predictor for awareness of protective measures. None of the proposed variables appears to be statistically significant factor for knowledge of what to take to a shelter. Finally, community social capital, being Catholic or Protestant, and regularly consulting the print media have significant, positive effects on familiarity with disaster committee responsibilities, while being over 65 and being a fisher or farmer are negatively related to this outcome. The comparison of the Nagelkerke $R^2$ for the models with and without social capital variables (not shown) indicate that the addition of social capital variables improved the proportion of variance explained by 33 percent for awareness of protective measures, 6 percent for knowledge of what to take to a shelter, and 49 percent for familiarity with disaster committee responsibilities.

In addition to these results, tests of the marginal effects equaling zero were performed; these tests assessed whether there was evidence of a different effect of predictors between each possible pair of outcomes. On the basis of the results of these tests (not shown), there was no evidence of any difference between the models for

awareness of protective measures and knowledge of what to take to a shelter. However, there were significant differences between the model for familiarity with responsibilities of disaster committees and the other two models for community social capital and religion variables (being a Catholic or being a Protestant). There were also significant differences between the models for familiarity with disaster committee responsibilities and for knowledge of what to take to a shelter for consultation of the print media and being a fisher or farmer.

Further, a linear trend test was performed for disaster committee effectiveness for each outcome. While the actual estimates are difficult to interpret practically, the tests reveal a positive, significant relationship between the community-level measure of disaster committee effectiveness and household awareness of what to take to a shelter ($b$ = 6.94, $s.e.$ = 0.64, p < 0.0001). The effect on familiarity with disaster committee responsibilities is also significant, but negative ($b$ = -1.35, $s.e.$ = 0.51, $p$ = 0.008). However, there does not appear to be a statistically significant linear relationship between disaster committee effectiveness and awareness of protective measures ($b$ = -0.29, $s.e.$ = 0.49, $p$ = 0.55).

## Discussion

This study explored the utility of a social capital approach for understanding how social interactions and exchange patterns may shape household awareness of appropriate disaster response in the context of long-term threats. There was an improvement in model evaluation statistics when social capital variables are added. The results thus confirm that a perspective based on relational and community social capital is useful to explain household awareness of how to get ready for and respond to disasters in normal times.

Results fail to support H1 as there was no evidence of a relationship between resource quality and any of the three awareness outcomes. This might be explained by deficiencies in the measurement of resource quality because the variable amalgamates several social resources into a single occupational status score. This might account for the nonsignificant results. Alternatively, evidence from other studies suggests that the disaster expertise or experience of network members might not be relevant. In a study of primary group influences on earthquake adjustments, Jackson and Mukerjee (1974) found that most respondents did not know or could not recall adjustments undertaken by their neighbors. Another study of earthquake awareness and preparedness in California by Turner et al. (1986) further revealed that the majority of people could not identify anyone in their social environment they could turn to for expert counsel on earthquakes. Thus, it is possible that people fail to recognize others with specialized knowledge in their environment.

Consistent with H2, resource diversity is a significant predictor for awareness of protective measures. The evidence of this direct effect echoes findings on warning

response that highlight how the availability of many peers affects the amount and specificity of information received and provides opportunities for reinforcement, thus enhancing the belief in warning accuracy (Lindell and Perry 2004). It further relates to claims that, although ties that connect people in similar situations (bonding social capital) provide the foundation for bringing individuals together, they can increase vulnerability to disasters. By contrast, bridging social capital (which encompasses people in dissimilar situations) permits leveraging a wider range of information and resources (Aghabakhshi and Gregor 2007; Beaudoin 2007; Eisenman, Cordasco, Asch, Golden, and Glik 2007; Fussel 2005; Miller 2007).

Despite the failure to find significant relationships between resource diversity and knowledge of what to take to a shelter and familiarity with disaster committee responsibilities, there is also no evidence of a different effect of resource diversity between each pair of awareness outcomes. Thus, the evidence is not sufficient to draw any conclusions regarding the goal-specificity of relational social capital and determine whether features such as resource diversity matter differently for specific aspects of disaster-related knowledge. This possibility should be examined in future research.

In support of H3, community social capital has a significant positive effect on familiarity with disaster committee responsibilities. Furthermore, the differences between this estimate and those for the effects of community social capital on awareness of protective actions and knowledge of what to take to a shelter are statistically significant. Thus, although the evidence regarding relational social capital is inconclusive in this respect, community social capital clearly affects different aspects of awareness differently. A significant direct positive effect of community social capital on familiarity with disaster committee responsibilities makes sense on an intuitive level. Disaster committees consist of volunteers who coordinate activities for the benefit of all at the community level. Therefore, it is logical that awareness of their responsibilities be associated with community social capital, which goes beyond the relationships of single actors to encompass aspects of a collective attitude towards the community as a whole (Esser 2008).

Although there were no hypotheses about the effects of institutional arrangements on the three awareness variables, it is notable that institutional variables did not perform very well. Awareness of the district officers' involvement in disaster preparedness does not appear to be a significant factor for any of the three awareness outcomes. The measure was not very refined, so alternative methods of measuring the role of district officers might yield different results. However, it is also possible that district officers truly have little impact on household awareness of what to do in a disaster. Indeed, they are primarily expected to support village disaster committees as opposed to working directly with the population.

Disaster committee effectiveness did have a significant, positive effect on knowledge of what to take to a shelter, but showed a significant, negative effect on familiarity with

disaster committee responsibilities. The latter result is counter-intuitive and might in reality have to do with the fact that the two committees with the lowest effectiveness scores are also the most recently established—having been established for less than a year at the time of the survey. New committees might benefit from a novelty effect, while the specific activities of more established committees may attract less attention, particularly in the absence of particular events requiring these committees to act. Further, although disaster committees are supposed to conduct Information, Education, and Communication activities throughout the year, their activities tend to be more concentrated during the hurricane season. Thus since the study was conducted outside of the hurricane season, the results are likely to underestimate a possibly stronger, positive short-term effect of disaster committee activities. Nonetheless this finding raises concerns regarding the ability of institutional arrangements to play a role in positioning households to be better prepared to address disasters over the long-term. This is consistent with the literature documenting the limited utility of information campaigns sponsored by official bodies, and the importance of social networks in effective action (Dynes 2006; Lindell and Perry 2000, 2004). This is important because it confirms arguments that hazard managers need to move away from traditional ways to manage risk information and consider strategies that effectively utilize the potential of existing patterns of social interactions to provide greater exposure to relevant information. However, more research is needed to add depth to the findings on relational and community social capital and support concrete suggestions on how to capitalize on their potential. Quantitative studies are needed to confirm the results from this research in other contexts, and to systematically explore the potential effects of other dimensions of relational and community social capital. Qualitative research could further inform the development of theories on the specific mechanisms by which relational and community social capital are brought to bear on specific aspects of awareness of what to do in a disaster.

This study was exploratory in nature and presents some limitations. First of all are the small sample size and the limited generalizability of results beyond the six study communities. The sample size, in particular, constrained the measurement of disaster committee effectiveness and the exploration of other community-level effects. Further, there are limitations to the measurement of social capital variables. As the previous section indicates, the factor analyses supported the unidimensionality of community social capital. However, there were deficiencies in the measurement model because the indicators showed limited convergent validity and accounted only for a small percentage of variance (which could be due to modest reliabilities or unmeasured factors). Thus, although there was support for H4, the measurement of community social capital stands to be improved. The difficulties encountered in this research reflect wider unresolved issues associated with the measurement of social capital as this endeavor remains to this day largely an empirical, context-specific problem with limited conceptual and theoretical guidance (Grootaert 2002). Where prior proven measures cannot be replicated,

it is strongly recommended to others interested in community social capital to measure a large set of variables or spend time conducting formative research to inform the development of appropriate scales.

The conceptualization and measurement of relational social capital also present some limitations. Like community social capital, relational social capital is a complex construct with many dimensions such as presence of specific alters, types of relationships, social resources, and aspects of network size or structure (Hurlbert et al. 2000; van der Gaag and Webber 2007). Measure construction is guided by a priori specification of the dimensions that are hypothesized to lead to productive outcomes (van der Gaag and Webber 2007). A limitation to this research is that it uses methods appropriate to investigate the effects of the *distribution* of resources on awareness of what to do in a disaster. It fails, however, to capture the ability of households to access and mobilize these resources. Types of relationships, including emotional closeness and physical proximity, may in particular affect the likelihood of actual transfer of resources (including information exchanges). Prior research has shown, for instance, that people are more likely to turn to relatives rather than non-kin for critical help and support in routine and crisis situations and for advice when making important decisions (Fischer 1982; Hurlbert et al. 2000; Kirschenbaum 2004). Thus other dimensions of relational social capital (such as density or geographic dispersion) may warrant attention in future research.

**Conclusion**

Earlier studies confirmed that immersion in social and community networks affects a range of behaviors in disaster situations. This research contributes both methodologically and substantively to earlier social network findings by demonstrating the relevance of social capital variables for explaining household awareness of what to do in a disaster in normal times. Relational and community social capital concepts and measures provide new insights regarding important aspects of social relationships because few disaster studies have examined these variables so far. These measures separate the contribution of social networks through the resources that can be accessed and used through personal dyadic relations with others (relational social capital), and characteristics emerging from community networks as collective units (community social capital). This is important because these measures provide nuanced findings regarding relevant dimensions of social relationships that move beyond the distinction between different types of social and community networks (e.g., kin vs. non-kin; institutional vs. non-institutional) to focus on the features and characteristics of social interactions. Although this study only explored the effects of specified dimensions of relational and community social capital, it opens up the possibility to apply social capital measures to gain new insights into how social

interaction and exchange patterns relate to other aspects of disaster-related knowledge, opinions, and behaviors.

The study findings expand on those of previous studies of warning response that reported the utility of social and community networks for assessing risks and propagating and confirming disaster-related information (Lindell and Perry 2004). This research confirms that relational and community social capital lead some households to be more knowledgeable than others about what to do to get ready and respond to disasters even in the absence of immediate crisis or risk communications that may raise the salience of disasters. Although this study did not address the relation of knowledge to later adjustment adoption, the implications of these findings are important in light of evidence suggesting that the receipt of information about what to do to get ready is the most important information in predicting action (Mileti and Darlington 1997).

Although confirming the predictive value of relational and community social capital for household awareness of what to do in a disaster, this study also makes clear that the effects of community social capital are specific to the aspects of awareness considered—protective actions, evacuation procedures, or disaster committee responsibilities. Findings on the goal-specificity of relational social capital are inconclusive. This notion of goal-specificity is significant as we seek ways to best provide households with the knowledge they need to effectively prepare for and respond to disasters and recognize the limitations of official communication programs. It indicates that practitioners need to carefully think about the social channels that are most relevant as they devise strategies to communicate specific types of messages. Consequently, more research is needed to systematically examine the effects of relational and community social capital variables in relation to disaster outcomes, and to better understand the specific roles they play and under what conditions.

## Notes

1. Based on the standard definitions proposed by the American Association for Public Opinion Research (2005), the minimum cooperation rate is defined as the number of complete interviews (179) divided by the number of interviews (182) plus the number of non-interviews that involve the identification and contact with an eligible respondent (26). The minimum response rate cannot be reported because interviewers failed to record the number of persons who were systematically unavailable whenever they attempted to contact them.

2. In addition to occupational status scores, previous studies using the Position Generator have also relied on prestige scores. The measure of diversity simply reflects the number of different positions accessed and is independent of the scores attached to each position. Resource quality was calculated as the mean score of all positions in

which the respondent indicated to know someone and is sensitive to the values attached to each position. An alternative indicator was created using average Ganzeboom and Treiman's Standard International Occupational Prestige Scale (SIOPS) (1996). The resource quality indicators built using SIOPS and ISEI are extremely highly correlated ($r = 0.95$ and $p < 0.0001$).

3. Because all respondents but one were able to name either two or three items to take to a shelter, knowledge of what to take to a shelter ended up being a dichotomous outcome with an outlier at zero. The zero value was replaced by "missing" to prevent convergence issues. Other outcome values for the corresponding household were not modified.

4. Commonly reported fit indices such as GFI, AFI, and PNFI are not available from LISREL when weights are used in the analysis.

5. Each item was given an equal weight in the index. An alternative index was created in which each item was given a weight equal to its factor loading in the CFA. The two social capital indexes are highly correlated ($r=0.96$ and $p<0.0001$) so the simpler formula was used.

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