

NON-EVACUATION BEFORE HURRICANE KATRINA: DID SOCIAL
NETWORKS MATTER?

A Thesis

Presented to the Faculty of the Graduate School
of Cornell University

In Partial Fulfillment of the Requirements for the Degree of
Master of Science

by

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January 2011

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ABSTRACT

Hurricane Katrina spurred the largest mass migration in United States' history since the Dust Bowl. However, many residents of the Gulf Coast decided not to evacuate. This thesis examines the issue of non-evacuation during Katrina. First, it situates the topic theoretically, in relation to four distinct literatures: demographic studies of migration; environmental sociology; the sociology of disaster; and the political geography of place. Among other things, this discussion suggests that social networks may have played an important cultural and material role in households' evacuation decisions. This expectation is tested in the second phase of this study using data from Harvard Medical School's Hurricane Katrina Community Advisory Group's survey of Gulf Coast residents. Contrary to expectations, however, the analyses here provide no evidence that networks affected the odds of timely evacuation during Hurricane Katrina. Instead, educational attainment was a significant predictor of evacuation behavior in the New Orleans metropolitan area; race and income were significant factors in the non-New Orleans sample. Moreover, storm preparation behavior and the number of evacuation warnings received by households both had significant effects on the odds of evacuating before the storm in the New Orleans metropolitan sample. Despite a number of key limitations imposed by the secondary nature of the data utilized in this thesis, the theoretical and empirical insights of this research suggest that future research should continue to seek a more nuanced understanding of evacuation behavior during extreme weather events.

BIOGRAPHICAL SKETCH

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ACKNOWLEDGMENTS

I would like to thank Professors David Brown and Max Pfeffer for their insight, guidance, and patience as they advised this research project. I also owe much to my colleagues Amit Anshumali, Ian Bailey, Andrew Curley, Sara Keene, Scott Sanders, and Professors Charles Geisler and Phillip McMichael for their time and insight during a Spring 2010 seminar, and throughout the many conversations that took place in a graduate student office in Warren Hall. The resources of Cornell University's Department of Development Sociology, the Population and Development Program, the Cornell Population Program, the Cornell Institute for Social and Economic Research, Harvard Medical School, and the Inter-University Consortium for Political and Social Research were all essential for this research.

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INTRODUCTION

On Monday, August 29, 2005, at 6:10 a.m. CDT, Hurricane Katrina made landfall at Buras, Louisiana. Fueled by unusually warm waters, the storm had reached Category five status as it crossed the Gulf of Mexico, packing sustained winds of over 155 m.p.h. Although Katrina had been downgraded to Category Three strength by the time of landfall, it still unleashed sustained winds of up to 121 m.p.h., pounding rains, and violent storm surge across a large swath of the Gulf Coast (109th U.S. Congress). By the time the destruction ceased (long after the actual storm passed), Katrina proved to be one of the most devastating (\$300 billion, 2.5 million residences damaged) and deadly (at least 1,800 people killed) storms the United States had ever seen.

Amidst all of the chaos and tragedy, images of residents stranded on their rooftops, crowded in and around the Superdome, and floating dead in the floodwaters were particularly disturbing to citizens in the U.S. and across the world. They raised a series of long-neglected questions about the class and “color of disaster” in the United States (Dyson 2006). Among many such observations by scholars and journalists, examples include the bias in evacuation plans favoring those who owned cars, the maltreatment of poor, and primarily black, evacuees in government-run shelters, and the disproportionate degree of physical damage in high-minority and low-income parishes and neighborhoods (Brookings Institution 2005, Brodie et al. 2006, Myers et al. 2008). Consistent with the thoughts of even the earliest sociologists of disaster (e.g. Quarantelli 1978), these scholars have demonstrated that the acute stress of Hurricane Katrina exposed many already-existing social problems.

The magnitude of disruption caused by the storm was embodied in the 700,000 to 1.2 million people who fled the affected areas—the largest mass migration in the U.S. since the Dust Bowl of the 1930s (Picou and Marshall 2007). Where these evacuee-migrants went, what they did in their destination, and whether or not they

returned (or plan to do so) all have important implications for their individual social and economic prospects, as well as the demographic and economic future of the Gulf Coast and receiving communities across the country (Fussell et al. 2010, Hori and Shafer 2010).

That said, this thesis is based on the premise that there is also much to learn by shifting our gaze to those who did not flee in advance of the storm. Giving particular attention to the New Orleans metropolitan area, it addresses the general question of why people stayed in their homes until after the storm struck, or never left at all. Comparing evacuee and non-evacuee households, this research explores the household-level factors that affected the odds of timely evacuation. The relative extent of households' social networks are of particular interest, as the main expectation of this study is that households with few distant social ties were more likely to have stayed through the start of the storm than households with high levels of network connections outside of their home county/parish. Those socially isolated households with low levels of both local and distant social ties are expected to have been the most likely to stay through at least part of the storm. These expected relationships will be considered in the context of historically important race and class relations, as well as other factors that previous research suggests may influence evacuation behavior.

THEORETICAL PERSPECTIVE

This thesis contributes to the broad and burgeoning literature examining the relationship between social dynamics and the environment in general, and the sociology of Hurricane Katrina in particular. More specifically, it addresses the issue of non-evacuation by engaging four literatures within social science: (1) demographic studies of migration, (2) environmental sociology, (3) the sociology of disaster; and (4) the political geography of place. This integrated approach seeks to overcome anecdotal and

commonsensical accounts of the storm by developing a perspective that is attuned to social structures and the more nuanced dimensions of social relations.

This attempt to locate the root of individual behavior in the context of micro-level social relations and macro-level structures is consistent with one of the fundamental tasks of sociology. This, as C.W. Mills puts it, is to develop “the capacity to range from the most impersonal and remote transformations to the most intimate features of the human self—and see the relations between the two” (Mills 7). In this case, the evacuation behavior of households will be analyzed at the population level, in an attempt to identify the social conditions that affected the odds that households would behave in a particular way.

To better situate this thesis and frame its precise research questions, it is worth addressing a number of theoretical and substantive lines of research that this study draws upon and is in dialogue with. These include the sociology of migration and environmental change, the discourse of displacement, and the broader policy implications of disaster theory and research. The following sections will locate this research in relation to these key issues—a discussion that will serve as a point of departure for a more detailed review of the literature relevant to this study.

The Sociology of Migration and Environmental Change

The methodology and substantive findings of this thesis contribute to research on the relationship between human migration and environment change, both acute (e.g. flooding) and long-term (e.g. desertification). In particular, this study challenges approaches that seek to isolate the causal power of environmental variables in the migration decision-making process (e.g. Reuveny and Moore 2009). Such works exemplify what Suhrke (1994) classifies as a “maximalist point of view,” from which “the environment is the primary, if not only cause of migration” (in Carr 926). Such

perspectives fail to account for the sociological factors that complicate the environment-migration relationship, even under conditions of extreme environmental stress. A more satisfactory approach would seek to understand environmental push factors, as well as the structural and cultural social conditions that affect a society's ability and proclivity to mitigate, adapt to, or flee from these changes. Such factors must be incorporated into multivariate, interdisciplinary frameworks for analysis of migration.

A review by Hunter (2005) demonstrates that such integrative approaches are both necessary and possible. Among other insights, she cites previous research to suggest that we must consider that (a) even in the face of dramatic environmental hazards/disasters, mobility may not be possible or practical for some groups; and (b) environmental hazards are perceived through culturally specific lenses, making the degree to which they prompt migration highly variable. Hunter concludes, "the association between migration and environmental hazards varies by context, hazard type, and household characteristics" (Hunter 297). Offering a slightly different take on this issue, Carr (2005) makes an equally important point as he writes,

...we must make explicit the connection between the political ecological attention to the social construction of the environment and the contemporary migration literature's minimalist focus on migrant subjectivities as a driver of migration. In short, we need to theorize explicitly how people apprehend, negotiate, and transform their local context in a manner that links environment to migration (Carr 929).

It is important to note that these arguments concerning migration are consistent with developments in the broader field of environmental sociology, which has taken up the theoretical problematic of understanding the relation between "society" and "nature". As Murphy (1994) puts it, "the relationship between social action and the dynamic processes of nature will have to be incorporated into sociological theory" (Murphy ix). Goldman and Schurman (2000) make a similar suggestion, writing,

“studies of nature-society relations need to consider ecological processes, political-economic structures, and meanings, values and agency as necessary and complementary components of analysis” (Goldman and Schurman 565). Although it may be difficult to fully deconstruct the nature-society binary on a practical basis, it is nonetheless necessary to better incorporate the fluid and mutually constitutive aspects of this relation into social and environmental research.

Indeed, such works lend support to the argument that the environment is inextricably linked to many social processes, including migration. This research highlights the complex and contingent nature of these connections, noting the significant mediating role that both cultural and structural factors play between environmental processes and social action. This thesis draws upon these insights to consider the link between migration and Hurricane Katrina. Sociological research on such extreme events is particularly important, as scholars and policymakers still often fail to view disasters through an adequately nuanced lens that engages micro- and macro-level aspects of social organization.

The Discourse of Displacement

Shifting attention to the residents of the Gulf coast who did not flee in advance of the storm is, in part, a strategy of challenging those scholars who use the terms “displacement” and “forced migration” uncritically. Although the language of displacement rightly emphasizes that some instances of human mobility are less voluntary than others, the voluntary-involuntary binary that such works depart from ultimately obfuscates the complexities that underlie any decision to migrate.

Of course, this is by no means the first acknowledgement of this problem. Researchers across various disciplines have argued that disaster- and environment-related migrations are less straightforward than often portrayed. In an important

challenge to the increasingly popular term “environmental refugee”, Black (2001) writes

It is unclear that the complex set of factors that lead to ‘environmental migration’... would suddenly evaporate or crystallize into a single ‘environmental’ cause at the time people become refugees. Although a distinction could be sustained at the level of proximate causes of flight, this is unhelpful from an academic point of view if it is accepted that the response to forced migration needs to be guided by underlying, rather than simply proximate causes (Black 13).

Similarly, other scholars have demonstrated the agency of actors to adapt to and resist the stresses of environmentally hazardous environments. Lein (2000) makes a particularly notable contribution by examining data on slum-inhabitants in Bangladesh, a country that is commonly (and quite rightly) used to justify dire warnings about environment-induced migrations. Contrary to the conventional portrayal of this country, however, this scholar argues that the empirical evidence paints a much more complex picture. He writes

...mass poverty and the special environmental setting in Bangladesh make it tempting to emphasize the involuntary aspects of migration... For an outsider, it is extremely difficult to apprehend that in one sense people willingly settle in the middle of a violent river, or one of the devastating urban slums of Dhaka. However, to see internal as well as international migration in Bangladesh as mechanistic responses to environmental or economic circumstances is to underestimate the complexities of migration behavior... (Lein 2000: 126).

The anthropologist James Ferguson (1992) makes a similar call to consider the contingencies of how exogenous “push” factors are actually experienced. He writes, “at a time when anthropologists are becoming more concerned with such things as displacement, migration, and exile, it is perhaps useful to remind ourselves that such

conditions are rarely experienced as absolute, unambivalent, or final” (Ferguson 90). Such processes are instead embedded within and mediated by a social reality of complex structures and cultural forces.

The abovementioned arguments serve as important warnings against hastily ascribing causes to migration behavior in environmentally tenuous or hazardous locations. This is a particularly common problem in studies of poor and/or discriminated-against populations, which are routinely portrayed as infinitely more vulnerable to displacement than others, objects to be easily swept away by environmental forces. However, drawing a direct relationship between income (or other such measures) and vulnerability fails to account for the more particular forms of differentiation that affect such populations in ways that may not necessary predispose them to flee a hazardous location.

In a slight aside, it is worth noting that the tendency to conflate income or socioeconomic status with vulnerability to “displacement” has its roots in the dominant episteme of modern capitalist society. As Agnew writes, “by dint of living in a society in which the metric of economic transactions, exchange value, is the dominant measure of worth, people come to accept it, use it as a natural measure of place-valuation and place definition” (Angew 34). While it is never possible to fully capture and represent the motivating factors behind each household’s migration decision, this thesis goes beyond (but does not neglect) income-based measures. It also considers the effect of more specific forms of social organization—mainly race relations, social networks and access to public information—on evacuation behavior. Such an approach is expected to shed light on the ways that axes of macro-structural inequality interact with other socially and geographically contingent factors (e.g. culture, place attachment, climate degree of flood risk).

The Sociology of Disaster

Sociologists of disaster have made important inroads establishing the importance of social structure and cultural norms in determining the outcome of environmental events. Hewitt (1983), for example, writes that disasters expose the “characteristic rather than accidental features of the places and societies where they occur” (Hewitt 25). By tracing the root of disasters to the conditions of everyday life in a society or social group, Hewitt’s argument suggests that explanations of disasters must be grounded in an appreciation of historical and contemporary social conditions and processes.

This imperative to historicize and contextualize disasters can be traced to the earliest sociologists of disaster. Quarantelli (1978), for instance, argued that “natural disasters”—in contrast to purely “physical events”—were defined by both their social impact and the subsequent social response to that impact. More recent scholars have gone further to suggest that social processes and conditions themselves contribute to the very occurrence of disasters. Working along these lines, Mileti (2001) writes

Many disaster losses—rather than stemming from unexpected events—are the predictable result of interactions among three major systems: the physical environment, which includes hazardous events; the social and demographic characteristics of the communities that experience them; and the buildings, roads, bridges, and other components of the constructed environment (Mileti 3).

In some ways echoing Mileti, Morrow (1999) lays out another particularly helpful conceptualization of natural disasters, saying,

The impact of a natural event on any given community...is not random, but determined by everyday patterns of social interaction and organization, particularly the resulting paradigms which determine access to resources... The effect on any particular household, therefore, results from a complex set of interacting conditions, some having to do

with geography and location, some with dwelling, and still others with the social and economic characteristics of the people living there (Morrow 2).

Both authors suggest that as the economy and built environment evolve in step with development and demographic changes, so does a society's relation to its "natural" environment.

This type of perspective stands in contrast to the common tendency to reduce a given disaster to a certain "defining" factor. Many of these reductionist arguments place undue stress on the construction of technological "defenses" against natural forces. For instance, in accounts of Hurricane Katrina, some scholars focused solely on the integrity of the levees (e.g. Kintisch 2005) or the design/use of public transportation systems (e.g. Colton 2006). Such accounts tend to operate on the basis of a narrow cost-benefit logic. For example, a civil engineer writing in the wake of the South Asian tsunami argues, "a better balance needs to be achieved between potential losses, in human and economic terms, from natural disasters and expenditures on infrastructure protection" (Uddin 6). While levees, earthquake-resistant buildings, public infrastructure, and other technologies undoubtedly have a critical role to play, technocentric perspectives neither appreciate the political economy that shapes the development and distribution of such technologies, nor the micro-level factors that shape the behavior of social actors in disaster contexts.

Sociological accounts of disaster also counter environmental reductionist explanations. From this view, hazards are defined by whether or not "fluctuations" in some natural variable(s) "exceed some critical threshold beyond the 'normal' band of tolerance" (Smith 10). This perspective relies heavily on meteorological records to develop probabilistic models of risk. Such approaches lead to warnings, for example, of increasingly destructive hurricanes as climate change contributes to unusually high

ocean water temperatures (Emanuel 2005). Despite the importance of such insights, they fail to consider the social processes that make environmental change a threat to society in the first place. For instance, this perspective cannot explain why some Category 3 Hurricanes have a greater impact than Category 5 storms, or why a 7.0-strength earthquake leads to more destruction than an 8.0. Indeed, this view does not adequately consider the processes that shape the distribution of the population and the resources needed to mitigate natural hazards. For example, when considering the coastal risks associated with climate change, one must account for the processes leading to an unequal distribution of the world's population in coastal areas, as well as the causes of disproportionate coastal urbanization in low-income countries (Jiang and Hardee 2009).

In contrast to the two extreme positions noted above, a more satisfactory understanding of disaster can be achieved by considering hazardous natural processes and technological “defenses” in the context of social dynamics. To avoid the various types of reductionism that are found within the literatures cited above, this thesis synthesizes various areas of theoretical and substantive research across the fields of social demography-migration studies, environmental sociology, disaster research, and the political geography of place. Although the secondary nature of the data analyzed in this thesis imposed a number of key limitations on the framework utilized in this thesis, the attention to the role of social networks is an initial step toward a perspective on migration that transcends (but still includes) social structure and/or environmental push factors.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

With these broader issues in mind, the following pages draw upon previous theoretical and empirical work to advance toward a more specific set of research

questions and develop a framework for analyzing evacuation behavior. As mentioned above, this review will draw upon insights from migration studies, environmental sociology, the sociology of disaster, and the political geography of place to consider why some residents of the Gulf Coast did not evacuate before Hurricane Katrina struck. Together, insights from these literatures will help address this multi-dimensional and multi-scalar issue, which ranges from the individual, perceptible level to that at which social and spatial structures are reproduced.

The Sociology of Migration: Why Social Networks Matter

Theoretically and substantively, studies of migration serve as the key point of departure for this thesis. Migration scholars have gone furthest to explain the causes and consequences of migration—and thus, conversely, non-migration. In particular, this research will draw upon the theoretical insights of work that examines the role of social relations and networks in shaping migration decisions (e.g. Massey 1990, Palloni et al. 2001). This research has challenged the assumptions of both neo-classical economics and structural-Marxist accounts, moving toward a more flexible, “meso-level” analysis of migration.

Although these approaches are multi-scalar in many ways, they take households as the primary unit in which migration decisions take place. This thesis will make the same assumption. Of course, it does not assume that the household behaves atomistically; it is itself embedded in various social relations that may facilitate or impede mobility. Indeed, it has been widely recognized that the character of historic social ties between locations in a migration network—as well as households’ particular relation to those networks—plays a fundamental role in mobility decisions. As Boyd (1989) explains,

Whether migration occurs or not is conditioned by historically generated social, political and economic structures of both sending and receiving societies. These structures are channeled through social relationships and social roles, which impact on individuals and groups (Boyd 642).

Taking a slightly different, but nonetheless helpful approach, Portes (1995) suggests that social networks, as well as the structures and norms they engender, alter the economic calculus of migration decisions. He writes,

Social networks are among the most important types of structures in which economic transactions are embedded. These are sets of recurrent associations between groups of people linked by occupation, familial, cultural, or affective ties. Networks are important in economic life because they are sources for the acquisition of scarce means...and because they simultaneously impose constraints on the unrestricted pursuit of personal gain (Portes 8).

In addition to the various obligations and affective relationships involved in networks, these relations have also been shown to provide both “information” (Winters, de Janvry, and Sadoulet 2001) and “direct assistance” (e.g. shelter, transportation) related to migration. These factors are also expected to be important in a disaster context.

Drawing back on Granovetter’s (1973) seminal work, it is important to distinguish between “strong”, intensive ties and the “weak” ties that constitute extensive social networks. He defines this notion of ties’ strength by writing, “the strength of a tie is a...combination of the amount of time, the emotional intensity, the intimacy...and the reciprocal services which characterize the tie” (Granovetter 1361). The character of a given relation, and the composition of an individual, household, and community’s portfolio of relations, has important consequences for the type of social resources they are able to acquire. As he says, “weak ties, often denounced as generative of alienation are here seen as indispensable to individuals' opportunities and to their integration into communities; strong ties, breeding local cohesion, lead to overall fragmentation”

(Granovetter 1378). Such social conditions may have important implications for community mobilization in times of disaster, as well as for households' evacuation prospects. It suggests that households with a preponderance of "strong ties", and in locations with a high degree of "local cohesion", may be less able and likely to mobilize to evacuate during a disaster than their neighbors with extra-local ties.

Although the strong and weak tie distinction is extremely important to this thesis, it is necessary to clarify, as Lin (1999) does, that networks in themselves are not resources. As he writes, "not all bridges (or network locations) lead to better information, influence, social credentials or reinforcement" (Lin 36). Therefore, "network locations should be treated as exogenous variables rather than endogenous variables of social capital itself" (Lin 37). In other words, networks may facilitate the acquisition of social resources, but this is highly dependent on the resources of the individual or group they are connected to—and of course, whether or not they are (or can be) actually utilized. This suggests a need to carefully consider the relationship between networks and socio-economic resources. Both the specific nature of social relations and the milieu in which they are embedded are important determinants of the type of resources accessible and/or likely to be accessed.

Similarly, Entwisle et al. (2007) show the necessity of making a conceptual distinction between "networks" and "context". The former term defines the "ties between individuals and groups of individuals... [which] may involve kinship, friendship, neighbor relations, social support, and so forth" (Entwisle et al. 1495). "Context", on the other hand, "relates to the social units within which individuals and groups of individuals are contained" (Entwisle et al. 1496). Networks and contexts should be viewed not as mutually exclusive, but interactive or even co-constitutive. This is consistent with much of the migration-specific literature, such as Massey's (1990) call for multi-level analysis. As he writes, "mutually reinforcing

interconnections among individual, household, and community level factors lead to the cumulative causation of migration” (Massey 18).

These various insights suggest that migration behavior—including the decision to stay—is partly a function of the character of the social networks one is connected to, as well as the context in which that network is situated. Occurring at multiple levels, these relationships provide varying degrees of access to important cultural and material resources, which help define the limits of what migration behaviors are considered possible. These relations may also have a significant effect on the decisions that determine what actual behavior occurs within these limits. As other scholars have shown, heterogeneity of perceptions and interpretations, as well as culturally specific notions of rationality, can alter decision-making calculi in ways not captured by traditional cost-benefit analysis (Kalberg 1980, Sen 2009). Since culture and ideology are constituted, transmitted, and transformed via social relations, one should expect significant differences to arise between households and social groups, depending on the type and extent of their ties.

With these important aspects of social networks in mind, it must be acknowledged that a number of unique conditions were in place during Katrina (and other acute disasters): the short time period for decision-making; the mandatory evacuation order; the threat of extreme environmental push factors; and the imperative for risk-minimizing (rather than, say, income maximizing) behavior. Moreover, Katrina-related evacuation was a single instance of (im)mobility, not long term migration system. This is particularly important caveat for Collyer (2005), who claims, “social network theory in migration has never claimed to explain the origin of migration... [it only explains] the path-dependency of migration systems” (Collyer 700).

Although the role of networks in long-term migration systems will be kept in mind for the sake of comparison, it is important to clarify that this thesis does not argue that social networks affect evacuation via the same mechanisms as they do decisions about long-term mobility. Nonetheless, it does contend that a perspective attuned to social networks remains helpful in understanding the complex of factors affecting household evacuation behavior. With a storm approaching and orders to evacuate, individuals and households are faced with a multitude of social and economic dilemmas that require prioritization and compromise—processes in which social networks play an important role.

More specifically, the abovementioned insights suggest that social networks operate in two important ways. First, these ties can be expected to have a significant effect on the values around which decision-making takes place, as culturally-specific norms and values are, at least partially, produced and transmitted through these relations. Moreover, such bonds developed via networks—between people, to particular places (home and ‘other’), and between past and present—are likely to be accentuated under the test of a disaster, with implications for evacuation behavior. For example, the tight bonds between a household and their neighborhood (as both a social and physical unit) may emerge as a major factor in the decision-making process. Such ties may increase the odds of staying, especially when the place and/or group of people that a household is “bonded to” are threatened in a disaster.

Second, social networks also serve as critical conduits for “material” resources, which can be of either an economic or social nature. In crisis situations, such resources range from information to transportation, shelter, and possibly even monetary assistance. In this way, networks may alter the costs and benefits of evacuation in a more utilitarian way, literally shaping the material costs of the decision to flee or stay.

Returning to the broader picture then, the character of a household's social relations can be expected to influence evacuation behavior on both a subjective (cultural, perceptual) and objective (material) basis. In short, networks are key determinants of the actual and/or perceived costs and benefits of evacuation and shape the very logic upon which such decisions are based.

Networks and Perceptions in Disaster Contexts

Previous research provides support for such claims about both migration and evacuation. Considering first the cultural/ideational role of social relations, scholars have long reported that imperfect information (e.g. Davanzo 1983) and individual perceptions (e.g. Lee 1966) play an important role in shaping migration dynamics (see also Massey 2002). While such false starts and non-starts are costly in a variety of ways during long-term migration decisions, the potential consequences are even more severe in the case of disaster-related evacuation: such faulty (accurate) information can lead to unnecessary evacuations, costly/deadly non-evacuations, or, most desirably, optimal outcomes. Of course, its recipient must also consider such information valid. As Perry (1994) writes, "reviews of empirical literature reveal considerable support for the notion that evacuation compliance is greatly enhanced if the warning recipient believes the pending disaster will result in direct and personal harm" (Perry 89).

Past work on disasters has highlighted differences in perceptions and the reception of information across social groups. For instance, Perry and Mushkatel (1986) found significant differences in the source of information, its perceived reliability, and the protective measures taken, between whites, blacks, and Mexican-Americans in a number of disasters. Turner et al. (1980) reported that blacks in southern California were relatively more fatalistic about earthquakes, while Mexican-Americans and whites were equally less so. Others, such as Flynn et al. (1994), have

found that risk perception is inversely related to income level (rather than ethnic group), which they suggest may be symptomatic of the relatively low levels of control poorer people have over their lives.

It is also worth noting that previous research shows that the effect of previous hurricane experience has been a significant, but inconsistent factor in evacuation decision-making (e.g. Hutton 1976, Baker 1979, Perry and Greene 1982, Sorensen et al. 1987, cited in Dash and Gladwin 2007). In one of the more recent works to address this issue, Dow and Cutter (1998) find that a hypothesized “crying wolf” syndrome is not supported in a case comparing Hurricanes Betsy and Fran. Instead, they emphasize that people depend more on private, inter-personal information than government warnings, thus making previous “false starts” by authorities less important than conventional wisdom suggests. Likewise, Gladwin and Peacock (1997) found no significant relationship between past hurricane experience and likelihood of evacuation before Hurricane Andrew. Broadly, these various findings suggest that previous experience has an inconsistent effect on evacuation behavior (Baker 1991), and that one must distinguish between the effect of unnecessary evacuation and actual storm experience on perceptions of risk (Lindell et al. 2005).

A number of studies on Katrina have touched upon the issue of perceptions. Burnside et al. (2007) found that public officials, family and friends, and exposure to visual images of actual storm damage each had significant impacts on hypothetical evacuation decisions of greater New Orleans residents. However, previous work by Burnside (2006) on the same population noted that demographic variables (age, race, education, etc.) were not significant determinants of intended evacuation behavior. This is supported by Elliot and Pais (2006), who show that self-reports of risk perception among non-evacuees did not systematically vary by race or class.

The findings above suggest that risk perception often varies by social group. However, studies focused on individual perception are clearly insufficient, in part suffering from an overly individualistic approach. The poor explanatory power of such approaches is exemplified in findings by Dow and Cutter (2000), in a study of South Carolina residents during Hurricane Floyd. After considering self-reported explanations for non-evacuation related to location, perceived safety, and past experience, they were still unable to account for a residual of between 33% and 50% (Dow and Cutter 149). This suggests that other, truly social factors were at play—confirming once again the need to transcend atomistic perspectives of evacuation behavior.

More broadly, it is important to note that the above findings are quite general in nature and do not specify the cultural mechanisms through which these differences emerge. Nor do they suggest that such relationships between demographic variables and risk perception are constant over space, time, or in relation to all of the various types of risk. Indeed, other studies (e.g. White 1974, Ives and Furseth 1983) suggest that the strength of these relationships is quite variable. The degree of ambiguity of these findings suggests that although attention to risk and information intake must be given, they cannot be considered outside the context of a broader constellation of social factors.

Race, Class, and Social Organization

Other research has moved beyond the methodological individualism of social psychology to consider the role of social and economic resources in evacuation behavior. For example, other studies have found racial differences in the communication of storm and evacuation information. Perry and Mushkatel (1986) and Perry and Nelson (1991) showed that Mexican-Americans used informal social networks to communicate disaster-related information more than blacks and whites,

both of whom were more likely to use formal news sources. A similar pattern holds true in the case of Hurricane Andrew, for which Morrow (1997) found that blacks and Hispanics were most likely to rely on relatives for information. Such differences are expected to have important effects of evacuation behavior, as the timing, quality, and perceived reliability of information varies across sources.

Moving beyond this focus on information, articles by Fothergill et al. (1999) and Fothergill and Peek (2004) provide extensive reviews of the many inequalities that often characterize natural disasters. They respectively demonstrate that race and class have emerged as significant axes of differentiation in evacuation patterns during some (though not all) natural disasters. A number of other studies have shown that regardless of information and perceptions, low-income residents have been systematically less likely to find resources to evacuate or make it to shelters (Gladwin and Peacock 1997, Morrow and Enarson 1996). Other empirical evidence largely supports these findings. Analyzing evacuation patterns during Hurricane Andrew, Gladwin and Peacock (1997) show that income had a statistically significant positive effect on the odds of evacuation. Morrow's (1997) work on that same event shows that the poorest non-evacuees were most likely to have stayed because they had no place to go. However, blacks and Hispanics—who were situated in unique positions in the “tripartite [racial] division” of Dade County—were still less likely to evacuate than their white neighbors, despite living in more vulnerable locations (Greiner and Morrow 47).

These findings clearly demonstrate the significance of “social structures, which dictate access to resources, power, and information” (Fothergill and Peek 104). However, the spatially and temporally uneven relationship between race, income, and disasters beg us to more fully contextualize these relationships. For example, Donner and Rodriguez (2008) situate race in the context of historical social and economic relations. They explain

Recent evidence also suggests that racial and ethnic minorities tend to hold lower trust in public institutions when compared to non-Hispanic whites... Accordingly, it is reasonable to hypothesize that that these groups may not be willing to seek help beyond a limited informal community when confronted with disasters. Persistent problems with chronic poverty, unemployment or underemployment, as well as their experiences with discrimination and racism...adversely impact the trust of minority groups in institutions that are designed to provide them with assistance both generally and at times of disasters specifically (Donner and Rodriguez 1099).

This highlights the need to move beyond simple descriptions of race and class to understand the more particular conditions that make such categories socially meaningful in a given place and at a given time. This thesis contends that it is not race and class per se that are important, but rather a more specific set of local social and cultural mechanisms that produce such patterns (and explaining, for example, why Donner and Rodriguez observe that some groups were “not willing” to search for alternative sources of aid).

Some previous work has made steps in this direction. Although many of these studies still utilize race and class uncritically, they all attend to more particular forms of social organization that underlie race- and class-based disparities. For example, there is evidence that differences in social ties help explain Gladwin and Peacock’s (1997) abovementioned observation of racialized evacuation patterns during Hurricane Andrew. More specifically, Morrow (1997) found that black and Hispanic residents were significantly more likely to have kin in close proximity before the storm. Although they do not report racial or income-based patterns, they also found that 38% of residents in an emergency post-storm tent city also had relatives staying in tents, which suggests that entire social networks were affected by the storm. Low-income households were also most likely to depend on family and friends for shelter (versus

hotels). Likewise, blacks and Hispanics were significantly more likely to have helped family or friends before and (just blacks) after the storm. Albeit indirectly, these findings in the case of Andrew suggest that the possession of (and need to utilize) social relations differed significantly between socio-economic groups.

Similar trends have emerged from work on Katrina. In a survey of evacuees, Spence et al. (2007) report significant black-white differences in sources of evacuation information. Where 56.4% of white respondents reported interpersonal information as “very important”, 74.6% of blacks and 77.1% of other non-whites did so (Spence et al. 547). Comparing specific Vietnamese and black neighborhoods in New Orleans, Li et al. (2008) reach similar conclusions, finding that blacks were more likely to rely on media or family than the government (Li et al. 275).

Airriess et al. (2008) found that although community-based social capital among Vietnamese residents of New Orleans was not a key factor in obtaining information about the storm, it did play a significant role in the actual process of evacuation (as well as return, and recovery). Drawing on a broader survey of Katrina-affected areas across the Gulf, Elliot and Pais (2006) found that race was a significant determinant of evacuation behavior in non-metro areas, with blacks significantly less likely to leave. In the city, however, income was the strongest (positive) and most consistent predictor of evacuation—although the small subset of the population that reported never leaving was almost entirely black.

Others have provided insight into the question of evacuation behavior in New Orleans. For example, a study by Haney et al. (2007) used the same Gallup data as Elliot and Pais to understand household evacuation strategies, including how they varied across race and income. They report that wealthier households were more likely than others to evacuate in unison, with household income having a statistically

significant negative effect on staying by division.¹ The income effect on staying in unison was also negative, but significantly weaker. On the other hand, blacks were less likely than whites to leave in unison, tending to either stay in unison or divide in some way. This suggests that blacks were, on average, more inclined to maintain at least some tie to home—even if the situation was perceived as dangerous enough to have some household members flee. Notably, however, Haney et al. explicitly note that they had “no direct measure of social networks” and therefore simply rely on race as a proxy—a highly problematic assumption (Haney et al. 86). While their reasoning has some merit, the conflation of race and network status seems problematic in light of the other race-class interactions they observe.

Taken together, the works of Airriess et al., Elliot and Pais, and Haney et al. suggest that networks, race, and class were all important factors in evacuation behavior during Hurricane Katrina. However, the variability between social groups (e.g. the Vietnamese) and regions (e.g. New Orleans City and others) suggests that further research is needed to explicate the nuanced relationship between these variables and behaviors. This thesis seeks to contribute to this task.

Networks, Nativity, Duration of Residence, and Place

A promising complement to the works cited above is found in works that consider the geographic distribution and temporal duration of social relations. For instance, Barnshaw and Trainor (2007) view Katrina through the lens of social capital, writing,

¹ A household was classified as having “stayed in division” if the individual observed in the sample stayed, but some household members left; a household was classified as having “evacuated in division” if the individual observed in the sample evacuated, but some household members stayed.

...our focus is on agents' ability to "cash in" or transform resting potential, or social network of loose associations, into beneficial resource allocation following a disaster. Therefore, we aim to better understand how preexisting networks in the Katrina catastrophe created situations that inhibited the transformation of social capital into tangible resources, thus rendering their accumulated social capital either situationally useless or detrimental (Barnshaw and Trainor 96).

Despite the potentially problematic economic view of social capital, this perspective takes us beyond the categories of race and class to view socio-economic resources from a more nuanced and multi-dimensional perspective. In contrast to a strictly hierarchical and categorical conceptualization of society, this view accounts for the quality (or character) of various forms of social capital that individuals and groups may possess, as well as how these resources are utilized in particular contexts.

Although Barnshaw and Trainor characterize their work as "exploratory research"—and consequently provide a less-than-rigorous analysis and set of findings—they report a number of important initial observations. Foremost, they note, "many evacuees reported fragmented or spatially concentrated social networks...", which could not be utilized in the state of crisis during Katrina (Barnshaw and Trainor 102). This is precisely the effect of "strong ties" that Granovetter demonstrated. Many evacuees also reported that a lack of financial resources and friends/family outside of the state had prevented such movements. Conversely, those with various combinations of financial resources and social networks were able to stay in hotels, apartments, and homes after the storm. However, these latter respondents are shown to be the exception rather than the rule, as 79% of evacuees reported they did not have friends or family they could move in with until they recovered (Barnshaw and Trainor 104).

It is likely that for many of those without support, their entire social network was affected. As the authors write, "several interviewees were members of large families, sometimes of 20 or more, all of whom lived in New Orleans and Orleans

Parish; as a result, all were affected by Hurricane Katrina” (Barnshaw and Trainor 103). Chamlee-Wright and Storr (2009) reach similar conclusions, noting, “while transplants could rely on extended kin in other parts of the country, large extended families all living in New Orleans were unable to render aid to one another as they were all caught in the same predicament” (Chamlee-Wright and Storr 626). These are critical observations that have largely been ignored in the literature, especially in relation to the attention afforded to car ownership (a concern that reflects a general inability to view evacuation as a truly social process).

Barnshaw and Trainor also noted that for some of their respondents, Katrina-related evacuation was the first time they had left the state of Louisiana. This anecdote is consistent with the city’s exceptionally high nativity rate: as of the 2000 Census, 77.4% of New Orleans’ 484,674 residents were born in Louisiana. This is the highest in-state nativity rate among major American cities, and, according to Campanella, has an extremely significant degree of social meaning in the city. In fact, this author has argued for an understanding of “nativity as ethnicity” (Campanella 270). That said, Falk (2004) suggests that such “rootedness” can be observed in many black communities across the rural South, thus New Orleans may be less of an exception than expected.

It is nonetheless worth noting that the population immobility that characterizes New Orleans is particularly salient among the city’s black population. According to Falk et al. (2006), only 3-4% of New Orleans’ black population moved there between 1995-2000—compared with 15-18% in Atlanta. This is evidence that “its local Black population was essentially reproducing itself from one generation to the next” (Falk et al. 120). It would nonetheless be a mistake to equate race (or class) with nativity and ‘rootedness’. As Campanella (2007) writes

Mapping out New Orleans' nativity patterns yields a whole new cultural geography compared to standard interpretations based on race, class, and other factors. The stark divide between the mostly black Lower Ninth Ward and mostly white St. Bernard Parish completely disappears when one plots nativity... New Orleans East and Westwego seem very different when we segment society by race, but quite similar when we do so by nativity. Conversely, Uptown and Lakeview seem the same in terms of age and class, but quite different in terms of nativity..." (Campanella 272).

This weak correlation between race and ethnicity suggests that the differences in culture and processes of socialization are so fundamental between high-native and high-transplant neighborhoods that racial boundaries may be complicated beyond recognition.

The social significance of nativity has a number of implications for thinking about evacuation behavior, particularly in New Orleans. For one, these population characteristics likely enhance the effect of historical events on contemporary culture via geographically close, strong intergenerational ties. For instance, the memory of Hurricane Betsy of 1965 remained fresh in the minds of many, as stories of this storm have been transmitted and reproduced in step with the city's population. As Bullard (2008) notes, many accounts of Betsy attribute the flooding of the Ninth Ward and other black areas during that storm to the intentional destruction of the particular levees protecting these neighborhoods. As Bullard describes:

Whether a conspiracy rumor or fact, the "Betsy experience" is the primary reason many Lower Ninth Ward residents keep hatchets in their attics. This mistrust of government probably saved thousands of lives after the levee breach four decades later when Katrina struck in 2005 (Bullard 761).

This conclusion is supported by Elder et al.'s (2007) study of over fifty black non-evacuees, in which the history of Betsy and general dissatisfaction with the

government—including explicit blame for perceived safety risks (e.g. faulty levees)—were among the commonly expressed sentiments. Findings such as these highlight the ways that population-level dynamics are implicated in the way that particular historical narratives are produced and reproduced. This, of course, has important consequences for evacuation behavior, since such narratives form part of the cultural framework again which decisions are made. These observations should also serve as a reminder that there are potentially fruitful opportunities for collaboration between such methodologically disparate disciplines as formal demography and anthropology.

The second major implication of New Orleans' high-nativity population relates to notions of community, place, and identity. Many social geographers, such as Agnew (1987), Fried (2000), and Gustafson (2001) have shown notions of “place” to be multi-dimensional and multi-scalar. For the purposes of this thesis, the most important insight provided by these works is that “meanings of place” are often “situated in the relationship between self, others, and/or environment, rather than unambiguously belonging to just one” (Gustafson 9). In other words, particular social relationships (e.g. kin networks), broader social identities (e.g. neighborhood-, race-, and/or class-based identity), and personal attachments to a specific location (e.g. a childhood home) interact to co-produce “place” as a physical and culturally meaningful concept.

It can be reasonably assumed that many residents' deep historical roots in New Orleans (or any location in rest of the Gulf) are associated with unique senses of place and place-based identity. As Gustafson (2001) writes, “places often have highly personal meanings...places where the respondents have lived for long periods or to which they have returned many times are associated with roots and continuity” (Gustafson 9). In one sense, this suggests that concepts of place transcend the actual people that inhabit it and claim it is as “their own.” Indeed, more general

characteristics—such as historical neighborhood identities, aesthetics, and culture—may play important roles among social groups and between people and places.

That said, it is also important to distinguish between nativity and duration of residence, since the latter may also have important implications for neighborhood-level social organization. As Sampson and Graif (2009) argue, “residential instability...might create disruption of institutional continuity, existing social networks, and social cohesion” (Sampson and Graif 1584). This suggests that the same processes that “disrupt” the strong ties of immobile populations may have broader, more negative effects on a neighborhood. In the case of New Orleans, however, the primary question will be whether the strong ties, cohesion, and institutions that were likely associated with the city’s relatively high degree of residential stability were conducive to, or prohibited, timely evacuation behavior.

Evidence from New Orleans suggests that, in many respects, social cohesion and place attachment remained strong among its residents. For example, Campanella, notes that identities and social actions often coalesce around nativity status. He writes, “the differences between natives and transplants almost seem to form, or at least inform, two separate sub-cultures, perhaps even two ethnicities”, forming a line of separation that transcends race and class on issues such as urban policy (Campanella 273-4). Making a more specific point, Bond-Graham observes that despite economists and sociologists’ common portrayal of communities like the Ninth Ward as oppressive slums, “community cohesion and people’s attachment to place has been profoundly powerful [there]” (Bond-Graham 5). Chamlee-Wright and Storr (2009) reach similar conclusions. After an extensive series of interviews of post-Katrina New Orleans residents and some non-returning evacuees, they report

Respondents overwhelmingly insist that New Orleans in general (and Ninth Ward neighborhoods in particular) possess a unique bundle of

characteristics that, when taken together, constitute a sense of place that cannot be found or replicated elsewhere... the Ninth Ward residents' insistence that 'there's no place like New Orleans' is somewhat remarkable since, at least for those who have returned, it is overriding otherwise negative perceptions that would lead people to abandon plans of returning (Chamlee-Wright and Storr 621, 624).

Although the latter statement suffers from a degree of selectivity bias, Chamlee-Wright and Storr's findings nonetheless demonstrate the intense sense of place that pervaded among many of New Orleans' poorest and most isolated residents.

While these insights do not adequately address the consequences of these communities' historical and contemporary position relative to mainstream society, they highlight the need to carefully distinguish between social isolation or deprivation and senses of place and community. The relationship between these two conditions is interactive and dynamic: particular types of cohesion emerge under particular social conditions, and with particular consequences. Illustrating this, Falk (2004) makes an important observation about how many blacks in the South have experienced "place" vis-à-vis a historically white supremacist society. Describing why some Southern blacks chose to remain in locations subjected to racist discrimination, he writes, "they knew well the white power structure and the well-established normative boundaries. Thus, black people could navigate their way through everyday life and nearly all situations that presented themselves" (Falk 146). While such insights surely do not apologize for racism and discrimination, they provide an important check on commonly held views that oversimplify important aspects of residential (and mobility) choices.

That said, if existing relations and institutions maintain highly unequal power relations and systematically limit the social efficacy of some groups, then "continuity" and "cohesion" might have negative consequences—in this case, for disaster response. Indeed, as Sampson and Morenoff (2006) report, "members of economically and

racially isolated communities, especially those least able to exercise political influence to obtain community services, are more likely than others to report alienation and powerlessness” (Sampson and Morenoff 191-2). This is consistent with Wilson’s (1987) notion of “social isolation”, which, he writes, “not only implies that contact between groups of different class and/or racial backgrounds is either lacking or has become increasingly intermittent, but that the nature of this contact enhances the effects of living in a highly concentrated poverty area” (Wilson 61). With this in mind, one can understand that the social cohesion described above may still take place in socially isolated and impoverished areas. Drawing again on Granovetter (1973), such communities are characterized by a disproportionate amount of “strong ties”, which leave them disconnected and fragmented from other (mainstream) social groups. The consequences of this are often negative—especially when the resources of mainstream society are of great importance, as they were during Katrina.

As a whole, the literature above highlights the important role that social networks play in human mobility generally, and disaster response more specifically. It challenges simplistic claims that stop at race, class, or the ownership of automobiles by also considering the role of more complex, less structural measures of social relations and organization. It stresses the multi-scalar nature of social networks, and the distribution of cultural and material resources they produce and reproduce across time and space. From individual perceptions to the broader political economy of urban spaces, the extent, character, and context of social ties are expected to have significant implications for households’ access to the social and economic resources relevant to evacuation. While race- and class-based groups do, almost by definition, have a close relation to networks, this review suggests that these categories are not sufficient.

Although this thesis cannot consider each of the factors discussed above because of data-related limitations, it moves beyond previous work to incorporate measures of social networking into its analysis. This step is expected to be particularly important when considering the case of Katrina in New Orleans—a city whose human and physical geographies were differentiated by various, intersecting axes of race, class, and place-based identities. The inclusion of both macro-structural (e.g. race, income) and micro-level (e.g. household ties, information attainment) variables is expected to provide a more nuanced explanation of evacuation dynamics than previous research, and shed light on potential avenues for future data collection and analysis.

RESEARCH FOCUS AND STRATEGY

The research above has shown that the evacuation process is complex and multi-scalar, and that the precise effect of race, class, and other independent variables on evacuation has varied on a case-by-case basis. Moreover, this literature shows that human mobility—evacuation in this case—can be studied from a number of perspectives and at a number of levels, from micro-level, social psychological factors to the broader social structures in which individuals and households are embedded.

While case studies that focus on one particular dimension of evacuation (e.g. individual risk perception, racial differences) are certainly important, the above review has shown that a network-oriented perspective has the potential to capture multiple dimensions of this process. Social networks “operate” at the individual and household levels by serving as conduits for the cultural and material resources that affect risk perceptions, as well as the ability and propensity of households to evacuate. They also work at the neighborhood and macro levels, as the particular constellation of a social group’s networks connects (or isolates) these groups in ways that shape their ability to mobilize and make claims on public resources. In instances where class- (or race)

based groups become meaningful on both a subjective and objective basis—what Marx referred to as a “class for itself”—then network arrangements may align closely with these categories. This, however, is not always the case.

Networks serve as a bridge by reinforcing (or contradicting) processes and conditions across scales, “interacting” or “intersecting” with other variables. As Hanneman and Riddle (2005) put it, a network approach captures the way that “[an] individual is embedded within a structure and how the structure emerges from the micro-relations between individual parts”. In short, this perspective is able to capture the mutually constitutive relationship between the micro and macro levels.

With that in mind, the purpose of this thesis is to understand the effect of household networks on evacuation behavior among residents of the Gulf Coast—giving particular attention to the city of New Orleans—before Hurricane Katrina. The primary question driving this study asks, *“Did the relative extent of a household’s social networks affect the likelihood that it would not evacuate?”* Previous research has failed to systematically examine the role of household social networks in evacuation behavior during Hurricane Katrina—and other disasters more broadly. By focusing on this factor, the thesis will fill these gaps in the research and consider the effect of networks in relation to those variables used in previous research.

The main expectation of this study is that households with many locally concentrated social ties were more likely to not evacuate before the storm than households with high levels of distant network connections. Those households with low levels of both local and distant ties (socially isolated) are expected to have been the least likely to evacuate before the storm. As previously discussed, the extent of household social networks is expected to affect evacuation behavior on both a cultural and material basis. They may influence the logic upon which the evacuation decision is based, as well as the tangible costs and benefits that define what behavior is possible or

probable. Moreover, households with many strong, local ties, but without weak, extensive ones, may be more likely to be natives of the county, parish, or state that they resided in. Although it would be unwise to classify these network attributes as a proxy to nativity (this thesis does not do so), it is possible to state that households with high levels of local ties and low levels of distant ties exhibit one of the key characteristics of an ideal-typical native.

This analysis of evacuation behavior will also consider a set of additional factors that have been found to have a significant effect in previous research. Specifically, indicators of storm preparation, information attainment, household size, income, and race will be included in the data analysis to isolate the effect of social ties. This is an important step beyond previous research, which has failed to move beyond ascribed categories and basic measures to consider measures of social networking in analysis of evacuation patterns.

DATA AND MEASURES

This question will be addressed using data from the baseline-year (2006) survey of Harvard Medical School's Hurricane Katrina Community Advisory Group (Kessler 2009). The purpose of this study was to "inform policy-makers of the impact of Hurricane Katrina on survivors' physical and mental health... as well as assist in future natural disaster planning efforts" (Kessler ii). Although the survey was designed to conduct social psychological research on the physical and mental health dimensions of the Hurricane Katrina disaster, it also includes important information about the evacuation behavior and demographic characteristics of the survey respondents. Most importantly, it is the only available source data on Katrina that includes measures of respondents' social networks.

That said, the secondary nature of this data limited this thesis in a number of significant ways. Foremost, the level of geography at which respondents were identified precluded the consideration of a number of potentially important variables, and thus limited the interpretations of the findings. County (parish) and sub-county (parish) identifiers would have made it possible to link household data to critical information about the context in which households were embedded, such as median neighborhood income and nativity rates. As the literature review suggested, such factors may have interacted with households' social networks to affect evacuation behavior. These variables are tightly linked to notions of "place" that link individuals and households to the people, culture, and physical environment of particular locations. Hence, such data would greatly strengthen analyses of evacuation behavior by accounting for the characteristics of the spatial context in which networks (and other variables) are situated.

The lack of any sub-state identifiers was particularly limiting for the interpretation of the non-New Orleans sample: it was not possible to gauge the geographic distribution of the respondents across the region (e.g. percent urban/rural), nor could I determine whether the respondents were under evacuation orders. It is thus not possible to know whether the patterns in evacuation behavior reflect social conditions or simply the geography of Katrina's impact. Such indicators would also have facilitated an analysis of the mobility decisions that took place during and after the storm. Geocodes could have been linked to other data to account for emergent environmental forces (e.g. flooding) and social processes (e.g. forced evacuations) that became relevant to mobility decisions during the storm and in its immediate aftermath.

It should also be noted that the inclusion of these measures would have represented a significant step toward the theoretical objective of developing an integrated understanding of social and environmental processes. As noted in the review

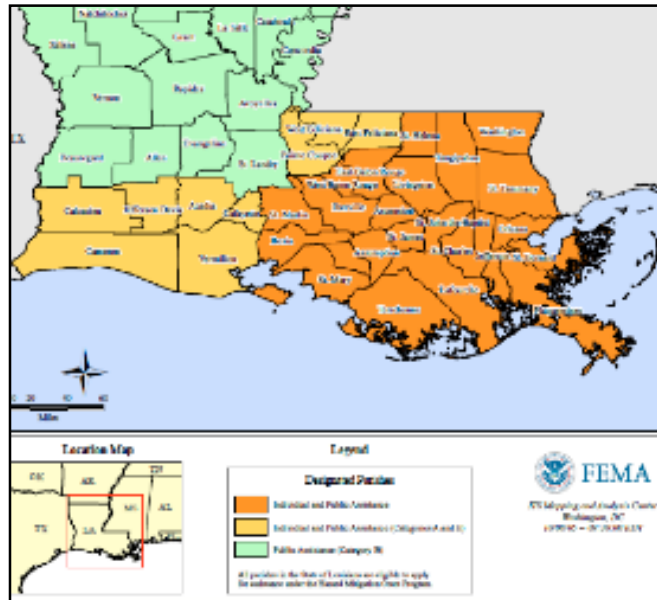
above, numerous scholars have argued that social and environmental forces must be viewed as interactive, and in some instances, co-constitutive. With the appropriate data, this thesis would have considered how environmental risk and actual environmental forces (e.g. storm surge, flooding) interacted with social conditions and behavior (e.g. recalcitrance to evacuate) to cause particular evacuation behaviors.

An additional limitation imposed by the use of secondary data, this analysis had to utilize a measure of social networks that was designed with social psychological research questions in mind. The questions asked in the survey used for this study were overly broad (e.g. how many friends outside of the county could you count on to share personal feelings?), and did not necessarily capture the number of ties that a household would rely upon in a time of emergency. A survey designed to study evacuation behavior would develop questions that captured both the generic ties that constitute a household's embeddedness in a community, and the more specific relations that factored into that household's evacuation decision.

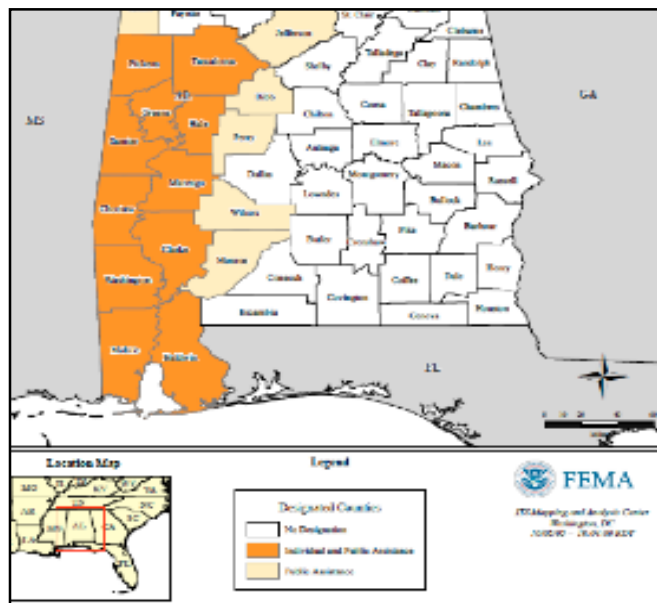
Despite these limitations, this survey provided sufficient information to examine the effect of social networks on evacuation behavior during Katrina. Using a multi-frame sampling method, the Advisory Group interviewed 1043 adult (ages 18 and over) respondents. The study aimed to acquire two representative samples. The first included pre-storm residents of the New Orleans Metropolitan area; the second consisted of those households that lived in the other counties or parishes² that were declared eligible for "individual assistance" by FEMA in the wake of the storm. As indicated by the medium and dark orange-shaded counties in the maps below, these counties and parishes were located in Louisiana, Mississippi, and Alabama. The New Orleans

² Counties are administrative units in Alabama and Mississippi; Parishes are the county-equivalent in Louisiana.

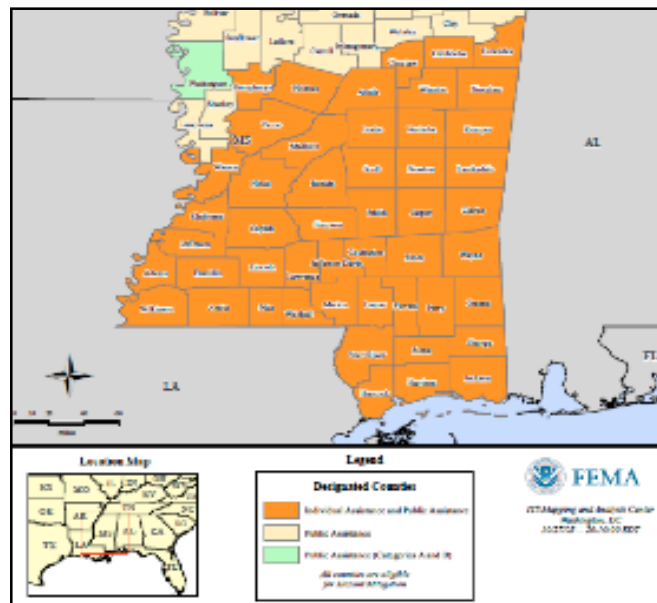
metropolitan sample netted 594 respondents, while the sample of the remaining counties and parishes included 449 respondents.



Map 1: Parish FEMA Status, Louisiana



Map 2: County FEMA Status, Alabama



Map 3: County FEMA Status, Mississippi

Drawing upon “safe lists”, an American Red Cross relief list, hotel registers, and random digit dialing, respondents were questioned via telephone interview. Of those households that were reached, 97.0% agreed to join the Advisory Group for this longitudinal study. After this initial contact and agreement, respondents were randomly selected among eligible adults in the household. It is important to note that the sample was limited by a set of criteria that excluded 6-8% of the sample frame: respondents had to speak English or Spanish, been physically and mentally able to participate in an interview, and have access to a telephone. Although it may be self evident, the sampling frame also included deceased respondents—all of whom would be considered “non-evacuees” in this study.

Respondents answered an extensive set of open- and close-ended questions. The open-ended questions were recorded as “oral histories”, which were not included in the data set being utilized (although it holds much promise for future research). All

respondents answered on behalf of their household, thus each case will be treated as a household. As discussed above, the analyses in this thesis assume the household to be the primary unit at which evacuation decisions are made.

Combining these sub-samples, the total 1043 respondents will be taken as the initial universe for data analysis. In addition to considering the effect of social networks on evacuation in this large sample, the inclusion of a geographic variable will examine the effect of living in (a) the New Orleans metropolitan area relative to living in (b) the remaining parishes and counties in Louisiana, Mississippi, and Alabama.

Before proceeding, it is necessary to make a number of clarifications regarding the variables used in this analysis. The following section will discuss the definition and construction of the dependent and independent variables, giving specific reference to the survey instrument used in this study.

Dependent Variable

Evacuation Status: Evacuee status will be defined according to whether the household evacuated before the storm, during it, after it, or never at all. Information on this behavior was obtained from responses to the following question:

Did you evacuate to a safe place outside the hurricane area before Katrina hit?

Households will be placed into one of two categories depending on their actions: (1) “evacuated before” or (2) “evacuated eventually or never”. Although one could treat those that eventually evacuated separately from those that never evacuated, this is a qualitatively different decision than whether or not to evacuate before the storm. Indeed, a separate analysis not included in this thesis demonstrated that the framework and variables utilized in this study does not adequately account for the difference in

these two sub-groups. Hence, this thesis focuses only on the pre-storm evacuation decision and therefore merges the households that “evacuated eventually” and “never evacuated” into a single “evacuated eventually or never” group.

Independent Variables

Social Networks: The social network variable—the focus of this thesis—accounts for the level of both intensive and extensive social network connections possessed by a household. This variable is based upon a simple four-box typology (see below), which categorizes households according to the relative extent of their networks. These measures were obtained from responses to the following two questions:

About how many friends or relatives in the county/parish were you close enough to that you could talk about your private feelings without feeling embarrassed?

About how many friends or relatives who did not live in the county/parish were you close enough to that you could talk about your private feelings without feeling embarrassed?

This relative measure of social networks (inside vs. outside county/parish) is more appropriate for an analysis of evacuation behavior than an indicator of absolute network extent since the objective is to move outside the county or parish under evacuation orders rather than to move as far as possible. For instance, having a relative in New York City was not necessarily an asset for evacuation, especially if the household in New Orleans could not afford to make that trip.

This four-category variable was constructed by dividing responses to the abovementioned questions according to a simply dichotomous classification: reports of 0-4 ties were considered “low”, with those of 5+ considered “high”. The line

partitioning these categories was based on both substantive meaning and the distribution of responses. The median response to the above questions were 5.0 and 3.0, respectively; hence 4.0 provides an optimal central point to create these binary categories around. Moreover, this particular division provided an adequate number of respondents when each network category was broken down in a contingency table comparing evacuees and non-evacuees.

	<u>Distant Networks</u>		
		<u>Low (0-4)</u>	<u>High (5+)</u>
<u>Local Networks</u>	<u>Low (0-4)</u>	A	B
	<u>High (5+)</u>	C	D

Figure 1: Social Network Variable Grouping Scheme

After classifying households' levels of both local and distant ties, the variable used in this study distinguishes between households that had: (1) low levels of both local and distant ties (Group A); (2) high levels of distant ties and low levels of local ties (Group B); (3) low levels of distant ties and high levels of local ties (Group C); and (4) high levels of both local and distant ties (Group D). Group D is the most embedded, while Group A is socially isolated. Group C is embedded locally, but lacks ties to the outside; Group B is embedded extra-locally, but lacks local ties. This method of categorization captures the aspect of social networks that is most important for this study: the relative distribution of households' local and distant networks.

Race: A dichotomous race variable distinguishes between black and white populations. Respondents could have also identified themselves as Hispanic or “other”, but these groups are excluded from analysis in order to focus on the black-white

cleavage. Hispanics and “Others” (e.g. Vietnamese) have unique positions vis-à-vis both blacks and whites in New Orleans and other affected areas, making it problematic to group them into a single “racial minority” group with blacks. Moreover, the relatively small sample size of these groups precludes robust statistical analysis of their evacuation behavior. When contingency tables of evacuation outcomes and independent variables are constructed for these groups, many cell counts are extremely small or zero, which artificially inflates coefficient estimates and standard errors (Hosmer and Lemeshow 129). Removing Hispanics and others excluded 6.4% of the combined sample.

Income: The household income reported by respondents was transformed into a four-part categorical variable. These categories represent four different ranges of the ratio of household income to the poverty line, which has the added benefit of controlling for household size. These four groups are as follows: (1) less than or equal to 1.5; (2) less than or equal to 3.0; (3) less than or equal to 6.0; and (4) greater than 6.0.

Educational Attainment: Unlike the other variables, the education measure accounts for the respondent, rather than characterizing the entire household. This maintains the possibility that one or more members of the household could have a higher (lower) level of educational attainment than the respondent. It is nonetheless an essential component of this analysis, as education serves as another important dimension of socioeconomic status (in addition to self-reported income). Not only is education less prone to measurement error (e.g. heaping of self-reported income), but it also has a substantively different meaning: where income represents an individual/households’ ability to acquire material resources and services, education represents both income-generating potential and that individual/household’s cognitive

and social abilities. The latter are certainly critical when navigating the “system” of mainstream society, which includes the logistical necessities of evacuation. Respondents’ levels of education attainment were transformed into four categories: (1) did not graduate from high school; (2) high school diploma or GED; (3) some college; and (4) Associates degree or greater.

Household Size: Household size is represented by a measure of the number of non-respondents reported to have been in the household at the time of the storm. Original responses ranged from 0 to 10, but these levels were truncated to maintain an appropriate frequency distribution for regression analysis. More specifically, responses of 5 to 10 were too infrequent to be analyzed as individual categories or as a combined 5-10 category; hence they were merged with responses of 4 into a 4+ group. Due to the limited range of responses, this variable was treated categorically, and broken down as follows: (1) 0 (16.4% of sample); (2) 1 (30.1%); (3) 2 (17.8%); (4) 3 (19.9%); and (5) 4+ (15.8%).

Storm-related Variables: Three variables were included to represent storm-related processes: information attainment and preparation behavior. First, a binary variable indicating the level of households’ storm preparation was derived from the question,

Did you pack three days of food and water in preparation for the hurricane?

It is important to note that this behavior was identified as an “evacuation preparation” measure in the survey.

A second variable accounts for the amount of warning time that households had before the storm struck. This measure was obtained from responses to the question,

How soon before hurricane Katrina hit did you first hear it might be coming?

Lastly, the number of evacuation preparedness recommendations that households saw or heard was collected through responses to the question,

When they first accounted the fact that Katrina was coming, local TV, radio, and newspapers told people four things they should do to prepare for the hurricane... About how many times did you hear or see a TV, radio, or print message that gave these four evacuation preparedness recommendations before Katrina?

Both of these latter variables were transformed to categorize responses as “low”, “medium”, and “high”. The range for each of these classifications was established according to the distribution of responses (to maintain a near-even distribution across a tripartite division), and broken down as follows: 0-4 evacuation warnings were classified as “low” (23.6% of respondents), 5-15 warnings as “moderate” (32.3%), and 16+ as high (44.1%); warning time of less than 48 hours was considered “low” (26.6%); 2-6 days warning “moderate” (33.4%); and more than 6 days “high” (40%).³

METHOD OF ANALYSIS

To estimate the effect of social networks and other factor on the likelihood of non-evacuation before Hurricane Katrina, binary logistic regression is utilized. This

³ The median warning time was 4 days; the median number of evacuation warnings was 12. Hence, the mean of the “moderate” level of both warning time and number of evacuation warnings is an approximate of the overall median.

statistical method has a number of advantages for this and other studies of the populations affected by Katrina more generally (Stringfield 2010). The outcome variable in logistic regression is always dichotomous, and the analysis is based upon the binomial—not normal—distribution (Hosmer and Lemshow 1989). The additional assumptions upon which logistic regression is based are also quite flexible. For example, unlike linear regression, it does not assume normally distributed variables or homoscedasticity. In this analysis, which includes only categorical independent variables, the most important assumptions are: (a) adequate sample size; (b) an adequate frequency distribution of cases across the dependent-independent contingency tables; and (c) an absence of multicollinearity.

The basic logit model is as follows:

$$z = \log (p_i/1-p_i) = B_0 + B_1X_1 + B_2X_2 + \dots + B_kX_{ik}$$

In this equation, B_0 is the constant and B_k is the effect of a unit change in X_{ik} on z , the log odds of the dependent variable (Hosmer and Lemshow 1989, Hori and Shafer 2010). The output from the SPSS (18.0.2) statistical software utilized in this study displays results in terms of odds ratios. Thus, a coefficient above 1.000 indicates that, holding all else constant, the odds of staying for the group signified by variable x are greater than the reference group; a coefficient of less than 1.000 indicates that the group is more likely to have evacuated.

As indicated previously, the objective of this study is to develop models predicting the odds of not leaving before the storm. This assumes that evacuating eventually and never evacuating are both problematic from a policy standpoint. Either of these outcomes is likely to increase the amount of public resources needed for rescue or other assistance. Delayed evacuation and outright staying also increase the amount of risk that these households are exposed to, thus increasing the likelihood of storm-related casualties. Understanding the sociological factors behind both of these two

sub-optimal outcomes may provide insight relevant to those concerned with evacuation compliance. Accordingly, evacuation was set as the reference category in the logistic regression, to be compared with the combined delayed evacuation and non-evacuation outcome.

This comparison will begin with an examination of the full/combined sample of all respondents in both New Orleans and the other storm affected areas. Separate analyses of the New Orleans metropolitan and non-New Orleans metropolitan area samples will be conducted if significant differences in evacuation behavior are found—as indicated by a significant coefficient on the variable signifying New Orleans/non-New Orleans location. For the analysis of each sample, a series of models will be constructed, beginning with a simple bivariate model in which the social network variable predicts evacuation behavior. Using this as a base, each additional model will add a set of theoretically relevant variables: socioeconomic, demographic, and storm related. Although each iteration of this model-building process will not be presented in this thesis, significant attention will be given to the potential presence of significant interaction effects. That said, only statistically significant interaction effects will be included in the results presented in this thesis.

Expected Relationships

Before describing and discussing the analyses and results in more depth, this section will clarify the expected effect of each independent variable on the likelihood of evacuating late or staying. This is particularly critical since the model-building process utilized in this thesis involves the inclusion of only theoretically important variables, rather than simply determining those that simply “fit” from a statistical perspective. Although the significance and goodness-of-fit of individual variables and overall

models will be central to the interpretation of these results, the realm of possible variables will be bounded by theory and previous empirical research.

The table below indicates the expected effect of each of the independent variables on the odds of evacuating compared with not evacuating.

Table 1: Expected Effect of Independent Variables

Variable	Expected Effect on Odds of “Staying”
Networks (High Local, Low Distant)	+
(Low Local, High Distant)	-
(High Local, High Distant)	-
Location (Non-New Orleans Metro)	+
(New Orleans City)	N.S.
Race (Black)	+
Income (Low)	+
Education (Low)	+
Household Size (Small)	-
Storm Preparation (No)	+
Warning Time (Low)	+
Number of Evacuation Warnings (Low)	+

Low levels of distant network ties are expected to positively affect the odds that households did not evacuate before the storm or at all. Thus, households with either low levels of both local and distant ties (social isolation) or high levels of local ties and low levels of distant ties are expected to have the highest odds of staying or delaying evacuation. Both arrangements of networks may have impeded (facilitated) household

evacuation “materially”—making it less possible—as well as “culturally”—making it less likely.

Location outside the New Orleans metropolitan area is expected to exert a positive effect on non-evacuation in the models of the full sample. Although the counties and parishes that comprise the universe of this study contained a large proportion of the 1.2 million Gulf Coast residents under some type of evacuation order, not all were mandatory, nor was the physical threat of the storm distributed evenly across the sampling frame. For example, as maps published on the FEMA website (not included) demonstrate, flood height and storm impact varied across the region. Hence, even when accounting for all of the factors included in this analysis, residents of the non-New Orleans region are expected to have been more likely to have not evacuated before the storm due to lesser political and environmental imperatives to evacuate.

If the location (New Orleans/non-New Orleans) variable is significant in the full model, separate analyses of the New Orleans metropolitan and non-New Orleans metropolitan samples would be merited. In this case, an additional geographic variable distinguishing between New Orleans City and suburbs will be incorporated into the New Orleans metropolitan area analysis. This variable is expected to have an insignificant effect, as evacuation orders were in place across both regions. Moreover, there are no other social conditions that are expected to differentiate the evacuation behavior of these populations when controlling for the other independent variables in the models. However, it is possible that unexplained differences may still emerge between these two regions—hence it is necessary to include this variable in the analysis.

Households of lower socioeconomic status—in this instance black, low-income, and/or low-education—are expected to have been more likely to delay evacuation or never evacuate. As discussed above, previous research suggests that socioeconomic status is positively associated with the ability and/or propensity of households to

evacuate (or engage in behaviors critical to the evacuation process) (e.g. Fothergill et al. 1999, Fothergill and Peek 2004). Although the character and causes of the inequalities that emerge in disasters are context-specific, they tend to reflect differences in economic conditions, social and cultural integration, and relations to the state.

Drawing upon a basic assumption about the material cost of evacuating, additional household members should increase the odds that a household stayed or delayed evacuating. Simply put, a ten-member household is more economically and logistically difficult to evacuate than a two-member household. Despite this expectation, this analysis will give specific attention to the possibility that the relationship between household size and evacuation behavior is not linear, but that there is an optimal household size for evacuation. In that instance, households above and below that size would both be more likely to have evacuated eventually or never evacuate.

Lastly, each of the three storm preparation variables, which contrast low to high (control) levels of preparation, is expected to have a positive effect on staying. A lack of storm preparation is expected to represent a low level of household awareness of and engagement with the development of the storm and government recommendations/orders. Similarly, low levels of warning time and evacuation warnings are expected to increase the odds of staying, since these households had less time to validate this knowledge and act upon it (e.g. by preparing).

ANALYSES AND RESULTS

The analytic portion of this thesis examines the differences between the population that evacuated before Hurricane Katrina and that which delayed evacuation or never evacuated. As explained above, the entire pooled sample will be analyzed first, with the results determining the need for separate analyses of the New Orleans and

non-New Orleans samples. In the event that a significant geographic difference emerges, the two sub-samples will also be analyzed separately to address the possibility that a different set of factors shaped evacuation behavior in each.

The frequency table below breaks down each variable by category for the combined, full sample and both sub-samples. After removing respondents who identified themselves as Hispanic and an “Other” racial group and deleting incomplete cases listwise (to assure that the samples included only respondents who answered all relevant questions), the full sample totaled 848 respondents (18% missing). After utilizing the same deletion strategy, the New Orleans and non-New Orleans samples totaled 395 (33% missing) and 375 (16%), respectively. It should be noted that the discrepancy between the size of the full sample and the sum of the two sub-samples is due to the difference in the geographic variable that was added to the New Orleans sample.

Table 2: Summary of Independent Variables

Independent Variable	Pooled Sample		New Orleans Sample		Non-New Orleans Sample	
	N	% of Category	N	% of Category	N	% of Category
Social Networks						
Low Local, Low Distant	395	37.9%	208	35.0%	187	41.6%
High Local, High Distant	343	32.9%	214	36.0%	129	28.7%
Low Local, High Distant	89	8.5%	50	8.4%	39	8.7%
High Local, Low Distant	183	17.5%	102	17.2%	81	18.0%
Geographic						
Non-New Orleans Metro	449	43.0%	N/A	N/A	N/A	N/A
New Orleans Metro	594	57.0%	N/A	N/A	N/A	N/A
New Orleans City	N/A	N/A	168	28.3%	N/A	N/A
Other New Orleans Metro	N/A	N/A	426	71.7%	N/A	N/A
Race						
White	707	67.8%	411	69.2%	296	65.9%
Non-Hispanic Black	270	25.9%	144	24.2%	126	28.1%
Income						
Income:Poverty <1.5	288	27.6%	120	20.2%	168	37.4%
Income:Poverty = 1.5-3	283	27.1%	159	26.8%	124	27.6%
Income:Poverty = 3-6	304	29.1%	197	33.2%	107	23.8%
Income:Poverty >6	168	16.1%	118	19.9%	50	11.1%
Education						
Less than HS Education	154	14.8%	68	11.4%	86	19.2%
HS or GED	320	30.7%	184	31.0%	136	30.3%
Some College	256	24.5%	141	23.7%	115	25.6%
Associates or more	313	30.0%	201	33.8%	112	24.9%
Demographics						
Add. Members HH = 0	171	16.4%	108	18.2%	63	14.0%
Add. Members HH = 1	314	30.1%	205	34.5%	109	24.3%
Add. Members HH = 2	186	17.8%	115	19.4%	71	15.8%
Add. Members HH = 3	208	19.9%	107	18.0%	101	22.5%
Add. Members HH = 4+	164	15.7%	59	9.9%	105	23.4%
Storm-related						
Evac. preparation = yes	658	63.1%	342	57.6%	130	29.0%
Evac. preparation = no	378	36.2%	248	41.8%	316	70.4%
Warning time = low	279	26.7%	189	31.8%	90	20.0%
Warning time = med.	349	33.5%	216	36.4%	133	29.6%
Warning time = high	382	36.6%	170	28.6%	212	47.2%
Evac. warnings = low	246	23.6%	157	26.4%	89	19.8%
Evac. warnings = med.	337	32.3%	181	30.5%	156	34.7%
Evac. warnings = high	370	35.5%	194	32.7%	176	39.2%
Listwise N	848		395		375	

It should also be noted that a two-sample chi-square test was performed for each of the response variables in each of the samples. As the table below shows, statistically

significant differences in the distribution of a number of independent variables were observed when comparing the New Orleans and non-New Orleans samples. This provides preliminary evidence that separate analyses of these two samples may be necessary.

Table 3: Results of Chi-Square Test

Variable	Pearson Chi-Square Value	p Value
Social Networks	7.230	.065*
Race	1.834	0.176
Income	47.252	.000***
Education	17.430	.001**
Additional Household Members	45.396	.000***
Evacuation Preparation	18.200	.000***
Warning Time	40.465	.000***
Number of Evacuation Warnings	8.717	.013**
*p<.10, **p<.05, ***p<.001		

Evacuation Before the Storm vs. During, After, or Never: Full Sample

The contingency table below provides the marginal percentages and totals of the independent variables according to their evacuation status. These figures provide critical insight into the bivariate relationship between each independent variable and evacuation behavior. By comparing the distribution of evacuees and non-evacuees among households in each category of the independent variable, a preliminary indication of the strength and direction of the association between the respective variables and evacuation outcomes can be ascertained.

With respect to the focus of this thesis—social networks—the table demonstrates that households with high levels of distant ties were most likely to have evacuated before the storm: those with low levels of local and distant ties had a similar, near-even distribution of evacuees and non-evacuees as those with high levels of local ties and low levels of distant ties. This stood in contrast to the remaining households, which had either a low level of local ties and high level of distant ties or high levels of

both types of ties. Almost two-thirds of the respondents in these latter two categories evacuated before the storm, a finding consistent with the expectation that households with high levels of distant ties were more likely to evacuate before the storm than others. In other words, this bivariate analysis provides evidence that the level of distant ties is a strong predictor of evacuation behavior.

Differences also emerge when comparing the race, class, and education statuses of evacuees and non-evacuees. A greater percentage of black respondents evacuated after the storm or never at all (51.9%) than before it (48.1%). This contrasts with whites, of whom 60.5% evacuated before the storm (39.5% eventually or never). A similar pattern of stratification is evident in the breakdown of income and education variables. A majority (54.7%) of the lowest income households did not evacuate before the storm, nor did 55.8% of those represented by the least-education respondents. More than half of the households in all other income and education categories evacuated before the storm, with the proportion of evacuees positively associated to both income and education. As hypothesized, both sets of figures suggest that socioeconomic status is negatively related to the odds of staying.

The breakdown of evacuation status across household sizes shows that a majority of 1-to-4 person households evacuated before the storm, with little variability in the distribution of evacuees and non-evacuees across these categories. However, the distribution reverses markedly for households of 5 or more people, of whom 54.6% did not evacuate before the storm. Although this is only one of five categories, it is nonetheless consistent with the notion that the logistic and economic costs of evacuation for very large households reduce their likelihood of evacuation. In other words, the effect of household size is not linear; rather, there is a size threshold for evacuation.

Among the storm-related variables that were analyzed, evacuation preparation and warning time deserve comment. Households that did not prepare by packing three

days of food and water were much more likely to evacuate prior to the storm (68.1%) compared with non-evacuees (31.9%)—which stands in contrast to the even distribution of evacuees and non-evacuees among those that did prepare. Speculatively, this suggests that many households took this measure as a means of preparing to stay and “ride out the storm”—rather than an evacuation preparation strategy as the survey designers expected.

The breakdown of warning time runs contrary to conventional wisdom: households with low and moderate levels of warning time were more likely to have evacuated before the storm than those with high levels. Of course, these differences may be explained by other factors—a possibility that will be explored in multivariable analysis below.

Perhaps the starkest differences emerged when the geographic distribution of evacuees is compared to that of non-evacuees. A much higher percentage of households living in the New Orleans metropolitan area before Katrina evacuated before the storm (77.9%) than those living in the remaining counties and parishes (30.6%). This likely reflects differences in issuance of evacuation warnings and the physical impact of the storm. It certainly provides an initial reason to believe that a strong understanding of evacuation behavior will require separate analyses of these two sub-samples.

Table 4: Contingency Table, Full Sample

Independent Variables by Evacuation Status: Full Sample				
	Evacuated Before %	Evacuated Before N	Evacuated Eventually/Never %	Evacuated Eventually/Never N
Social Networks				
Low Local, Low Distant	53.9%	212	46.1%	181
High Local, High Distant	62.5%	213	37.5%	128
Low Local, High Distant	62.5%	55	37.5%	33
High Local, Low Distant	53.0%	97	47.0%	86
Geographic				
Non-New Orleans Metro	30.6%	137	69.4%	311
New Orleans Metro	77.9%	460	22.1%	130
Race				
White	60.5%	425	39.5%	277
Non-Hispanic Black	48.1%	130	51.9%	140
Income				
Income:Poverty <1.5	45.3%	130	54.7%	157
Income:Poverty = 1.5-3	57.8%	163	42.2%	119
Income:Poverty = 3-6	64.0%	194	36.0%	109
Income:Poverty >6	66.3%	110	33.7%	56
Education				
Less than HS Education	44.2%	68	55.8%	86
HS or GED	56.9%	181	43.1%	137
Some College	54.5%	139	45.5%	116
Associates or more	67.2%	209	32.8%	102
Demographics				
Add. Members HH = 0	58.0%	98	42.0%	71
Add. Members HH = 1	63.9%	200	36.1%	113
Add. Members HH = 2	60.0%	111	40.0%	74
Add. Members HH = 3	54.8%	114	45.2%	94
Add. Members HH = 4+	45.4%	74	54.6%	89
Storm-related				
Evac. preparation = yes	51.7%	339	48.3%	317
Evac. preparation = no	68.1%	256	31.9%	120
Warning time				
Warning time = low	64.4%	179	35.6%	99
Warning time = med.	63.0%	218	37.0%	128
Warning time = high	48.3%	184	51.7%	197
Evac. warnings				
Evac. warnings = low	56.6%	138	43.4%	106
Evac. warnings = med.	56.1%	188	43.9%	147
Evac. warnings = high	57.6%	213	42.4%	157

Building upon these initial comparisons of evacuees and those households that delayed evacuation or never left, binary logistic regression is utilized to examine if the strong effect of distant social ties shown in Table 4 remains in a multivariate context.

The set of models below predict the odds of not evacuating before Hurricane Katrina—that is, non-evacuees that left during the storm, after it, or never at all. As discussed above, these three categories were merged because this analysis focuses on the decision to stay (evacuate) before the storm struck, not the factors that differentiate the final outcome of those that initially stayed.

This analysis begins with a simple model (Model 1) predicting the effect of social networking on evacuation behavior. Households with low levels of both local and distant ties serve as the reference category, and will continue to do so for the remainder of this thesis. As the most “socially isolated”, this group is expected to be the most likely to have not evacuated before the storm. Moreover, with low levels of both types of social networks, it provides a “baseline” against which the other “portfolios” of social relationships can be easily compared. In this first model, the estimated odds of staying were statistically significant only for households with high levels of both local and distant ties. This is in line with expectations, as these households were the most “socially connected” in the sample. That said, the non-significant coefficient for households with high levels of distant ties and low levels of local ties does not support the hypothesis that distant ties were most critical in the evacuation decision. This runs contrary to the findings of the contingency table analysis.

Model 2 adds a geographic variable to account for households’ location inside (outside) the New Orleans metropolitan area. As the descriptive statistics above anticipated, households in the non-New Orleans region are significantly more likely to have stayed than those in the New Orleans metropolitan area. Moreover, the social network variable becomes statistically non-significant after controlling for location, suggesting that much of that original network effect could be explained by location.

As Models 3-5 show, the coefficients for the geographic and social network variables remain relatively consistent as socioeconomic, demographic, and storm-related variables are gradually added. Model 3 adds race, income, and education, as measures of socioeconomic status.⁴ It is important to note that these variables were subjected to collinearity diagnostic tests. Tolerance levels were near 1.0 for each, and the variance inflation factor (VIF) was below 10.0—in fact, none was over 2.0. These results allow us to conclude that multicollinearity was not a problem, and all three variables can be included in the model. Moreover, race-income, race-education, and income-education interaction terms were included in various other iterations of this model, but were not statistically significant at the .05 level (and thus not included). Model 4 controls for household size, while Model 5 adds the three storm-related variables of interest—evacuation preparation, warning time, and number of evacuation warnings.

In the final model (Model 5), we see that race and education are the strongest socioeconomic predictors of evacuation behavior. Blacks and households represented by low-educated respondents were 1.6 and 2.1 times more likely, respectively, to have not evacuated before the storm than their white and highest-educated counterparts. Despite the suggestion of the crosstabulations above, family size had no significant effect. However, evacuation preparation and the number of evacuation warnings that households received are statistically significant predictors of evacuation. As expected, households that received few warnings were less likely to have evacuated than those that received a high number of warnings. However, contrary to original expectations and the survey's "evacuation preparation" label, households that did not pack three days

⁴ Some readers may be interested to know that in a model including only social networks, location, and race as independent variables, only race and location were statistically significant. Race (black) had a coefficient of 1.719, with a p-value of 0.001; Location (New Orleans metro) had a coefficient of 8.054, with a p-value of .000.

of food and water in advance of the storm were more likely to have evacuated than those that took this measure.

It is also important to note the overall model statistics included at the bottom of Table 4. Each of the overall models is statistically significant at the 0.05 or .001 level. The -2 Log Likelihood Ratio does not provide much information in itself; however, the decrease in the magnitude of this ratio suggests that the latter models were strongest. The Hosmer-Lemeshow goodness-of-fit test—similar to a chi-square test—provides insight into the fit of the observed values relative to expected values. P-values greater than 0.05 fail to overturn the null hypothesis that there is no difference between observed and expected values. Hence, all of the models displayed in Table 5 “pass” the Hosmer-Lemeshow test. Lastly, two pseudo R-squared measures are included in Table 5. The dichotomous dependent variable makes the interpretation of these statistics less straightforward (and more disputed among statisticians) than a traditional R-square measure. Nonetheless, the increase in both pseudo R-squared statistics across the five models demonstrates that the explanatory power grows in each subsequent model. In short then, these measures of overall fit and explanatory power provide support for the models—and suggest that the final model is the strongest of the five.

Returning to the substantive interpretation of these analyses, this group of models indicates that the odds of evacuation differed significantly between the New Orleans metropolitan area and other counties and parishes. This suggests that separate analyses of both sub-samples are needed. This is particularly important due to the geographical expanse of the non-New Orleans sample. The diversity of pre-storm social conditions, as well as the storm impact and political responses in this region, make it difficult to make the same claims as may be possible with the separate New Orleans sample

Table 5: Results of Logistic Regression Analysis, Full Sample

Predicting the odds of not evacuating before Hurricane Katrina; Full Sample (n=848) (Significance levels in parentheses)						
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Network variables						
Low Local, Low Distant ^a						
High Local, High Distant	.704 (.020)**	.819 (.244)	.724 (.042)*	.916 (.642)	.925 (.681)	.927 (.706)
Low Local, High Distant	.703 (.146)	.688 (.173)	.731 (.215)	.747 (.317)	.750 (.323)	.639 (.154)
High Local, Low Distant	1.038 (.833)	1.141 (.518)	1.103	1.298 (.226)	1.314 (.207)	1.329 (.213)
Geographic Variables						
Non-New Orleans Metro		8.135 (.000)***		7.893 (.000)***	7.891 (.000)***	7.644 (.000)***
New Orleans Metro ^a						
Socio-economic variables						
White ^a						
Non-Hispanic Black			1.632 (.001)***	1.568 (.012)**	1.544 (.019)**	1.618 (.016)**
Income : Poverty <1.5				.984 (.955)	.925 (.790)	.756 (.377)
Income : Poverty = 1.5-3				.858 (.560)	.822 (.460)	.726 (.258)
Income : Poverty = 3-6				.919 (.734)	.901 (.675)	.833 (.487)
Income : Poverty >6 ^a						
Less than HS Education				1.797 (.030)**	1.825 (.026)**	2.172 (.009)**
HS or GED				1.495 (.057)*	1.509 (.052)*	1.398 (.140)
Some College				1.497 (.061)*	1.505 (.058)*	1.433 (.112)
Associates or more ^a						
Demographic variables						
Add. Members of HH = 0					1.126 (.665)	.979 (.944)
Add. Members of HH = 1					.778 (.312)	.760 (.300)
Add. Members of HH = 2					.863 (.585)	.858 (.591)
Add. Members of HH = 3					.928 (.770)	.913 (.740)
Add. Members of HH = 4+ ^a						

Table 5 Continued

Storm-related variables						
Evacuation preparation = yes ^a						
Evacuation preparation = no						.554 (.001)**
Warning time = low						.764 (.202)
Warning time = medium						.786 (.221)
Warning time = high ^a						
Evacuation warnings = low						1.736 (.014)**
Evacuation warnings = medium						1.138 (.503)
Evacuation warnings = high ^a						
Overall model significance	0.048**	0.000***	0.000***	0.000***	0.000*	0.000***
(-) 2 Log Likelihood	1363.145	1129.274	1265.599	1043.613	1040.854	918.797
Hosmer-Lemeshow	1	0.768	0.077	0.776	0.712	0.969
Cox-Snell R-Squared	0.008	0.214	0.021	0.227	0.229	0.245
Nagelkerke R-Squared	0.011	0.287	0.028	0.304	0.307	0.329
*Reference category *p<.10, **p<.05, ***p<.001						

Evacuation Before the Storm vs. During, After, or Never: New Orleans Sample

To further explore the significant effect of geographic location in the combined sample, this section focuses exclusively on the New Orleans metropolitan area sample. This sub-sample will be subject to the same descriptive and regression analyses as the full sample.

The descriptive contingency table below once again displays the marginal percentages and totals of the independent variables according to their evacuation status. The differences that emerge along social network lines are less than in the full sample, although households with high levels of distant ties continued to have higher proportions (approximately 25%) of non-evacuees than households with few distant ties (approximately 18%). This is consistent with expectations, but the association is weak in this bivariate context.

A geographic variable was also included in the analysis of the New Orleans sample. In this case, it accounts for the dichotomy between New Orleans City and the remainder of the New Orleans metropolitan area. The differences between these two locations are minimal, as nearly three-quarters of the respondents in both areas evacuated before the storm.

The racial breakdown of evacuation behavior is consistent with expectations, although perhaps not as stark as expected: while 20.1% of whites did not evacuate before the storm, 29.2% of blacks stayed. The descriptions of the two other indicators of socioeconomic status are also in line with above hypotheses: a greater proportion of low-income and low-education households were non-evacuees than their higher-status counterparts. More specifically, 33.6% of the lowest-income households did not evacuate before the storm, which compares to only 16.4% of those in the highest income category. The educational trend is similar, with 33.8% and 15.0% of those in the lowest and highest categories, respectively, not evacuating before the storm.

Among households in the New Orleans sample, the breakdown of evacuees and non-evacuees by household size yielded slight and inconsistent differences. However, notable trends did emerge when comparing evacuation status groups according to the storm-related variables. As in the combined sample, households that took preparation measures were less likely to have evacuated before the storm (73.2%) than those who did not (85.0%). Households that received a low number of evacuation warnings were slightly more likely to have stayed (26.5%) than those who received medium and high numbers of warnings (both 20.6%). Finally, it is interesting to note that households that received high levels of warning time were less likely than others to have evacuated before the storm. This is contrary to conventional wisdom and expectations, but remains to be tested in multivariate analysis.

Table 6: Contingency Table, New Orleans Sample

Independent Variables by Evacuation Status: New Orleans Sample				
	Evacuated Before N	Evacuated Before %	Evacuated Eventually/Never N	Evacuated Eventually/Never %
Social Networks				
Low Local, Low Distant	74.3%	153	25.7%	53
High Local, High Distant	82.6%	176	17.4%	37
Low Local, High Distant	81.6%	40	18.4%	9
High Local, Low Distant	74.5%	76	25.5%	26
Geographic				
New Orleans City	73.7%	123	26.3%	44
New Orleans Metro	79.7%	337	20.3%	86
Race				
White	79.9%	325	20.1%	82
Non-Hispanic Black	70.8%	102	29.2%	42
Income				
Income:Poverty <1.5	66.4%	79	33.6%	40
Income:Poverty = 1.5-3	79.1%	125	20.9%	33
Income:Poverty = 3-6	80.7%	159	19.3%	38
Income:Poverty >6	83.6%	97	16.4%	19
Education				
Less than HS Education	66.2%	45	33.8%	23
HS or GED	74.7%	136	25.3%	46
Some College	77.9%	109	22.1%	31
Associates or more	85.0%	170	15.0%	30
Demographics				
Add. Members HH = 0	72.0%	77	28.0%	30
Add. Members HH = 1	81.9%	167	18.1%	37
Add. Members HH = 2	79.8%	91	20.2%	23
Add. Members HH = 3	75.7%	81	24.3%	26
Add. Members HH = 4+	75.9%	44	24.1%	14
Storm-related				
Evac. preparation = yes	73.2%	249	26.8%	91
Evac. preparation = no	85.0%	209	15.0%	37
Warning time				
Warning time = low	78.2%	147	21.8%	41
Warning time = med.	81.8%	175	18.2%	39
Warning time = high	74.6%	126	25.4%	43
Evac. warnings				
Evac. warnings = low	73.5%	114	26.5%	41
Evac. warnings = med.	79.4%	143	20.6%	37
Evac. warnings = high	79.4%	154	20.6%	40

Employing the same model building logic as in the analysis of the pooled sample, the analysis of non-evacuation from the New Orleans metropolitan area began with a

simple prediction of the odds of non-evacuation using household social networks as the only independent variable. In contrast to the pooled model, households with high levels of both local and distant ties are found to have been significantly less likely to have not evacuated before the storm than their socially isolated counterparts. This effect remains significant, even after controlling for geographic location (New Orleans City/remaining metropolitan area) in Model 2. This suggests that it is not merely the level of local or distant ties that matters most in the evacuation process, but rather overall “social embeddedness.” In other words, households that had high levels of social ties at both local and distant levels were uniquely (and advantageously) positioned vis-à-vis ‘mainstream’ society in a way that allowed them to access the resources needed to evacuate better than those with other types of social ties.

This network effect diminishes, however, after controlling for the additional sets of variables that are added in Models 3-5. It should be noted that collinearity diagnostics again confirmed the absence of multicollinearity between these socioeconomic indicators. Likewise, interaction terms were not significant in other interactions of this model not shown here. Among the three socioeconomic indicators⁵ that were included, education emerges as the only significant predictor of the odds of evacuation behavior. It is particularly notable that the effect of education was significant when controlling for income. This suggests that education is more than a means to acquire economic resources; it provides social skills (e.g. navigating “the system” that were important in this disaster context. In the final model, those households represented by respondents with less than a high school education were approximately 3.0 times more likely to have stayed than their highest-educated

⁵ In a model whose independent variables include only social networks, location, and race, only social networks are statistically significant. Those households with high levels of both local and distant social networks had a coefficient of 0.603, with a p-value of .048. All other categories of this variable had non-significant coefficients.

neighbors. Those represented by holders of a high school diploma were slightly less than two times more likely to have not evacuated before the storm than the reference group.⁶

Among the demographic and storm-related variables, only storm preparation and the number of evacuation warnings had significant effects on the odds of not evacuating before the storm. Households that did not prepare by packing three days of food and water were less than half as likely to have stayed through at least part of the storm than those that did prepare. Similar to the pooled analysis, the effect of evacuation warnings was consistent with expectations, with those receiving a low number of warnings nearly twice as likely to have failed to evacuate before Katrina.

Lastly, the measures of overall fit and explanatory power provide support for the latter models. Each of the latter three models is significant at the .05 level, and “passes” the Hosmer-Lemeshow goodness-of-fit test at the .001 level. The -2 Log Likelihood Ratio and pseudo R-squared measures all indicate that explanatory power increases with each subsequent model, and that Model 5 is the strongest of those included in Table 6.

⁶ This statistic is significant only at the .10 level.

Table 7: Results of Logistic Regression Analysis, New Orleans Sample

Predicting the odds of not evacuating before Hurricane Katrina; New Orleans Sample (n=395)					
(Significance levels in parentheses)					
	Model 1	Model 2	Model 3	Model 4	Model 5
Network variables					
Low Local, Low Distant ^a					
High Local, High Distant	.607 (.038)**	.589 (.029)**	.723 (.225)	.732 (.249)	.715 (.245)
Low Local, High Distant	.650 (.283)	.658 (.299)	.851 (.701)	.827 (.655)	.649 (.388)
High Local, Low Distant	.988 (.964)	.999 (.996)	1.152 (.628)	1.209 (.526)	1.101 (.764)
Geographic Variables					
New Orleans City		1.407 (.121)	1.425 (.176)	1.416 (.191)	1.441 (.210)
New Orleans Metro ^a					
Socio-economic variables					
White ^a					
Non-Hispanic Black			1.087 (.762)	1.045 (.877)	1.051 (.870)
Income : Poverty <1.5			1.888 (.116)	1.725 (.185)	1.396 (.456)
Income : Poverty = 1.5-3			1.225 (.589)	1.165 (.687)	1.030 (.942)
Income : Poverty = 3-6			1.318 (.428)	1.348 (.396)	1.227 (.578)
Income : Poverty >6 ^a					
Less than HS Education			2.160 (.051)*	2.270 (.040)**	3.037 (.011)**
HS or GED			1.709 (.080)*	1.703 (.084)*	1.785 (.086)*
Some College			1.425 (.272)	1.460 (.245)	1.480 (.267)
Associates or more ^a					
Demographic variables					
Add. Members of HH = 0				1.301 (.516)	1.083 (.859)
Add. Members of HH = 1				.690 (.351)	.642 (.298)
Add. Members of HH = 2				.773 (.537)	.609 (.272)
Add. Members of HH = 3				1.174 (.694)	1.052 (.908)
Add. Members of HH = 4+ ^a					
Storm-related variables					
Evacuation preparation = yes ^a					
Evacuaton preparation = no					.451 (.002)**
Warning time = low					1.018 (.953)
Warning time = medium					.992 (.978)
Warning time = high ^a					
Evacuation warnings = low					1.829 (.049)**
Evacuation warnings = medium					.941 (.835)
Evacuation warnings = high ^a					
Overall model significance	0.138	0.096*	0.018**	0.018**	0.003**
(-) 2 Log Likelihood	594.152	591.786	542.654	536.985	460.100
Hosmer-Lemeshow	1.000	0.723	0.774	0.267	0.539
Cox-Snell R-Squared	0.010	0.014	0.042	0.052	0.085
Nagelkerke R-Squared	0.015	0.021	0.064	0.080	0.129

^aReference category *p<.10, **p<.05, ***p<.001

Evacuation Before the Storm vs. During, After, or Never: Non-New Orleans Sample

Turning to the sub-sample of counties and parishes outside of the New Orleans metropolitan area, descriptive cross-tabulations once again serve as the point of

departure. The main trend to emerge with respect to social networks is that households with high levels of distant ties and low levels of proximate ties were the most likely to have evacuated before the storm. In contrast, households with a high density of local ties were slightly more likely to have failed to evacuate before the storm, regardless of their level of distant ties. It was thus the level of local social ties that distinguished the population that evacuated before the storm from that which evacuated during or after. This runs contrary to the New Orleans sample, in which evacuation status was associated with the level of households' distant ties, regardless of the level of their local network connections.

Examining evacuation status according to race, we see that a higher percentage of blacks (77.8%) did not evacuate before the storm when compared with whites (66.1%). The association of income and education with evacuation behavior is much less clear. The differences among income categories are slight and contrary to expectations: the highest-income category has the highest percentage of non-evacuees (74.0%). With respect to education, the distributions of evacuees and non-evacuees are inconsistent, with households headed by respondents with less than a high school education (73.3%) or some college (73.9%) having a higher percentage of non-evacuees than those headed by holders of high school (91%) or college diplomas (85%). The breakdown of household size and evacuation status is similarly ambiguous, with no clear pattern emerging from these marginal proportions.

Finally, analysis of the storm-related variables reveals that, contrary to the findings for the New Orleans sample, a greater percentage (36.2%) of the households that packed three days of food and water evacuated before the storm than those that did not prepare (28.5%). The association between evacuation behavior and warning time was again contrary to expectation: a greater proportion of households that received high levels of warning time did not evacuate before the storm (72.6%) when compared to

those receiving low or moderate warning time. Lastly, a breakdown of households by the number of evacuation warnings they received yields only slight differences. These are nonetheless consistent with expectations, with households receiving a low (73.0%) and moderate (71%) number of evacuation warnings more likely to have not evacuated before the storm than those that received a high number of warnings (66.5%)

Table 8: Contingency Table, Non-New Orleans Sample

Independent Variables by Evacuation Status: Non-New Orleans Sample				
	Evacuated Before N	Evacuated Before %	Evacuated Eventually/Never N	Evacuated Eventually/Never %
Social Networks				
Low Local, Low Distant	31.6%	59	68.4%	128
High Local, High Distant	28.9%	37	71.1%	91
Low Local, High Distant	38.5%	15	61.5%	24
High Local, Low Distant	25.9%	21	74.1%	60
Race				
White	33.9%	100	66.1%	195
Non-Hispanic Black	22.2%	28	77.8%	98
Income				
Income:Poverty <1.5	30.4%	51	69.6%	117
Income:Poverty = 1.5-3	30.6%	38	69.4%	86
Income:Poverty = 3-6	33.0%	35	67.0%	71
Income:Poverty >6	26.0%	13	74.0%	37
Education				
Less than HS Education	26.7%	23	73.3%	63
HS or GED	33.1%	45	66.9%	91
Some College	26.1%	30	73.9%	85
Associates or more	35.1%	39	64.9%	72
Demographics				
Add. Members HH = 0	33.9%	21	66.1%	41
Add. Members HH = 1	30.3%	33	69.7%	76
Add. Members HH = 2	28.2%	20	71.8%	51
Add. Members HH = 3	32.7%	33	67.3%	68
Add. Members HH = 4+	28.6%	30	71.4%	75
Storm-related				
Evac. preparation = yes	36.2%	47	63.8%	83
Evac. preparation = no	28.5%	90	71.5%	226
Warning time				
Warning time = low	35.6%	32	64.4%	58
Warning time = med.	32.6%	43	67.4%	89
Warning time = high	27.4%	58	72.6%	154
Evacuation warnings				
Evac. warnings = low	27.0%	24	73.0%	65
Evac. warnings = med.	29.0%	45	71.0%	110
Evac. warnings = high	33.5%	59	66.5%	117

The data in Table 8 below describes a series of logistic regression models of this data, which were developed in accordance to the same strategy used above. Once again, the first model simply predicts the odds of non-evacuation with respect to only the social network variable—providing a base from which additional models were developed. The effect of this factor is not significant in this, or any of the subsequent models.

In fact, as socioeconomic⁷, demographic, and storm-related variables are added in Models 2-4, only race and income emerge as significant predictors—and the latter only at the .10 level.⁸ More specifically, blacks were slightly more than twice as likely to have failed to evacuate before the storm than whites. Contrary to expectations, however, the poorest households were more than twice as likely to have evacuated before the storm than their high-income counterparts. This may reflect a disproportionate degree of environmental risk (e.g. flooding) among low-income households—but data limitations prevent any such conclusion to be made.

In addition to these limitations, the measures of overall model fit and explanatory power suggest that the variables included in this analysis are poor predictors of evacuation behavior in the non-New Orleans sample. Although the Hosmer-Lemeshow test suggests that the fit of the models is acceptable, none of the models are significant at the .10 level. The pseudo R-squared measures are also less than the pooled and New Orleans metropolitan area samples.

These counterintuitive findings, and the generally poor explanatory power of these models, likely reflect the heterogeneity of social and environmental conditions in this large, non-New Orleans sample. For example, it is possible that wealthy households were situated in less environmentally vulnerable locations—a suggestion

⁷ A model in which social networks and race are the only independent variables, only race has a statistically significant effect (coefficient=1.920; p=0.011).

⁸ Collinearity diagnostics confirmed, once again, the absence of multicollinearity. Interaction terms for the socioeconomic variables were also non-significant (p<0.05).

consistent with the previous research of political geographers reviewed above. This is only speculation, however, as it is difficult to analyze evacuation behavior among a sample of respondents who were faced such varying degrees of imperative to evacuate. As discussed in the data and measures section, this variance could have been accounted for with geocoded data; but interpretations are extremely limited without it.

Table 9: Results of Logistic Regression Analysis, Non-New Orleans Sample

Predicting the odds of evacuating before Hurricane Katrina; Non-New Orleans Sample (n=375)				
(Significance Level in Parentheses)				
	Model 1	Model 2	Model 3	Model 4
Network variables				
Low Local, Low Distant ^a				
High Local, High Distant	1.134 (.617)	1.058 (.839)	1.067 (.820)	1.098 (.756)
Low Local, High Distant	.738 (.404)	.645 (.261)	.648 (.268)	.644 (.279)
High Local, Low Distant	1.317 (.356)	1.418 (.279)	1.422 (.276)	1.516 (.222)
Socio-economic variables				
White ^a				
Non-Hispanic Black		2.054 (.011)**	2.028 (.013)**	2.159 (.013)**
Income : Poverty <1.5		.465 (.096)*	.433 (.079)*	.367 (.055)*
Income : Poverty = 1.5-3		.543 (.168)	.523 (.152)	.437 (.092)*
Income : Poverty = 3-6		.593 (.225)	.561 (.188)	.502 (.147)
Income : Poverty >6 ^a				
Less than HS Education		1.538 (.243)	1.531 (.251)	1.814 (.150)
HS or GED		1.363 (.312)	1.350 (.330)	1.155 (.658)
Some College		1.610 (.129)	1.625 (.124)	1.527 (.195)
Associates or more ^a				
Demographic variables				
Add. Members of HH = 0			.794 (.551)	.765 (.509)
Add. Members of HH = 1			.805 (.522)	.809 (.552)
Add. Members of HH = 2			.989 (.976)	1.102 (.814)
Add. Members of HH = 3			.677 (.236)	.680 (.272)
Add. Members of HH = 4+ ^a				
Storm-related variables				
Evacuation preparation = yes ^a				
Evacuation preparation = no				.667 (.122)
Warning time = low				.639 (.148)
Warning time = medium				.762 (.329)
Warning time = high ^a				
Evacuation warnings = low				1.509 (.224)
Evacuation warnings = medium				1.248 (.418)
Evacuation warnings = high ^a				
Overall model significance	0.534	0.163	0.311	0.170
(-) 2 Log Likelihood	531.780	487.650	485.828	437.586
Hosmer-Lemeshow	1.000	0.672	0.320	0.659
Cox-Snell R-Squared	0.005	0.034	0.038	0.064
Nagelkerke R-Squared	0.007	0.048	0.054	0.090

^aReference category *p<.10, **p<.05, ***p<.001

Conclusions: Findings, Expectations, and Previous Research

The analyses above have demonstrated significant differences between the factors affecting evacuation behavior during Hurricane Katrina in New Orleans metropolitan area and the remainder of the counties and parishes eligible for FEMA individual assistance. Although the geographic diversity of the non-New Orleans sample—and thus also the combined sample—limits the comparisons that can be drawn from these findings, an overall comparison between the final models, as well as with previous research, is nonetheless instructive.

The table below lists the estimated effect of each independent variable on the odds of delaying evacuation or never evacuating relative to evacuating before the storm. The symbols represent the “direction” of the effect on the odds of staying, with a positive or negative sign indicating that the variable was significant within the minimal .10 threshold in a final multivariate model. Attention will be afforded primarily to the two sub-samples: comparisons between these groups and the full sample are problematic because the latter are endogenous to the former.

Examining the role of social networks first, we see that expectations failed to be met in any case. The only significant network effects were observed in the simplest models of the combined and New Orleans samples (before controlling for other factors). While this should certainly not discourage further research on the role of social networks in disaster situations, these findings simply do not lend support to the argument that the strength of a household’s ties plays a significant role in evacuation decisions during Hurricane Katrina. While this “non-finding” may be partly explained by poor measurement, it is also possible that the social embeddedness represented by networks does not play a significant role in the relatively short evacuation decision-making process. Instead, more basic resources—such as money and access to basic information—play a more central role. Although this is contrary to the expectations of

this thesis, it is worth noting that this is consistent with scholars of migration who argue that networks explain only the maintenance of long-term migration systems (not the short-term emergence of migration).

The effects of the two basic geographic variables that were included in these analyses were consistent with expectations. Net of social networks, socio-demographic characteristics, and evacuation preparation, affected households living outside of the New Orleans metropolitan area were significantly more likely to stay than those living in the New Orleans metropolitan area. Moreover, there was no significant difference in the odds of delaying evacuation or never evacuating (compared with evacuating before the storm) between the city of New Orleans and the remaining parts of the metropolitan area. Both findings support the conclusion that the degree to which evacuation was necessary was significantly more heterogeneous across non-New Orleans sample frame than in the New Orleans metropolitan area.

The effect of race was consistent with expectations in the non-New Orleans sample, with blacks more likely to have delayed evacuation or never evacuated than whites. However, in sharp contrast to expectations and popular reports, there were no significant racial differences when predicting the odds of evacuating eventually or never in the New Orleans metropolitan area.

Education was the only socioeconomic factor with a significant effect in the New Orleans sample. As expected, households represented by respondents with low educational attainment were more likely to have not evacuated before the storm than their highly educated counterparts. This was not the case in the non-New Orleans sample, where the effect of education was not significant. However, households in this sample with an income-to-poverty line ratio of 3 or less were more likely to have delayed evacuation or not evacuated at all (when compared to leaving before the storm) than those in the highest income category.

In contrast to expectations, household size did not have a significant effect at any order or in any sample. However, two of the three storm-related variables did emerge as significant factors in the New Orleans sample. First, households that packed three days of food and water were more likely to have stayed through at least the beginning of the storm than those that did not take this measure. Although this behavior is potentially important for evacuees and non-evacuees alike, the findings of this thesis suggest that this action was largely taken as a means of preparing to endure the storm rather than evacuate. This suggests that policymakers should emphasize that such basic preparation steps are not adequate to “ride out the storm”, and that evacuation is the best option. Conversely, they should state that evacuation is a necessary but insufficient step: evacuees must prepare for their time away from home to avoid a situation in which they lack the basic necessities.

Second, analyses of the New Orleans metropolitan area found that, as expected, households that received a low number of evacuation warnings were more likely to have delayed evacuation or never left at all than those that received a high number of warnings. Considered in relation to the lack of statistical significance of warning time—the amount of time before the storm that households heard it might strike—this suggests that official evacuation warnings do indeed influence behavior more than informal social relations.

Table 10: Observed Effect of Independent Variables

Effect on Odds of Evacuating Eventually or Never Evacuating vs. Evacuating Before				
	Expected	Full Sample	NO Sample	Non-NO Sample
Network variables				
Low Local, Low Distant ^a				
High Local, High Distant	-	N.S.	N.S.	N.S.
Low Local, High Distant	-	N.S.	N.S.	N.S.
High Local, Low Distant	+	N.S.	N.S.	N.S.
Geographic Variables				
Non-New Orleans Metro	+	+	N/A	N/A
New Orleans Metro ^a				
New Orleans City	N.S.	N/A	N.S.	N/A
New Orleans Metro ^a				
Socio-economic variables				
White ^a				
Non-Hispanic Black	+	+	N.S.	+
Income : Poverty <=1.5	+	N.S.	N.S.	+
Income : Poverty = 1.5-3	+	N.S.	N.S.	+
Income : Poverty = 3-6	+	N.S.	N.S.	N.S.
Income : Poverty >6 ^a				
Less than HS Education	+	+	+	N.S.
HS or GED	+	N.S.	+	N.S.
Some College	+	N.S.	N.S.	N.S.
Associates or more ^a				
Demographic variables				
Add. Members of HH = 0	-	N.S.	N.S.	N.S.
Add. Members of HH = 1	-	N.S.	N.S.	N.S.
Add. Members of HH = 2	-	N.S.	N.S.	N.S.
Add. Members of HH = 3	-	N.S.	N.S.	N.S.
Add. Members of HH = 4+ ^a				
Storm-related variables				
Evacuation preparation = yes ^a				
Evacuation preparation = no	+	-	-	N.S.
Warning time = low	+	N.S.	N.S.	N.S.
Warning time = med	+	N.S.	N.S.	N.S.
Warning time = high ^a				
Evacuation warnings = low	+	+	+	N.S.
Evacuation warnings = med	+	N.S.	N.S.	N.S.
Evacuation warnings = high ^a				

In addition to comparing the various analyses in this thesis, it is important to consider these results in relation to previous research on evacuation behavior during Hurricane Katrina. As mentioned in the literature review above, Elliot and Pais (2006) and Haney et al. (2007) conducted the only two systematic studies of evacuation timing and patterns to date. Despite the slightly divergent foci of their research, these studies nonetheless provide important points for comparison and triangulation (particularly since they draw upon a different source of data than this thesis).

Elliot and Pais examined a Gallup Poll sample of Gulf Coast residents who had sought help from the Red Cross during or after the storm. Separating New Orleans City residents from others, they compared the odds of (a) evacuating during or after the storm relative to doing so before it and (b) never evacuating relative to doing so before the storm. Controlling for the respondents' sex, age, and homeowner and parental statuses, the objective of this component of their study was to understand the effects of race and class on "evacuation timing".

Among New Orleans City residents, Elliot and Pais found a strong negative relationship between income and the odds of evacuating before the storm (both comparisons). As they report,

New Orleanians with household incomes in the \$40,000-50,000 range were nearly twice as likely as those in the \$10,000-20,000 range to evacuate before, as opposed to after the storm. This class difference climbs to nearly threefold when predicting odds of not evacuating the city at all (Elliot and Pais 308).

This is consistent with the findings this thesis, which show a significant negative relationship between socioeconomic status and the odds that residents of the entire New Orleans metropolitan area evacuated eventually or never evacuated relative to doing so before the storm. However, this thesis found that education is a stronger

socioeconomic predictor of evacuation behavior than income. It also shows that storm related variables—preparation behavior and the number of evacuation warnings received by a household—had an important effect on the odds of non-evacuation.

Very strong and significant racial differences within the city also emerged in Elliot and Pais’s study, but only when comparing those respondents that evacuated before relative to those that never evacuated. This is consistent with this thesis, which found a non-significant effect of race on the odds of delaying evacuation or never evacuating from the New Orleans metropolitan sample. As discussed earlier, this thesis did not examine the population that never evacuated separately from households that delayed evacuation.

Income differences were non-significant outside of the city of New Orleans in Elliot and Pais’s study. The findings of this thesis suggest otherwise, as households in the lowest income category were significantly less likely than their high-income counterparts to have evacuated eventually or never evacuated than to have done so before the storm. However, this difference may be more methodological than substantive, as Elliot and Pais include the non-city New Orleans metropolitan area in their “other” sample.

With respect to race in the region outside of New Orleans, Elliot and Pais report that, net of all other factors, blacks were approximately 1.5 times more likely than whites to evacuate after the storm, rather than before it (Elliot and Pais 308). Likewise, this thesis finds that blacks were more than twice as likely to have delayed evacuation or never evacuated than to have done so before the storm.

The analysis of Haney et al. (2007) uses the same Gallup data as above, but considers both the timing and strategy of household evacuation. The former distinguishes between those who left before the storm and those who left during or after it, or never at all; the latter dichotomy refers to whether the household left (stayed) in

unison, or separated in some way. With respect to the latter category, if the individual observed in the sample evacuated—but without his or her entire household—they are considered to have “evacuated in division”; if they stayed—but with some household members evacuating—they were considered to have “stayed in division.” Although slight complications are introduced by their distinctions between evacuation strategies, a number of important points can be gleaned from this comparison.

Predicting the odds of “staying in unison” to “evacuating in unison”, Haney et al. find that the odds of staying were 4.44 less for New Orleans residents; 1.65 higher for childless males; 1.57 higher for blacks; and decreased by 0.22 for every increase in a logged and centered category of income. Using the same reference category, odds of “staying by division” were 2.18 higher for childless men; 1.97 higher for fathers; 1.62 higher for those with religious faith; 1.56 higher for those employed before the hurricane; 1.52 higher for blacks; and decreased by 0.58 for every increase in a logged and centered categorization of income. Lastly, comparing those who “evacuated by division” to those who “evacuated in unison”, the odds of the latter increased by 1.40 for blacks; and increased by 1.28 for those employed before the hurricane.

Despite a number of incomparable variables, a number of important points emerge. First, both Haney et al. and this thesis observe that non-New Orleans residents were much less likely to have stayed than leave before Katrina struck. Haney et al. also found that the odds of both forms of staying were significantly higher for blacks than whites. This is consistent with the analysis of the full model in this thesis, which finds that blacks were slightly more than 1.5 times as likely to have evacuated eventually or never at all than leave before the storm. Likewise, Haney et al. find a negative relationship between income and the odds of staying in some form (when controlling for location). Although the inclusion of a measure of educational attainment in this

thesis leads to slightly different conclusions, the studies agree on the general, negative relationship between socioeconomic status and the odds of staying.

Broadly then, we see that the findings of this thesis are consistent with previous research on evacuation behavior during Katrina. The only significant difference observed was with respect to the effect of income in the non-New Orleans region. As a result of previously mentioned methodological differences, it is not possible to make definitive statements on this disparity.

Despite these agreements, it is important to emphasize that this thesis went beyond these previous studies to find a relationship between storm preparation behaviors, the receipt of evacuation warnings, and evacuation outcomes. In this way, the study accounted for the degree to which households were “engaged” in critical pre-storm developments. Although the social network variable was non-significant in each of the analyses, these findings do lend some support to the notion that the evacuation behavior cannot be explained in only structural terms, and that households’ position vis-à-vis social process (e.g. the flow of information) is important in disaster contexts.

CONCLUSION

This thesis has examined household evacuation behavior in New Orleans and other significantly affected counties and parishes throughout the Gulf Coast during Hurricane Katrina. Drawing upon insights from the sociological literature on migration, it sought to provide a unique perspective on human mobility during the storm by focusing on the role of social networks. This thesis was guided by the expectation that households with low levels of distant social ties would be more likely to have not evacuated before the storm than those with a high level of distant network connections.

Contrary to expectations, however, the analyses here provide no evidence that networks affected the odds of evacuation during Hurricane Katrina. Instead, the

findings of this thesis largely confirmed those of previous research, which suggest that race and socioeconomic status were the main factors explaining evacuation behavior during Hurricane Katrina. More specifically, educational attainment was a significant predictor of evacuation behavior in the New Orleans metropolitan area; race and income were significant factors in the non-New Orleans sample.

In addition to, and going beyond previous research, this thesis found that a number of storm-related variables neglected in previous studies (Elliot and Pais 2006, Haney et al. 2007) had important associations with evacuation behavior. Storm preparation behavior and the number of evacuation warnings received by households both had significant effects on the odds of evacuating before the storm in the New Orleans metropolitan sample. In contrast to some previous research (e.g. Dow and Cutter 1998) the latter finding suggests that official evacuation-related information does indeed play an important role in households' evacuation decisions. The former result has less clear implications. The positive relationship between storm preparation and the odds of non-evacuation suggests that most of the households that packed three days of food and water viewed this as a means of preparing to ride out the storm, not evacuate. Future research should seek to understand why households that were engaged in storm-related developments enough to prepare did not heed warnings to evacuate. Conversely, research should also consider why households that followed evacuation orders did not take the steps needed to live as evacuees for at least three days.

A number of other issues emerge from these analyses, and have implications for the interpretation of these findings and future research. First, the differences between the New Orleans and non-New Orleans samples require further study. As mentioned above, a truly comparative study will require more detailed information about the non-New Orleans sample. This includes data on the geographic distribution of the

respondents across the region (e.g. urban vs. rural), as well as the status of evacuation orders and the degree of storm impact in their counties and parishes of origin.

Second, further research should examine the factors that differentiated the households that (a) evacuated during the storm; (b) evacuated after the storm; or (c) never evacuated. Analyses not included in this thesis found that the set of variables used to predict the odds of evacuation before the storm do not adequately explain these differences in evacuation behavior after the storm struck. Hence, future research should consider other important variables that may have emerged during the storm—such as storm surge, flood depth, and forced evacuation (or rescue)—which may have pushed significant numbers of households to evacuate. In short, it is likely that unique sets of variables explain the decision-making processes before and during/after a storm hits.

This is only one example of a general need to strengthen or include a number of additional measures in future research on Katrina, and environment-related human mobility more broadly. Foremost, the measure of social networks used in this study could be greatly strengthened by collecting data on more storm-specific aspects of households' social ties. The questions asked in the survey used for this study were overly broad, and do not necessarily capture the number of ties that a household would rely upon in a time of emergency. Questions in future surveys should be developed specifically to measure this latter type of tie. Moreover, ethnographic fieldwork could be utilized to understand the particular ways that households' social ties affected their evacuation decisions.

The discussion in the literature review above also suggested that the context in which networks are located may play an important role in how they shape mobility. This is tightly linked to notions of “place” that link individuals and households to the people, culture, and physical environment of particular locations. Hence, better geographic variables, including neighborhood-level indicators (e.g. median income,

population turnover rates), would greatly strengthen analyses of evacuation behavior by accounting for the characteristics of the spatial context in which networks (and other variables) are situated. Again, ethnographic research could examine the cultural mechanisms through which notions of “place” and affective bonds between neighbors affect evacuation decisions.

Linking respondents’ to micro-level geographic identifiers would also facilitate the inclusion of environmental and storm-related indicators into analyses of evacuation behavior. These data would deepen the understanding of both samples by accounting for emergent environmental forces (e.g. flooding), thus strengthening the analysis of mobility decisions that took place during and after the storm. Even more, the inclusion of these measures would have represented a significant step toward the theoretical objective of developing an integrated understanding of social and environmental processes.

Indeed, the particular limitations of the secondary data used in this thesis prevented the adequate integration of social and environmental variables. A more satisfactory analysis would have considered additional aspects of the storm, including the relationship between physical vulnerability, perceptions of environmental risk, and evacuation behavior. Moreover, given more detailed geographic data, it would have been possible to consider the relationship between race, income (and perhaps other factors, e.g. nativity) and environmental vulnerability in the region.

Despite these limitations and shortcomings, the findings of this thesis confirmed that households’ position vis-à-vis mainstream society was important in the context of Hurricane Katrina. This was apparent not only in the significance of race, education, and income, but also in the importance of information attainment (number of evacuation warnings). Although the effect of storm preparations raises a number of potentially important questions, the former findings support the claim that those with the least

resources were least likely to evacuate during Katrina. This is particularly true for the New Orleans sample, where the significance of education demonstrates that evacuation is not merely a question of economic capability. This argument should be used as a point of departure for future research, which, with geocoded data and improved measures of social networks, should continue to seek an understanding of the nuances in environment-related human mobility.

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