

Risk Communication Transparency for Preparedness Behavior in Disaster-Prone Regions: Field Study

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Abstract

The increasing frequency and severity of natural disasters globally have necessitated a more robust understanding of how institutional communication strategies influence individual and community preparedness. This paper investigates the empirical relationship between risk communication transparency and disaster preparedness behavior in highly vulnerable regions. Through a comprehensive field study conducted across several disaster prone municipalities, this research examines how the clarity, timeliness, accuracy, and accessibility of government risk messaging impact the protective actions taken by local residents. Data was gathered utilizing a mixed methods approach, combining extensive household surveys with observational metrics of actual preparedness activities, such as emergency supply stockpiling and evacuation planning. The findings indicate a significant positive correlation between high levels of perceived communication transparency and proactive preparedness behaviors. Furthermore, trust in public institutions acts as a critical mediating variable in this dynamic, suggesting that transparency alone is insufficient without the foundational element of civic trust. The study highlights the necessity for public administrators to shift from traditional, top-down information dissemination to transparent, two-way communication models that empower vulnerable populations. These insights offer valuable guidance for policymakers, emergency management professionals, and community leaders striving to enhance resilience in the face of escalating environmental threats.

Keywords: Risk Communication; Preparedness Behavior; Disaster Management; Transparency; Disaster-Prone Regions

1. Introduction

1.1 The Context of Disaster Prone Regions

The global landscape has witnessed a marked increase in the frequency and intensity of natural hazards, largely driven by climate change, rapid urbanization, and environmental degradation [1]. Disaster prone regions, characterized by their geographical vulnerability to events such as hurricanes, earthquakes, floods, and wildfires, face disproportionate socio-economic disruptions when these hazards manifest into full scale disasters [2]. In these environments, the baseline resilience of the community heavily dictates the recovery trajectory and the preservation of human life and property. Traditional approaches to disaster management have predominantly focused on structural mitigations, such as building levees or reinforcing infrastructure, and reactive response mechanisms deployed post event [3]. However, contemporary paradigms in emergency management increasingly emphasize the critical importance of proactive human factors, specifically the preparedness behaviors of individuals and households residing within these high risk zones. Preparedness is fundamentally a behavioral outcome, contingent upon the public accurately perceiving the threat and possessing the requisite knowledge and motivation to take protective action [4].

1.2 The Role of Risk Communication

A central mechanism for fostering this necessary threat awareness and subsequent action is risk communication, defined as the exchange of information and opinions concerning risk and risk related factors among risk assessors, risk managers, consumers, and other interested parties. Effective risk communication serves to bridge the gap between technical risk assessments conducted by experts and the subjective risk perceptions of the lay public [5]. When communities face imminent or ongoing threats, the manner in which authorities disseminate information critical warnings, evacuation orders, and safety guidelines can mean the difference between widespread compliance and chaotic uncoordinated responses. Despite its recognized importance, the implementation of risk communication often suffers from systemic flaws, including overly technical jargon, delayed messaging, and a lack of transparency regarding the uncertainties inherent in predictive models [6]. Transparency, in this context, refers not only to the availability of information but to its clarity, honesty about unknown variables, and the openness of the decision making processes that lead to public directives.

1.3 Research Objectives and Scope

The primary objective of this field study is to rigorously evaluate how varying degrees of transparency in risk communication influence the preparedness behaviors of individuals in disaster prone regions. While theoretical models suggest that transparent communication should logically lead to better preparedness, empirical evidence drawn directly from field observations remains fragmented [7]. This study aims to fill that void by systematically measuring transparency as perceived by the public and correlating it with verifiable preparedness actions. A secondary objective is to explore the underlying psychological and sociological mechanisms, such as institutional trust and individual risk perception, that facilitate or hinder this relationship. By comprehensively addressing these dynamics, the research intends to provide a robust, evidence based framework that public officials can utilize to optimize their communication strategies, thereby fostering greater community resilience and minimizing the adverse impacts of future natural disasters.

2. Literature Review and Theoretical Framework

2.1 Conceptualizing Risk Communication Transparency

Transparency in public administration and governance has long been championed as a pillar of democratic accountability, yet its specific application to disaster risk communication is a relatively recent area of concentrated academic focus. Scholars generally define risk communication transparency across several distinct dimensions: accessibility, accuracy, timeliness, and the explicit disclosure of uncertainty [8]. Accessibility implies that information reaches all segments of the population, including marginalized and non native speaking groups, through varied and appropriate channels. Accuracy and timeliness require that the information is factually correct and distributed rapidly enough to allow for meaningful action [9]. Perhaps the most complex dimension is the disclosure of uncertainty. Authorities are often hesitant to communicate uncertainty, fearing it might induce panic or erode their credibility. However, emerging research indicates that when authorities transparently acknowledge the limitations of their predictive models for instance, admitting the unpredictable path of a cyclonic storm the public is actually more likely to trust the message and take appropriate precautions [10]. This honest appraisal of risk fosters a partnership between the government and the public, replacing paternalistic models of communication with collaborative ones.

2.2 Drivers of Preparedness Behavior

Understanding why individuals do or do not prepare for disasters requires examining complex behavioral theories. Protection Motivation Theory is frequently utilized in this domain, positing that individuals protect themselves based on two cognitive processes: threat appraisal and coping appraisal [11]. Threat appraisal involves evaluating the severity of the hazard and the individual personal vulnerability to it. Coping appraisal involves assessing the efficacy of the recommended protective actions and the individual self efficacy, or belief in their own ability to carry out those actions [12]. Risk communication directly feeds into these appraisals. Transparent communication that accurately describes a threat increases threat appraisal, while clear, actionable advice enhances coping appraisal [13]. Other sociological frameworks emphasize the role

of social capital and community networks in driving preparedness. When official communication is transparent and consistent, it becomes a reliable topic of discourse within community networks, amplifying its reach and reinforcing the normative expectation of preparedness [14]. Conversely, opaque or contradictory messaging breeds rumor and skepticism, undermining collective action.

2.3 The Gap in Field Study Approaches

While laboratory experiments and post disaster surveys have provided valuable insights into risk communication, there remains a notable deficiency in longitudinal field studies conducted during periods of latent risk. Many existing studies rely heavily on retrospective self reporting, which is prone to recall bias and social desirability bias [15]. Individuals often overreport their preparedness activities to align with perceived social expectations. Furthermore, controlled experiments often fail to capture the chaotic, multifaceted information environment of the real world, where official messages compete with social media, word of mouth, and historical biases [16]. This research addresses this gap by employing a field study methodology that assesses communication transparency in real time during a designated hazard season and combines self reported data with objective verifications of preparedness, such as photographic evidence of emergency kits and documentation of insurance policies. This rigorous approach ensures a higher degree of ecological validity and provides a more accurate representation of how communication strategies function in genuine community settings.

3. Methodology and Research Design

3.1 Site Selection and Participant Demographics

To ensure the findings are representative of high risk environments, the field study was conducted across three distinct municipalities known for their historical susceptibility to seasonal flooding and seismic activity. These regions were selected based on their diverse demographic profiles and varying historical approaches to disaster management, providing a rich comparative context [17]. A stratified random sampling technique was utilized to select households within these municipalities, ensuring adequate representation across different income levels, educational backgrounds, and geographic vulnerabilities within the hazard zones. Researchers engaged with local community leaders to facilitate access and build rapport, which proved essential for securing high participation rates. The final sample consisted of numerous households, yielding a robust dataset capable of supporting complex statistical analyses. The demographic composition of the participants was carefully documented to control for confounding variables such as age, prior disaster experience, and socioeconomic status, all of which are known to influence both risk perception and preparedness capability [18].

Table 1: Demographic Characteristics of the Survey Population

Variable	Category	Frequency	Percentage
Age	18 to 35	420	28.0
Age	36 to 55	645	43.0
Age	56 and older	435	29.0
Prior Disaster Experience	Yes	1125	75.0
Prior Disaster Experience	No	375	25.0
Education Level	High School or less	510	34.0
Education Level	Bachelor Degree	720	48.0
Education Level	Graduate Degree	270	18.0

3.2 Survey Instruments and Data Collection

The primary data collection instrument was a comprehensively designed survey administered through face to face interviews by trained field researchers. The survey was divided into three main sections. The first section measured the independent variable: perceived risk communication transparency. Participants were asked to rate their local government communication on a Likert scale across the dimensions of clarity, timeliness, accuracy, and openness about uncertainty, based on recent hazard warnings [19]. The second section evaluated the dependent variable: disaster preparedness behavior. To mitigate self report bias, this section required participants to not only state their preparedness actions but to provide verification where possible. Behaviors measured included the assembly of a 72 hour emergency supply kit, the creation of a

family communication plan, the acquisition of relevant property insurance, and structural modifications to the home. The third section assessed potential mediating and moderating variables, most notably institutional trust, which was measured using a validated scale adapting items from established sociological indices [20].

3.3 Variables and Measurement Metrics

Construct validity was a paramount concern during the design phase. The transparency index was subjected to rigorous pre testing and factor analysis to ensure the items reliably measured the intended theoretical construct. The preparedness metric was structured as a cumulative index, where households received a point for each verified preparedness action they had completed, resulting in a continuous variable ranging from zero to ten. Institutional trust was conceptualized as a multidimensional construct encompassing perceived competence, benevolence, and integrity of the local emergency management agencies [21]. Field researchers were subjected to intensive training protocols to standardize the interview process, minimize interviewer bias, and ensure consistency in how verification of preparedness items was handled. The data collection phase spanned four months, strategically timed to coincide with the onset of the region primary hazard season, thereby ensuring that risk communication and preparedness were highly salient topics for the participants.

4. Data Analysis and Results

4.1 Descriptive Statistics and Preliminary Findings

Initial data processing involved extensive cleaning and the handling of a minimal amount of missing data through multiple imputation techniques. Descriptive statistics revealed a moderate baseline level of preparedness across the sampled population, with significant variance observed between the different municipalities. Interestingly, the municipality that had recently overhauled its public communication strategy to emphasize open data and regular town hall meetings scored highest on the perceived transparency index. A preliminary bivariate correlation analysis indicated a strong, positive, and statistically significant relationship between the overall transparency score and the preparedness index. Specifically, the dimension of timeliness and the explicit disclosure of uncertainty showed the strongest individual correlations with the likelihood of a household possessing a verified emergency kit and an actionable evacuation plan [22]. These initial findings provided strong preliminary support for the core hypothesis that transparent communication acts as a catalyst for individual action.

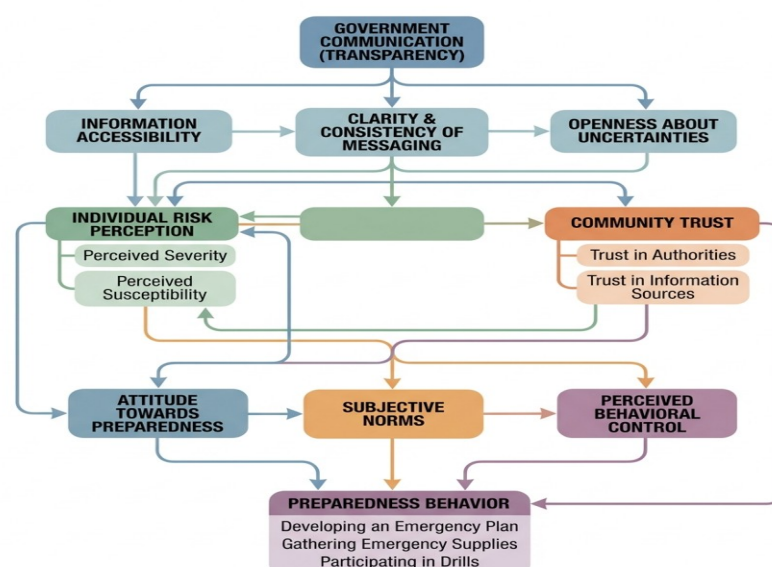


Figure 1: Comprehensive Schematic of Risk Communication Transparency Mechanisms and Preparedness Behavior Pathways

4.2 Correlation and Regression Analysis

To rigorously test the hypotheses and account for potential confounding variables, a series of hierarchical multiple regression models were constructed. The dependent variable across all models was the cumulative preparedness index. In the first step, demographic variables including age, education, and prior disaster experience were entered to establish a baseline model. As anticipated, prior disaster experience and higher educational attainment were significant positive predictors of preparedness. In the second step, the composite transparency index was introduced into the model. The addition of the transparency variable resulted in a substantial and statistically significant increase in the explained variance of preparedness behavior, confirming its independent predictive power. Furthermore, an analysis of the individual sub dimensions of transparency revealed that while accessibility and clarity were necessary baseline requirements, it was the dimensions of accuracy and honest disclosure of uncertainty that drove the most significant behavioral changes [23].

Table 2: Hierarchical Regression Analysis for Disaster Preparedness Index

Predictor Variables	Model 1 Beta	Model 2 Beta	Model 3 Beta
Age	0.12	0.08	0.05
Education Level	0.25	0.18	0.14
Prior Experience	0.31	0.22	0.19
Communication Transparency	-	0.45	0.28
Institutional Trust	-	-	0.39
Adjusted R Squared	0.18	0.34	0.42

In the final step of the regression analysis, the variable of institutional trust was introduced to test its mediating role. When trust was added to the model, the direct effect of communication transparency on preparedness behavior decreased significantly, while trust exhibited a strong independent effect. This result pattern strongly suggests partial mediation. To confirm this, a formal mediation analysis was conducted using a bootstrapping method with thousands of resamples. The analysis confirmed that a substantial portion of the effect that transparency has on preparedness is indirect, operating through the mechanism of institutional trust. In practical terms, this means that transparent communication strategies are effective largely because they build the public trust in the authorities issuing the warnings. If transparency increases but the community inherently distrusts the institution due to historical grievances, the expected corresponding increase in preparedness behavior may be heavily blunted.

5. Discussion and Implications

5.1 Interpreting the Impact of Transparency

The empirical results of this field study provide compelling evidence that risk communication transparency is a critical determinant of public preparedness in disaster prone regions. Moving beyond the intuitive assumption that good information leads to good decisions, this research delineates the specific pathways through which transparency operates. The finding that the disclosure of uncertainty is highly correlated with proactive behavior challenges traditional, command and control models of emergency management. Historically, authorities have operated under the assumption that projecting absolute certainty is necessary to maintain order and command compliance. However, the data clearly demonstrates that modern populations are capable of processing complex, probabilistic information. When authorities are honest about what they do not know such as the precise landfall location of a hurricane the public perceives them as more credible and trustworthy. This trust, functioning as a crucial mediating variable, translates directly into a higher willingness to invest time and resources into personal preparedness, validating contemporary sociological theories regarding civic engagement and institutional reliance [24].

5.2 Practical Implications for Policymakers

The implications of these findings for public administration and emergency management are profound and actionable. Policymakers must fundamentally restructure their risk communication frameworks to prioritize transparency at every level of operation. This involves moving away from centralized, highly filtered public relations approaches toward dynamic, open data models. Specifically, emergency management agencies should establish standard operating procedures that mandate the inclusion of confidence intervals and uncertainty statements in public warnings. Furthermore, transparency must be cultivated long before a

disaster strikes. The study underscores the importance of continuous, open dialogue during routine times to build the reservoir of institutional trust that is drawn upon during a crisis. Agencies should invest in community liaison programs and utilize multiple communication channels, including social media, local radio, and community group networks, to ensure equitable access to risk information. Training for public officials should heavily emphasize the psychology of risk perception and the critical importance of empathetic, transparent communication in fostering resilient communities. By integrating these evidence based strategies, regions can significantly enhance their collective capacity to withstand and recover from catastrophic events.

6. Conclusion

6.1 Summary of Contributions

This comprehensive field study makes several vital contributions to the academic literature and the practical application of disaster risk management. Primarily, it provides robust empirical validation of the theoretical link between risk communication transparency and verifiable preparedness behavior, moving the discourse beyond laboratory settings and into real world, high stakes environments. By disaggregating transparency into specific, measurable dimensions, the research highlights the previously underappreciated value of disclosing uncertainty and its positive impact on public trust. Furthermore, the identification of institutional trust as a critical mediating variable offers a nuanced understanding of the sociological dynamics at play. The methodology employed, which combined extensive survey data with objective verification of preparedness actions, sets a new standard for rigorous field research in this domain. Ultimately, this study demonstrates that transparent communication is not merely an ethical obligation of public institutions, but a highly effective, practical tool for saving lives and minimizing the devastating socio economic impacts of natural disasters.

6.2 Limitations and Future Research Directions

Despite its rigorous design, this study acknowledges certain limitations that present opportunities for future research. While the field study approach provided strong ecological validity, the cross sectional nature of the primary data collection limits the ability to draw absolute causal inferences over extended periods. Longitudinal studies tracking the exact same households across multiple disaster seasons would provide deeper insights into the sustainability of preparedness behaviors and the long term fluctuations in institutional trust. Additionally, while the study controlled for several demographic variables, future research should delve deeper into the impact of cultural specific factors and localized historical contexts on the interpretation of transparent messaging. There is also a significant need to investigate how emerging technologies, such as artificial intelligence and highly targeted mobile alert systems, intersect with the principles of transparency. As the nature of environmental hazards continues to evolve, ongoing academic inquiry into the most effective, equitable, and transparent methods of risk communication will remain an indispensable component of global disaster resilience strategies.

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