



## Teaching to the nth: Narrative knowledge and the relational model of risk communication

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### ABSTRACT

All too often, warnings and evacuation advisories during extreme weather events go unheeded. Of the many issues facing risk communication, three stand out, in particular. The first concerns the problem that risk messages often do not seem self-relevant to the public. The second, related, issue is that the language is often seen as merely technical and perfunctory. The third is that, especially among marginalized population groups, too many are not reached by risk communication. The paper takes up a *relational model of risk communication* that seeks to frame messages as narratives each member can transmit. This model, where residents act as local expert risk communicators, has been translated into lessons for primary curricula. The idea is that students themselves can bring knowledge into homes and neighborhoods, reaching even the most excluded. The model involves democratizing risk communication, where students become teachers, and they help others become teachers as well ("teaching to the nth"). We implement the model in a primary school in Leyte province, Philippines. Initial results are encouraging, and the paper concludes with further discussion of the broader applications of the relational model for disaster risk reduction.

### 1. Introduction

The field of risk communication has developed, over the decades, in breadth and sophistication. Scholars and practitioners know much more now than when the field's pioneers began their initial investigations.<sup>1</sup> Despite these advances, all too often, people in a risk situation do not heed warnings or take risk-preventive actions. This is no more apparent, and tragic, than in the case of extreme weather events, such as tropical cyclones and the hazards that attend these (storm surge, mudslides, floods).

Despite the fact that the great majority of residents in Southwestern Bangladesh received warning messages prior to landfall of Cyclone Sidr in 2007, thousands stayed in their homes, resulting in at least 3400 fatalities [1]. Warnings of a cataclysmic cyclone were issued at least four days prior to landfall of Supertyphoon Haiyan in Tacloban City in 2013, yet thousands were trapped in their homes by the ensuing storm surge and perished [2].<sup>2</sup> Similarly, in a post-event analysis after a tropical cyclone struck Andhra Pradesh, India, Sharma et al. [3] found that 46% of the affected population received evacuation messages but chose to ignore them. It was clear, in these cases, that relatively straightforward warning messages were broadly disseminated, and that much

of the affected populations had received information about the impending event, yet thousands chose not to take risk-preventive action (such as evacuation). The persistent question is: "Why does it happen?" and, closely following it, "What can we do about it?"

Filipinos are used to strong tropical cyclones. But while tropical cyclones (i.e., typhoons) are an annual occurrence in the Philippines, affecting every region periodically, large storm surges are sporadic. In fact, prior to Typhoon Haiyan, the most comparable events that previously befell Tacloban City occurred in 1897 and 1912 [4,5]. The government bureau charged with typhoon warnings is the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA). PAGASA's normal protocol is to issue typhoon bulletins projecting typhoon path and strength, along with a rating indicating severity of the coming cyclone. These bulletins also mention regions where storm surge risk is elevated. In the case of Typhoon Haiyan, PAGASA issued warnings about the impending storm surge, along with information on record wind speeds. Previous analyses suggested that the pro-forma warning templates used by the agency did not suffice to engage people enough to take risk-preventive action --i.e., they were regarded as routine, formal announcements, people did not feel they were relevant to their own situation, and they were unfamiliar with techni-

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cal terms like "storm surge" [6–8]. There is also the general problem of making sense of a complex array of information about a coming event and, clearly, in the case of Typhoon Haiyan, leaders and officials were not cued to focus on the specific threat of storm surge [9]. The present paper describes a new *relational model of risk communication* and how it was tested in the Philippines.

We cannot sum up the considerable literature on risk communication and will only draw some of the most relevant elements from it that pertain directly to our work (though comprehensive reviews can be found in Ref. [10,11]). Much of the pioneering work on risk communication stemmed from work in psychology and the decision sciences, where the foremost question was the fidelity with which risk messages were transmitted to and interpreted by the receiving public [12]. Heuristics used by people to interpret risk warnings are also a factor –e.g., familiar risks, such as floods, register less strongly than the unfamiliar, such as nuclear fallout, [13,14]. In some cases, members of the public were found to misinterpret probabilistic information, so that more absolute judgments (e.g., to act on or ignore warnings) might result [15,16]. In some cases, members of the public are seen to use flawed mental models to understand a risk situation [17]. The latter issue is evident in the case of tropical cyclones, where people's mental models may focus largely on the contribution of rain to flooding, ignoring the possibility of strong winds pushing ocean water onto a coastal area [18]. Much risk perception literature problematizes the gap between the risk as understood by the expert and that understood by the message recipient.

More complex models of the decision process, such as the PADM or Protective Action Decision Model [19], depict the process as a sequence of events. In the very first step, message recipients, use decision aids such as cues from the immediate environment, credibility of the message source, and others to decide whether to initiate action or to prolong waiting for additional information [20]. This poses a problem in cases where the immediate environment lacks sufficient cues –e.g., researchers found that the calm conditions the day before the cyclone's landfall lulled people into inaction [21]. Personal and community experiences, registered in individual or collective memory, can prime people to action [14,22]. But this is a problem when the predicted event is an infrequent one (e.g., a fifty year flood or a record storm surge) for which the populace cannot draw on any relevant experience [23]. This latter problem was indeed seen in recent disasters, where none in the community had any experience of such record storm surges and underestimated the risk (e.g., Ref. [24,25]).

Without rehashing the expansive literature on risk communication, the most prevalent focus of this literature has been on the cognition of risk. Though some of the literature has mentioned them (e.g. Refs. [26]), the issues of agency and empowerment have received relatively less attention. By this we mean the degree to which a person feels like she/he has the ability to act upon their situation and is empowered to do so despite limitations such as lack of resources. Among particularly vulnerable communities, there is the risk of inaction due to learned helplessness [27].

We begin by realizing that, in some cases, messages have been transmitted and received and, yet, people fail to respond. The literature provides some clues as to why this might occur. First, there is research that finds that, often, members of the public will receive and comprehend risk messages but not feel that such information is relevant to themselves and their particular contexts. This dimension of self-rele-

vance is a central concern of the elaboration-likelihood theory of risk [28]. Other researchers suggest that, even if a person basically understands the content of a risk message, it can remain a fairly abstract notion of the risk that does not elicit involvement on the person's part. On the other hand, when the message has the characteristic of vividness, then it has a greater chance of triggering, through affect, a person's full attention and priming the person to imagine the situation more richly [29–32]). These two characteristics of effective messages, self-relevance and vividness, will be taken up further in this work. As some researchers have noted, messages can be more effective when they are less like an impersonal technical bulletin and more like personalized communication [33–36]. Vividness, on the other hand, is related to how realistic the description of the actual hazard, and its consequences, are [28].

Self-relevance and vividness stand out as important characteristics of effective early warning messages. In a number of case studies, post-event interviews suggested that most of the affected population received the warning messages and understood what they were saying. However, they dismissed it because they felt it was not so relevant to their own situations, that the messages were the same routine messages sent before every event, or that the predictions did not seem to realistic (e.g., Ref. [6,7,37,38]). For some, the official warnings did not suffice, and they waited for other cues to confirm the information from the warnings [1]. In other cases, people chose to ignore the advisories because of factors outside the message, such as the distance or poor condition of evacuation centers, reluctance to leave belongings and livestock, and others (e.g., Ref. [39,40]).

Another possibility is that people can be hindered by a feeling of powerlessness, and they can take on a passive attitude towards risk [41]. This lack of a sense of agency can stem from fatalism (e.g., Refs. [39,42]). Or it can emerge from social structures that are disempowering, as women can experience in some communities (e.g., Ref. [43]). This lack of agency is of particular concern among the most vulnerable [44,45].

Conversely, a sense of agency can develop through interventions that seek some type of *empowerment* of the vulnerable. Empowerment describes the process by which people gain control over issues that concern them [46,47]. Empowerment means that a person has a sense of agency, that one is able to take risk-reducing action. But what type of interventions foster this?

In the following discussion, we describe an intervention that seeks to "democratize" risk communication. This means that knowledge is not uni-directional, as if from expert to non-expert, but rather from peer to peer. Participants learn to be teachers themselves. Such intervention needs to affirm participants' sense of self-determination –i.e., the idea that they are not simply passive recipients of directives but reflective decision-makers [48,49].

The intervention should have some aspect of competency-building, which enables participants to gain resources or skills that allow them to act in the face of risk [50]. For a person to decide to act, they have to have a sense of self-efficacy, or the idea that their actions will matter [51]. In the workshop described below, participants take on skills on being risk communicators and on helping others be the same.

Message characteristics such as self-relevance and vividness are central to risk communication pathways that posit people as having the time and opportunity to weigh information carefully and come to a reasoned decision. However, responses to risk-preventive messages proceeds through multiple pathways and some people react by simply following directives from official channels, trusting these authorities to have weighed all the factors and taken their situation into account [28]. For this reason, we also wish to assess how more relational (and narrative-based) messaging performs vis-à-vis dimensions such as trust in and perceived authority of the message source [52,53].

<sup>1</sup> Early literature on risk communication include National Risk Council [62]; Covello, Baram and Partan [63]; Covello, Slovic, and Von Winterfeldt [64].

<sup>2</sup> Though official government estimates set the number of fatalities at 6,400, other sources reported that this was, whether intended or not, considerably underreported (e.g., Ref. [65]).

In the rest of this article, we describe what we refer to as a Relational Model of Risk Communication that responds to the issue of inaction even when risk messages are received and basically understood. We then describe field testing of the relational model, which involved designing and implementing a risk communication workshop in a primary school setting. Consistent with the idea of democratizing risk communication, the specific intervention focusing on school-age children draws from the idea that no one should simply be a passive recipient of risk communication but, rather, an active risk communicator herself. Moreover, such an approach should empower the most vulnerable in a community (e.g., children, lower-income residents, displaced populations). In this model, students learn to be teachers, and they help others to become teachers, and so on, a modality the project team referred to as "teaching to the nth".

## 2. A relational model of risk communication

We begin with the phenomenon that occurs all too often, when community residents (or other recipients of risk communication) do receive a message and, even when the directives of the message are understood (e.g., evacuate immediately), they fail to comply.

The problem we take up is that of the separation of the subject (i.e., the source of the communication) from the object (i.e., the recipient). In the extreme, the object of risk communication can be treated as a passive recipient of risk knowledge who then immediately follows the dictates of the message. As has been pointed out by scholars of risk communication, such a model is too stringent and assumes too much of the idea of order-compliance and assumes too little about people's agency. Treated as passive consumers of these messages, members of the public can choose to simply reject (or accept) a message without deliberation. Even worse, such a practice can be disempowering, perhaps discouraging people from taking pro-active measures to reduce their vulnerability.

The response to this, as some practitioners have recognized, should be a more empowering mode of risk communication. The public should be treated as equal partners in the process, who are able to understand, weigh information, and judge what actions are appropriate. Risk communication scholars have pointed out the need to not just throw technical information at people and assume that they will comply with directives. Instead, knowledge must be shared in ways that are most comprehensible to the greatest number of people.

Lyotard was one of the first to point out that this involves choosing between two modes of communication [54]. The first, which is the regime of the technical, assumes that only technicians can converse in a specialized knowledge, and that non-experts should be simply consumers of the technician's advice. There is another way of speaking, however, which is what Lyotard referred to as narrative knowledge. Narrative is the mode of communication where everyone in a community can engage in mutual discussion. Everybody becomes a bearer of knowledge, and everyone is able to share such knowledge. This second mode of communication has a dimension of empowerment, as well, as those who participate in such exchange of knowledge also experience greater self-efficacy, possessing deeper knowledge of the issue at hand and being more able to identify and pursue appropriate courses of action. Lyotard emphasized the need to communicate knowledge using everyday language, but also involved in this practice is the idea of greater inclusion and empowerment.

Narrative communication is, classically, the conversation that occurs face-to-face among people in a social setting. There is the possibility, too, that such communication engenders trust as opposed to receiving messages from an impersonal or even anonymous source. The relational approach aims to reduce some of the asymmetries that can impede many instances of risk communication [55], as well as highlighting the important dimension of language [56].

Recently, Lejano et al. [57] proposed a Relational Model of Risk Communication that seeks to democratize the process through:

- using everyday speech to convey risk information,
- crafting messages that emulate talk between two peers,
- encouraging members of the public to also be active risk communicators,
- and, thus, increasing the chances that even the most excluded are touched by the message.

The last item, which is the idea that messages can be broadly interspersed through a social network, emerges from the basic framing of risk communication as a peer-to-peer exchange. In such a model, all in the community are able to act as risk communicators. This paper will employ this model in the design and analysis of the risk communication exercise.

This approach involves, first, framing messages in narrative form, using everyday language in a style emulating face-to-face communication. In the rest of the article, we will refer this as narrative communication, contrasting this with official technical warnings, that latter referred to as technical communication. The idea is to construct messages that are in a form most conducive for transmittal from one member of the public to another. And, to be clear: narrative is all about, not the watering down, but the enrichment of communication.

The second dimension to this approach involves fostering the public's involvement in risk communication. The idea is to democratize the process and take advantage of the ways that messages can spread through a social network, reaching even those otherwise excluded or not in tune to official communication (e.g., Ref. [58]). In practice, this can go beyond the act of messaging and involve training and other forms of enabling people to engage in risk communication themselves and to train others to do so --i.e., teaching "to the nth power" [59]. There is an additional benefit from the public's participation in risk communication, as some researchers suggest that peer feedback can reinforce risk-preventive behavior [60].

As discussed below, we test these ideas among primary school children, first comparing the effect of narrative versus technical communication. We then assess the effect of the training on the students' willingness to participate in risk communication. There is a risk to more relational modes of communicating, using narrative rather than technical advisories, such as the possibility that the public might see less authority in the former, which might reduce the extent to which some segment of the public is strongly rule-compliant. On the other hand, there is the possibility that a relational approach can simulate the form of communication where a person receives advice from a known and trusted other. We will assess the pilot test cognizant of these possibilities.

## 3. Context and methodology

This research project was started in 2015 after the onslaught of super typhoon Haiyan which devastated Tacloban City, and declared as ground zero of the disaster. The research team developed an online tutorial on risk communication in response, and this was pilot tested at the community level [6]. Reflecting on the study approach, the team thought that such training would be even more effective if people were introduced to it much earlier. Thus, lesson plans were developed for elementary school teachers and students. Pilot testing with 6th grade students were conducted in Tacloban, with the support and approval of the Department of Education, after which science teachers in attendance suggested integration of the lesson module into the formal science curriculum. The team then submitted the module to the district curriculum board for vetting and, afterwards, to the national Bureau of Curriculum. During the vetting process, it was learned that the national science curriculum did not yet have any lesson plans on storm surge risk communication and, furthermore, that the best fit would be for

the 5th grade level. After a series of revisions, aimed at fitting the lessons to department guidelines and competency requirements, the District Superintendent endorsed the documents to the Regional Director who endorsed the same to the National level for approval. The research team intends to continue evaluating the effectiveness of the program in the coming years, thus adding to the database.<sup>3</sup>

The pilot study was conducted as part of a larger effort to design lesson plans revolving around extreme weather and other natural hazards and inclusion into the Philippines' public school curriculum. The pilot testing of the lesson plans was conducted as a requirement of the Philippine Department of Education's vetting process. Tacloban City District volunteered to be the test site, as part of a broader mission to integrate disaster risk reduction in primary and secondary education [61]. Generally, the goal of this effort is to empower all sectors (including students and teachers) to become resilience advocate against the impacts of storm surge and other extreme weather events. The pilot is part of an approval process involving: 1) presentation of the lesson plans for department evaluation; 2) evaluation of the competencies and their appropriateness for a particular grade level (e.g. Grade 5 or 6); 3) revision of the lesson plans in accordance with the inputs from department supervisors/evaluators; and 4) integration of the lesson plans into curricula at different levels (i.e., city, regional, and national).

The project team met with the department, and a work plan was drawn up, followed by an orientation meeting with city department officials and local teachers. Twenty participating teachers volunteered to conduct the pilot testing, and they attended a demonstration lesson conducted by two master teachers. Suggestions from supervisors, principals, and other evaluators were received after the demo, and the lesson plan for the risk communication workshop (or workshop, for short) finalized. The pilot testing was conducted with sixth grade students with photo and video documentation done by the project team. Pre- and post-survey data was collated, tabulated, and analyzed.

The pilot testing workshop at the classroom level is built around the idea of empowering students to be risk communicators of storm surge. The demo lesson plans on communicating the risks of Storm Surge and other extreme events were composed of two parts: The "Elements of a Message" where the learners were able to identify the necessary ingredients of hazard warning messages; and the "Principles of Risk Communication" where the learners were able to personalize, localize and dramatize storm surge/mudslide information.

The sample size was 360 students, 47% female and 53% male, with an age distribution consisting of 35% aged 10 years, 48% aged 11 years, and 12% aged 12 years, and the rest outside the range. The pre-survey involved students reading a warning message and answering a series of questions. Students were randomly assigned to two groups: a control group assigned a technical bulletin about a hypothetical typhoon, and a test group assigned a narrative message containing the same informational content but couched in conversational form. Efforts were made, while random selecting students, to assign an equal or almost equal proportion of females in either group, as well as the males. The two competing messages are shown in Table 1.

After reading their assigned messages, the students answered a series of questions, shown below, testing self-relevance, vividness, trust, and authority, respectively.

- How much do you feel the message addressed you (and your family) directly?  
Choose one of the following (1–7).

<sup>3</sup> Further details of the methodology, including the survey instrument, can be found on the project website: <https://environmental-communication.space>.

**Table 1**  
Warning messages for control and test groups.

MESSAGE 1 (CONTROL)	
PAGASA forecast:	1 ft storm surge by tomorrow, according to PAGASA storm surge model.
Risk:	Possible danger at this level of surge, high velocity flowrate.
Hazard:	Possible injuries from trauma or drowning from flood.
Recommendation:	Evacuation of residents in affected area.
MESSAGE 2 (TEST)	
Dear Resident,	
According to PAGASA, our barangay may experience a storm surge of 1 ft tomorrow. A 1 ft surge will go up to your knees but will also have a high velocity. You and your family may be in danger. Even if low, you may be swept by the water and carried away. You or your family can be hurt or even drown as the fast-moving water carries you away. Please evacuate immediately. Call me should you need assistance.	
Your tanod, Mariano Loreto.	

- How much did the message vividly describe the situation? ("Vivid" means "easy to understand, easy to imagine"). Choose one of the following (1–7).
- How much did you trust the one sending the message? Choose one of the following (1–7).
- How much authority does the sender of the message have? Choose one of the following (1–7).

Note that the source of the narrative message is a fictitious government official, which removes the possibility that the survey respondent will be gauging the trustworthiness and trust of the message on the basis of actual knowledge of its sender.

After the initial survey, students then participated in the risk communication workshop, where they learned how to craft and transmit narrative messages providing early warning and other advice in a typhoon situation. To test self-efficacy in communicating risk, they answered the following question pre- and post-workshop. In addition, two other questions were asked to test learning.

- If you see a bulletin in school from PAGASA warning residents of your barangay of a coming storm surge, how confident are you that you can communicate the warning to your parents and neighbors? (1–7)
- What is a storm surge? (0 = wrong, 1 = correct)
- Where is the risk of storm surge greatest? (0 = wrong, 1 = correct)

Responses for the test and control groups were compared across the four dimensions of self-relevance, vividness, trust, and authority. Since a number of students left some responses blank, these non-responses were deleted from the data prior to analysis. A test of normality was run, and it was verified that the data departed from normality. A Mann-Whitney *U* test was performed using SPSS.

We also analyzed changes in willingness to engage in risk communication pre- and post-workshop. Differences between the pre- and post-surveys were analyzed using a Wilcoxon test for paired ordinal data.

#### 4. Results and discussion

The comparison in survey responses between the test and control groups are shown in Table 2. Sample sizes differ for each survey question because we deleted surveys where the question was not answered.

It appears that the narrative form of messaging rates more highly on self-relevance and vividness than the control. This is in accord with the rationale for the relational model. Communication between one peer to another is inherently recognized as self-relevant, since it is directed to the recipient directly and presumably related to the recipient's immediate circumstances. This is in contrast to conventional official messages, which are broadcast to the entire population indiscriminately.

**Table 2**  
Results of mann-whitney U test comparing control and test groups (n = 326)<sup>a</sup>.

Survey Item	Group	Mean	U	Z	p
Q1 (self-relevance)	Narrative	5.76	10959	-3.005	0.003 <sup>c</sup>
	Bulletin	5.27			
Q2 (vividness)	Narrative	5.29	11902	-1.724	0.085 <sup>b</sup>
	Bulletin	4.88			
Q3 (authority)	Narrative	5.12	12752	-0.661	0.509
	Bulletin	4.96			
Q4 (trust)	Narrative	4.86	12504	-0.956	0.339
	Bulletin	4.68			

(n = 326)<sup>c</sup>

<sup>a</sup> The sample size includes only valid surveys, as some respondents did not fill in the blanks on these questions.

<sup>b</sup> Significant to at least 90% confidence.

<sup>c</sup> Significant to at least 95% confidence.

nately. The narrative message tested in this research was not actually directed to the reader (and the stated author is a fictitious person), but it took on the form (or simulated) direct peer-to-peer communication. The results in Table 2 suggest that evoking the form of direct communication may convey some advantages.

In addition, since narrative forms of messaging take advantage of the storylike qualities of its format, it is reasonable that such communication is more likely to promote the message recipient's imagining of the situation. As such, it is reasonable that narrative messages might perform better with regard to vividness, as seen in the table.

There is a concern, however, that narrative messages, because they depart from convention, might carry less authoritative weight than a conventional official bulletin. In Table 2, we also compare how the test and control groups rate their respective messages with regard to authority and trust. Though the narrative message had slightly higher means (on both trust and authority) than the control, there were no statistically significant differences between the two groups. This suggests no significant loss (or gain) in level of trustworthiness and authority. While the relational model suggests that trust may be inherent in communication between a person and a known other, the message used in this case study may not trigger such amplified trust. Perhaps trust requires actual relationships between message sender and message receiver, as opposed to the fictitious person named in the message.

The relational model promotes the idea that all can participate in risk communication. We also tested whether the empowerment-based risk communication workshop increased the participant's sense of agency—here measured as one's confidence to participate in risk communication. As shown in Table 3, the students' level of confidence after the workshop was significantly higher than prior to the workshop. This supports the relational model, which recognizes that people need not only be recipients but also active agents of risk communication.

**Table 3**  
Results of Wilcoxon (paired sample) Test of Pre- and Post-Workshop Surveys.

Question	Difference in Mean Responses (Post-Pre)	Z	p
Q1. Willingness to engage in risk communication (n = 333) <sup>a</sup>	0.65	-5.36	<0.0001 <sup>b</sup>
Q2. What is a storm surge (n = 350)	0.14	-5.08	<0.0001 <sup>b</sup>
Q3. Where is the risk greatest (n = 349)	0.27	-8.54	<0.0001 <sup>b</sup>

<sup>a</sup> Sample sizes reduced because incomplete surveys for each particular question were removed.

<sup>b</sup> Significant to at least 95% confidence.

While this result gives some favorable support for the relational model, we are not able to exactly assess what types of activities lead to an increased sense of agency and willingness to participate in risk communication. There are numerous things that occur in a workshop—dialogue, reflection, incidental activities, humor, chitchat, as well as conventional information exchange. Moreover, the way the workshop is run can conceivably have appreciable influence on effectiveness.

## 5. Conclusion

We began with the recurring problem of non-compliance with agency advisories, in the face of an oncoming extreme weather event, even when messages are received and basically understood. As a growing literature points out, in many cases, it is because the messages do not resonate with the public or capture their interest sufficiently to be internalized, deliberated, and acted upon.

We investigated whether narrative messages, in consonance with a relational model of risk communication, might be more effective in terms of the receiver recognizing them as self-relevant and in the vividness of its imagery. We also assessed whether or not these messages do not, conversely, suffer from a loss in the level of trust and authority accorded to it from the recipient. In addition to the message itself, we investigated the possibility that empowerment-based strategies (such as training in risk communication) might foster a greater ability and willingness on the part of the public to be active agents in risk communication. The results are encouraging in that, at least in some cases, the relational approach may provide advantages over conventional messaging.

However, there might be other characteristics that may complicate the advantages of the relational approach. Fortunately, modes of messaging are not mutually exclusive. The most effective strategy is to probably employ both modes of messaging, and others as well (including the use of graphics, voice messaging, video, and others). There remains, inherently, some separation (in terms of knowledge base, responsibility, institutional practices, or other factors) between the technical expert or agency official and members of the public. While we may recognize that everyone should be partners in risk communication, their roles will never be equal. For this reason, we recommend a mixed strategy for disseminating risk knowledge, utilizing multiple messages (using both formal and everyday language) and media (formal and informal). The epistemological divide is not so absolute as Lyotard might have portrayed and, in the world of practice, technical knowledge necessarily co-exists with narrative knowledge.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ijdr.2020.101720>.

## Uncited references

[].

## References

- [1] B K Paul, S Dutt, Hazard warnings and responses to evacuation orders: the case of Bangladesh's cyclone Sidr, *Geogr. Rev.* 100 (2010) 336–355.
- [2] R Lejano, J M Tan, A M W Wilson, Learning from typhoon haiyan, *Nature* 518 (7537) (2015) 35.
- [3] U Sharma, A Patwardhan, D Parthasarathy, Assessing adaptive capacity to tropical cyclones in the East coast of India: a pilot study of public response to cyclone warning information, *Climatic Change* 94 (1–2) (2009) 189–209.
- [4] J L A Soria, A D Switzer, C L Villanoy, H M Fritz, P H T Bilgera, O C Cabrera, I Q Fernandez, Repeat storm surge disasters of Typhoon Haiyan and its 1897 predecessor in the Philippines, *Bull. Am. Meteorol. Soc.* 97 (1) (2016) 31–48.
- [5] A M F Lagmay, R P Agaton, M A C Bahala, J B L T Briones, K M C Cabacaba, C V C Caro, M T F Mungcal, Devastating storm surges of typhoon haiyan, *Int. J. Disaster Risk Reduction* 11 (2015) 1–12.
- [6] R P Lejano, J M Tan, A M W Wilson, A textual processing model of risk communication: lessons from Typhoon Haiyan, *Weather, Climate, Soc.* 8 (4) (2016) 447–463.
- [7] Y Jibiki, S Kure, M Kuri, Y Ono, Analysis of early warning systems: the case of super-typhoon Haiyan, *International Journal of Disaster Risk Reduction* 15 (2016) 24–28.
- [8] G Doroja-Cadiente, P N Valdez, A linguistic landscape analysis of public signs after Typhoon Haiyan, *Int. J. Asia Pac. Stud.* 15 (1) (2019).
- [9] E M P Gacasan, M W Wiggins, Sensemaking through cue utilisation in disaster recovery project management, *Int. J. Proj. Manag.* 35 (5) (2017) 818–826.
- [10] A Heijmans, From vulnerability to empowerment, *Mapping Vulnerability*, Routledge, 2013, pp. 134–146.
- [11] R E Lundgren, A H McMakin, *Risk Communication: A Handbook for Communicating Environmental, Safety, and Health Risks*, John Wiley & Sons, 2018.
- [12] R L Keeney, D Von Winterfeldt, Improving risk communication, *Risk Anal.* 6 (4) (1986) 417–424.
- [13] P Slovic, E Peters, M L Finucane, D G MacGregor, Affect, risk, and decision making, *Health Psychol.* 24 (4S) (2005) S35.
- [14] C Keller, M Siegrist, H Gutscher, The role of the affect and availability heuristics in risk communication, *Risk Anal.* 26 (3) (2006) 631–639.
- [15] V H Visschers, R M Meertens, W W Passchier, N N De Vries, Probability information in risk communication: a review of the research literature, *Risk Anal.: Int. J.* 29 (2) (2009) 267–287.
- [16] B Fischhoff, Risk perception and communication, *Risk Analysis and Human Behavior*, Routledge, 2013, pp. 17–46.
- [17] A Bostrom, R E Morss, J K Lazo, J L Demuth, H Lazrus, R Hudson, A mental models study of hurricane forecast and warning production, communication, and decision-making, *Weather, Climate, Soc.* 8 (2) (2016) 111–129.
- [18] H Lazrus, R E Morss, J L Demuth, J K Lazo, A Bostrom, “Know what to do if you encounter a flash flood”: mental models analysis for improving flash flood risk communication and public decision making, *Risk Anal.* 36 (2) (2016) 411–427.
- [19] M K Lindell, R W Perry, The protective action decision model: theoretical modifications and additional evidence, *Risk Anal.: Int. J.* 32 (4) (2012) 616–632.
- [20] R L Heath, J Lee, M J Palenchar, L L Lemon, Risk communication emergency response preparedness: contextual assessment of the protective action decision model, *Risk Anal.* 38 (2) (2018) 333–344.
- [21] S N Dalisay, M T De Guzman, Risk and culture: the case of typhoon Haiyan in the Philippines, *Disaster Prev. Manag.: Int. J.* 25 (5) (2016) 701–714.
- [22] S K Rød, C Botan, A Hølen, Risk communication and the willingness to follow evacuation instructions in a natural disaster, *Health Risk Soc.* 14 (1) (2012) 87–99.
- [23] A Hall, G Endfield, “Snow scenes”: exploring the role of memory and place in commemorating extreme winters, *Weather, Climate, Soc.* 8 (1) (2016) 5–19.
- [24] F O Adeola, Katrina cataclysm: does duration of residency and prior experience affect impacts, evacuation, and adaptation behavior among survivors?, *Environ. Behav.* 41 (4) (2009) 459–489.
- [25] E Alam, A E Collins, Cyclone disaster vulnerability and response experiences in coastal Bangladesh, *Disasters* 34 (4) (2010) 931–954.
- [26] S Hochrainer-Stigler, C Colon, G Boza, Å Brännström, J Linnerooth-Bayer, G Pflug, U Dieckmann, Measuring, modeling, and managing systemic risk: the missing aspect of human agency, *J. Risk Res.* (2019) 1–17.
- [27] S F Maier, M E Seligman, Learned helplessness at fifty: insights from neuroscience, *Psychol. Rev.* 123 (4) (2016) 349.
- [28] R E Petty, J T Cacioppo, *Communication and Persuasion: Central and Peripheral Routes to Attitude Change*, Springer, 1986, p. 262.
- [29] P A Rippetoe, R W Rogers, Effects of components of protection-motivation theory on adaptive and maladaptive coping with a health threat, *J. Pers. Soc. Psychol.* 52 (3) (1987) 596.
- [30] K E Rowan, Goals, obstacles, and strategies in risk communication: a problem-solving approach to improving communication about risks, *J. Appl. Commun. Res.* 19 (4) (1991) 300–329.
- [31] S M Smith, D R Shaffer, Vividness can undermine or enhance message processing: the moderating role of vividness congruency, *Pers. Soc. Psychol. Bull.* 26 (7) (2000) 769–779.
- [32] J Myers, Stalking the “Vividness Effect” in the preventive health message: the moderating role of argument quality on the effectiveness of message vividness, *J. Promot. Manag.* 20 (5) (2014) 628–646.
- [33] J H Sorensen, B V Sorensen, *Community Processes: Warning and Evacuation*, Handbook of Disaster Research, 2007, pp. 183–199.
- [34] L S Meredith, Coauthors, Analysis of Risk Communication Strategies and Approaches with At-Risk Populations to Enhance Emergency Preparedness, Response, and Recovery, U.S. Department of Health and Human Services, 2009, p. 48, <https://aspe.hhs.gov/report/analysis-risk-communication-strategies-and-approaches-risk-populations-enhance-emergency-preparedness-response-and-recovery-final-report>.
- [35] B Morrow, L Nadeau, National Weather Service Warning Coordination Meteorologists Survey on Tropical and Extratropical Cyclone Forecast Products: Report to NOAA, Eastern Research Group, Inc, 2013 Available online at, [https://www.academia.edu/4314855/National\\_Weather\\_Service\\_Warning\\_Coordination\\_Meteorologists\\_Survey\\_of\\_Tropical\\_and\\_Extratropical\\_Cyclone\\_Forecast\\_Products](https://www.academia.edu/4314855/National_Weather_Service_Warning_Coordination_Meteorologists_Survey_of_Tropical_and_Extratropical_Cyclone_Forecast_Products).
- [36] Y Cao, B J Boruff, I M McNeill, Towards personalised public warnings: harnessing technological advancements to promote better individual decision-making in the face of disasters, *International Journal of Digital Earth* 10 (12) (2017) 1231–1252.
- [37] S.A. Botictic The Philippines: forecasting with confidence. Centre humanes-re-source recovery movement online publication downloaded at [https://www.preventionweb.net/files/36231\\_36231forecastingwithconfidenceexten.pdf](https://www.preventionweb.net/files/36231_36231forecastingwithconfidenceexten.pdf) 2013
- [38] O Neussner, Assessment of Early Warning Efforts in Leytefor Typhoon Haiyan/Yolanda, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), 2014, p. 64, <https://www.preventionweb.net/publications/view/36860>.
- [39] B K Paul, H Rashid, M S Islam, L M Hunt, Cyclone evacuation in Bangladesh: tropical cyclones Gorky (1991) vs. Sidr (2007), *Environ. Hazards* 9 (1) (2010) 89–101.
- [40] C Roy, S K Sarkar, J Åberg, R Kovordanyi, The current cyclone early warning system in Bangladesh: providers' and receivers' views, *Int. J. Disaster Risk Reduction* 12 (2015) 285–299.
- [41] A Cornia, K Dressel, P Pfeil, Risk cultures and dominant approaches towards disasters in seven European countries, *J. Risk Res.* 19 (3) (2016) 288–304.
- [42] E Rindrasih, T Hartmann, P Witte, T Spit, A Zoomers, Travelling without a helmet: tourists' vulnerabilities and responses to disasters in Indonesia, *Disasters* 42 (4) (2018) 782–803.
- [43] R Islam, Vulnerability and Coping Strategies of Women in Disaster: A Study on Coastal Areas of Bangladesh, The Arts Faculty Journal, Institute of Social Welfare and Research, University of Dhaka, 2011.
- [44] K Brown, E Westaway, Agency, capacity, and resilience to environmental change: lessons from human development, well-being, and disasters, *Annu. Rev. Environ. Resour.* 36 (2011) 321–342.
- [45] K Grove, Agency, affect, and the immunological politics of disaster resilience, *Environ. Plann. Soc. Space* 32 (2) (2014) 240–256.
- [46] J Rapoport, Terms of empowerment, *Am. J. Community Psychol.* 23 (1987).
- [47] M A Zimmerman, Psychological empowerment: issues and illustrations, *Am. J. Community Psychol.* 23 (5) (1995) 581–599.
- [48] I Aujoulat, O Luminet, A Deccache, The perspective of patients on their experience of powerlessness, *Qual. Health Res.* 17 (2007) 772–785, doi:10.1177/1049732307302665.
- [49] E M Castro, T Van Regenmortel, K Vanhaecht, W Sermeus, A Van Hecke, Patient empowerment, patient participation and patient-centeredness in hospital care: a concept analysis based on a literature review, *Patient Educ. Counsel.* 99 (12) (2016) 1923–1939.
- [50] W Bennis, B Nanus, *Leaders: the Strategies of Taking Charge*, Harper & Row, New York, 1985.
- [51] P Babicky, S Seebauer, The two faces of social capital in private flood mitigation: opposing effects on risk perception, self-efficacy and coping capacity, *J. Risk Res.* 20 (8) (2017) 1017–1037.
- [52] E F Ter Hurme, J M Gutteling, How to trust? The importance of self-efficacy and social trust in public responses to industrial risks, *J. Risk Res.* 12 (6) (2009) 809–824.
- [53] J R Allen Catellier, Z J Yang, Trust and affect: how do they impact risk information seeking in a health context?, *J. Risk Res.* 15 (8) (2012) 897–911.
- [54] J F Lyotard, *The Postmodern Condition: A Report on Knowledge*, U of Minnesota Press, Minn, 1984.
- [55] M Hayenhjelm, Asymmetries in risk communication, *Risk Manag.* 8 (1) (2006) 1–15.
- [56] A D Sivil, T Aamodt, A dialogue-based weather forecast: adapting language to end-users to improve communication, *Weather* 74 (12) (2019) 436–441.
- [57] R P Lejano, E V Casas Jr., R B Montes, L P Lengwa, Weather, climate, and narrative: a relational model for democratizing risk communication, *Weather, Climate, and Society* 10 (3) (2018) 579–594.
- [58] S Hanson-Easey, D Every, A Hansen, P Bi, Risk communication for new and emerging communities: the contingent role of social capital, *Int. J. Disaster Risk Reduction* 28 (2018) 620–628.
- [59] R P Lejano, M S Rahman, L Kabir, Risk Communication for Empowerment: Interventions in a Rohingya Refugee Settlement, *Risk Analysis*, 2020 (in press).
- [60] S Verroen, J M Gutteling, P W De Vries, Enhancing self-protective behavior: efficacy beliefs and peer feedback in risk communication, *Risk Anal.* 33 (7) (2013) 1252–1264.
- [61] M J P Yanger, Disaster risk reduction and management infusion in the education curriculum in taclaban city, Philippines, *Prism* 23 (1) (2018) 43–56.
- [62] National Research Council, *Improving Risk Communication*, 1983, 1983 (Washington, D.C.).
- [63] V T Covello, M Baram, D Partan, Informing People about Environmental Health Risks: A Review of Obstacles to Public Understanding and Effective Risk Communication, Butterworth Legal Publishers, Salem, NH, 1985.
- [64] V T Covello, P Slovic, D Von Winterfeldt, Risk communication: a review of the literature, *Risk Abstracts* 3 (1986) 171–182.
- [65] B Avila, How Many Casualties from Typhoon “Yolanda?”, PhilStar.com, 2014 [Available online at, <http://www.philstar.com/opinion/2014/08/23/1360818/how-many-%20casualties-typhoon-yolanda>. (Accessed 25 October 2014).