PUBLIC RESPONSE TO DISASTER WARNINGS

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Social and behavioral science research on public response to warnings of impending community-wide disasters has been conducted for over a half-century. This research has explored how variation in a range of factors (including the *content* of warning messages and alternative message *delivery* approaches) impact motivating people at risk to take effective and timely protective actions. This white paper synthesizes these research findings.

Scientific Study of Human Response to Warnings

Alternative knowledge bases. Four alternative knowledge bases are currently used to inform the practice of issuing warnings to endangered publics. Knowledge can be based on personal "experience." Warning practitioners gain knowledge about public response to warnings based on warning events personally experienced. Emergency managers often refer to this knowledge base as "lessons learned." Knowledge can also be based on "revelation." Revealed knowledge is when someone tells you something. This way of knowing is often referred to as "best practices" in the emergency management community. Knowledge about public warnings is often based on "intuition." Intuited knowledge is when something just seems like a "good idea." The last available knowledge base is knowledge gained through the use of "science". The scientific method generates knowledge by testing hypotheses to determine if "A" predicts "B" and it then uses systematic empirical observations to reach conclusions. What is reported in this white paper is knowledge about public warning response gained by use of the scientific method. Consequently, what follows may or may not conform to reader's knowledge accumulated through personal experience, revelation, or intuition. Scientific evidence-based approaches for public disaster warnings are, in fact, rarely used in practice.

Existing research evidence has been abstracted. Scientific research into public warning response spans at least the last half century. There are now some 350 publications that report findings from events studied around the world. All of these publications have been read and summarized in a 350 page annotated bibliography that describes each research publication, and it reports on the key findings in each document. It is available to all at: www.colorado.edu/hazards/publications/informer/infrmr2/pubhazbibann.pdf

Research locations and hazard types investigated. This research literature includes public warning response research in different nations including Austria, Bangladesh, Bhopal, Canada, China, Colombia, Greece, Great Britain, Italy, Japan, Malaysia, Mexico, the Netherlands, Peru, the Philippines, Polynesia, and others; however, most studies by far have been done in the US. Additionally, this research literature covers most disaster types for which warning is possible including most natural hazards, hazardous materials, technological accidents, and acts of terrorism. Over the years, there have been several attempts to synthesize knowledge from this published research record (McLuckie 1975; White and Haas 1975; Mileti 1999). The most recent and most complete published synthesis (Mileti and Sorensen 1990) is titled "*Communication of Emergency Public Warnings: A Social Science Perspective and State-of-the-Art Assessment.*" It reports on the organizational elements of warning systems, warning system

preparedness, historic sources of warning system failures, and it summarizes findings on the range of different factors that influence public warning response. These include how warning messages are worded and how they are delivered. Although now somewhat out-of-date, it remains the most comprehensive synthesis available. It can be accessed at: http://emc.ornl.gov/EMCWeb/EMC/PDF/CommunicationFinal.pdf

Two general conclusions. The scientific research record provides strong evidence for two general conclusions about public warning and subsequent public protective action-taking. Both of these are important for the reader to keep in mind as this paper is read. First, *people stay people despite differences in the hazards being investigated*. In other words, "people knowledge" transcends hazard type because the same factors that influence public warning action in response to one type of hazard apply to warnings of other hazard types. These factors have often been modeled, reduced to mathematical equations, and "the same equations apply" across different hazards and events. Consequently, the general knowledge that is available from the all-hazards research set is available and useful to those charged with issuing warnings for any one particular hazard type. It is a mistake to ponder how the public would respond to warnings for a particular hazard type, and then seek answers from the narrow available research record on just that one hazard. Doing so would certainly exclude knowledge transferable from investigations based on other hazards. Second, profound differences in the "*quantities*" for the factors in the equations that predict public warning response exist across different specific events, nations, and cultures. It is these differences that account for some of the very different event-specific public warning response outcomes that are observed across different events. These outcome differences do not negate the fact that the same predictive equations apply in almost all events and circumstances.

Public Warning Response Myths

Before anything else, it is vital to address three very prevalent "world-wide myths" about public response to warnings of disasters. These myths have had a large and negative impact on issuing timely and effective public disaster warnings and belief in them continues to cost lives worldwide. A myth exists when: (a) it is believed to be true, but it's not; (b) when people think they have evidence for something, but they do not; and (c) when people will not stop believing it no matter what they might read to the contrary.

Myth one: panic. The concern that a warning could start a public panic is found around the world, across our nation, and it exists across time. It has repeatedly constrained providing an endangered public with effective warnings. The myth has delayed warning dissemination until there is more certainty that an event will actually happen as warning decision makers delay warnings so as to not unnecessarily create a public panic. It has also led to down-playing risk in warnings for the very same reason. Impacts like these rob the public of both the time and motivation that they need to act. People can, in fact panic, but panic has *never* resulted from issuing disaster warnings.

Panic is a *very rare* form of human behavior. It only occurs when four conditions are present. First, people are in a confined space like in closed-in room or in a theater. Second, escape routes are present. Third, people are convinced that death is certain if they do not traverse the escape routes to safety. But convincing people that death is certain is almost impossible before an event has happened. Most people must see others dying *in situ* to believe that they too

might die, for example, as might be observed during a fire in a confined room. When these conditions exist, people sometimes "panic" to compete with each other to traverse the available escape routes to preserve their own life. But panic is actually rare even when these four necessary but not sufficient conditions for it to occur exist.

Belief in the panic myth may never be replaced with the reality. There are two reasons why. The first is that non-panic is taken as evidence of panic. For example, news reporters go to disaster events expecting to see, report on, and photograph panic. They observe "non-panic", but they do see people with heightened awareness, concern, and stress. They report this as people in a state of "near panic." Others read the story and "near-panic" is equated to "panic" resulting in the perpetuation of the panic myth. The second is an error in inference. For example, rare cases of panic do occur, but in events characterized by the conditions listed above. Panic in these non-warning events is incorrectly taken as evidence of the potential for panic in response to warnings.

Myth two: short warnings. The idea that public warnings must be short is all pervasive and found across our nation and even around the world. Advertisers know to communicate in simple language and in few words. These attributes are needed to keep an audience's attention, sell products, and keep air-time costs low. This practice is often incorrectly transferred to public disaster warnings. Warning messages should be simply worded, but short public warning messages do not adequately motivate public protective actions. In fact, short messages actually slowdown public action-taking because they create an "information starved" public. People at risk want to know as much as they can about pending events for which warnings are issued, and they are naturally drawn to media and to each other to find out more before protective actions are begun. And all people, as was first discovered by Drabek (1969), need to confirm warnings and the appropriateness of protective actions before acting. Short warnings that do not tell the public everything they need to hear spark people at risk on a search for more information before they take protective action. The information they find as a result of this search can be wrong and inconsistent. And searching for more information because of short official warnings lengthens the time between getting a warning and starting a protective action. This unnecessarily leaves some members of the public at risk longer which can be a problem in rapid onset events.

Myth three: cry wolf. Worldwide, people believe that the public is less inclined to act on disaster warnings after events for which warnings were issued that did not occur. In reality, people do respond after events for which warnings were issued but impacts did not materialize, but perhaps differently. Research documents that events like these can actually facilitate subsequent public warning response if they are followed by efforts to educate the public. But this happens only when the reason for warnings not followed by impact is explained to the public. Explanations like these happen rarely. The real issue is not that such events decay future public response but that they anger local government because they cost them money that they did not need to spend.

The Public Warning Challenge
Reality for human beings is what people "think" is real. Human mental constructs of reality relate to "objective" reality to the extent that personal objective experiences shape perceptions. But most people rarely, if ever, experience nature's extremes in the form of natural and other disaster types. The result is that most people do not perceive risk. Instead, most think

they are safe from nature and other violent forces. Research into human risk perception concludes that most people think disasters will not happen in the near future, and if they do, that they will happen to someone else and not to them. The rare exceptions are found in human populations that "repetitively" experience disasters, for example, human settlements along rivers that frequently flood. The general inclination is that most people go through their lives believing that they are safe. This poses a large problem for those who might issue public disaster warnings. Warnings must overcome people's natural belief to think that they are safe, and then guide them to take protective actions that are inconsistent with their perceptions of safety. This is the "prime pubic warning challenge".

There is elaborate research-based empirical evidence on the topic of what it takes for warnings to help people to shed their safety perceptions and then take timely and effective protective actions. Here is what has been learned. People do not immediately respond to early warnings because they first "search" for additional information to "confirm" that they are really at risk. This search response happens despite the technology used to give warnings. Searching is a social phenomenon. It involves talking things over with others and seeking to hear the same warning over and over and from different sources before safety perceptions are relinquished. Warned people turn to friends, relatives, and strangers to determine if they agree that risk is present and if protective actions are warranted. This process--constructing new perceptions of risk out of existing perceptions of safety--adds time before protective actions are taken, it is fundamental to human beings worldwide, and it simply is not going to change. Public warnings work best when they facilitate the process and speed it along. Ignoring this basic human element in providing public disaster warnings has and will continue to cost human lives.

Wording Warning Messages
What is said and not said in a public warning message has a profound effect on what people think and then do in response to hearing that warning message. Research evidence, accumulated and replicated over decades, can be summarized as follows. Three topics are vital to address in a public warning message to maximize the odds that the endangered public takes timely and effective actions. These are: source, content, and style.

Source. Emergency warning planners around the world embark on quests for a "credible" warning spokesperson because they think source credibility will generate public warning belief. But, in reality, there is no single credible spokesperson to be found. There are three reasons why. First, different people in the public have different ideas about who is and who is not credible. Second, people's ideas about credibility change over time. Third, spokesperson credibility and warning message belief are different, and the former does not guarantee the latter. In fact, if one relies on spokesperson credibility to foster warning belief the entire warning enterprise may be is destined to fail from a public response viewpoint. Here is an example why. The single most credible source of warning information in the US is firefighters. They have the highest sole-source credibility with 35 percent of the nation's population. But even they leave 65 percent of the population behind. The most credible early warning source is not a single spokesperson at all. It is a group of different people and organizations. For example, a group that includes a scientist from the scientific organization that detected the pending risk, the local mayor, the Red Cross or Red Crescent because so many people in the public associate them with disasters, a familiar local media announcer, and more. Creating a mixed panel to be the source public warnings requires

that many agree to partner to be a warning co-source long before a particular events occur. Consequently, it falls into the domain of pre-event emergency planning.

Content. Research also documents the need for four additional items to be in a warning to facilitate public protective action taking. First, and most important, is to give people "guidance about exactly what they should do" using words that paint the picture of what their response should look like. For example, and in reference to the protective actions of evacuation, it is less effective to say "evacuate" or "get to high ground" than to say "by evacuate to high ground we mean climb the slopes around town until you are higher than the tallest downtown buildings". Second, warning messages should tell people about "the timing" of their actions. Warnings have a higher probability of being followed by appropriate public response it they tell people when they should start and by when they should complete the recommended protective action. For example, "begin evacuating now, do not delay, evacuate now and be on ground higher than the tallest buildings in town no later than 4:15 p.m. this afternoon". Third, warnings tend to work better when they tell people "who does and who does not have to take the protective action" and also explain why. People in harm's way need to clearly understand that you are talking to them. And people who are safe need to be told so. For example, "if you are in the city limits and south of the Red River evacuate now, if you are not in this area there is no reason for you to do anything because other areas will not flood". Last, people are more apt to take protective actions if the warning informs them about the pending hazard's "consequences and how the protective action will cut their pending losses". But research does not conclude that warnings should provide people with a science lecture about the phenomenon that is about to occur. It does conclude that the basis for protective action recommendations should be clear to the people being warned. For example, "the area of town south of Red River will be hit by a wave of water higher than all the rooftops that will be moving at 40 miles per hour; relocating to areas that will not flood will keep you safe".

Style. Warning message style is about how the warning is "worded and spoken" and it too influences public response. Research documents five style elements to use (Mileti and Sorensen 1990). The first is "clarity." Research clearly documents that simply worded messages work best. Jargon should never be used. A good rule of thumb to use in wording a public warning is that you should say it another way if your grandmother could not understand it. For example, a warning for an accident at a nuclear power plant should not say "a breach in containment may result because of a transient excursion of core materials from the containment vessel". Instead, it should say "radiation may leak out of the building and into the air". The second important style element is to be "specific." Warning information that is precise and non-ambiguous works best. For example, it could cost lives if you advise people to evacuate and do not explain what you mean because the word evacuate will mean different things to different people. For example, "go north away from the coast line until you are 10 blocks inland and at least past the Intercontinental Highway". A third style element to include is "certainty". This means provide authoritative and confident language about what you tell people. One may wonder how to be certain about the uncertain disaster forecasts that so often come from scientists. Here is how you do it. Tell people "we cannot know if the tsunami will actually reach our coastline or exactly how high it may be if it does, but all the experts agree that it's likely enough that everyone should evacuate now. "Accuracy" is the fourth warning style element to affect public response. The people you warn need to think that they are being given accurate information. Inaccurate information or errors in information confuse people and their response. An example is

provided by the 1979 accident at one of the Three Mile Island nuclear reactors when a spokesperson for the US Nuclear Regulatory Commission stated that there would be an explosion at the power plant. He was referring to a gas bubble exploding inside a pipe in the reactor building but did not say so. Many people around the plant thought he meant that the plant would explode like a nuclear bomb. Information accuracy means telling people the truth. But it also means thinking about how people will interpret what you say. The final warning style element is "consistency." Consistent information works best. Inconsistent information can leave people with too much choice about the risk and protective action-taking. And given the choice, most people prefer selecting information that says they are safe and not at risk. Consistency is applicable to a single message itself, and also applies across messages. Changes from past messages should be explained in subsequent messages. Why what you are saying is different from what others have said also needs to be explained. And inconsistencies inside a message should be removed. For example, it is inconsistent to say "a dirty bomb has just been exploded downtown, don't worry". People should be worried about such an event. Telling them to not worry--likely because someone hopes to avoid starting a panic--gives them inconsistent information that erodes warning effectiveness.

Warning Message Delivery

How warning messages are delivered to the public also influences public action-taking because the delivery method impacts the amount of time it takes people in the public to convert pre-warning "perceptions of safety" into "perceptions of risk". Research documents three message delivery factors that impact people's warning response. These are the number of communication channels used, the type of channels used, and the frequency with which the warning message is communicated to the public.

Put simply, the more different channels of communication are used to communicate the warning message to the same public the better. The types of communication channels available in a society depend on many things, for example, level of development. But all societies have multiple and diverse channels to use. For example, in societies with elaborate available technologies, early warnings heard over many different television channels, different radio stations, reverse 911 telephone call out systems to homes and over cell phones, texted messages, and so on result in giving the public more multiple warning message exposures. And doing so shortens the time people need to have "perceptions of risk" replace "perceptions of safety" resulting in more timely public protective action taking. When communication channels are selected, consider that personal channels are the most effective of all. Warnings delivered to people at the front door, a police car broadcasting a message on someone's street, or that comes over the kitchen telephone make it easier for people to conclude that they are among those being warned.

As the number of times that people hear the same warning message increases, the more likely they are to become convinced that they are at risk and then take a protective action. In fact, the more a warning is heard over and over the better. This key research finding is easily converted into warning plans: repeat the warning, then repeat the warning again and again, and do not stop repeating it.

The Prime Application Constraint

Those who write the warning messages that are actually issued to the public rarely, if ever, have a working knowledge of the science-based research findings in the social sciences about public warning response and the factors that direct it. This results in less effective warning messages being issued to the public than is possible, and includes warnings from government detection agencies, local government authorities, and others. Local government officials have the prime responsibility in our society to issue warnings to people in their jurisdictions. Even if national or international warning centers "detect" danger, local officials typically word most of the actual warning messages that reach the people in harm's way. But there are too many local officials--and turnover among them is too high--to train them all about how to word early warnings based on social science research findings. One solution might be to create a handbook of "draft" public warning messages based on the accumulated research evidence. The handbook could be to all those who might ever issue public warnings to turn to when public warnings are needed. A similar document might also be prepared for warning centers who sometimes directly issue warnings to the public. "Evidence-based" draft messages could serve as a starting place for writing early warnings that are actually disseminated. No such "Warning Message Handbook" exists and none are planned.

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