NOAA Weather Radio as an Emergency Communication Vehicle in West Tennessee

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ABSTRACT

In March 1994, a telephone survey was conducted in west Tennessee to determine the extent to which NOAA Weather Radio (NWR) is used by residents of the region. Interviews were completed with 407 respondents for an error rate of ±4.86%. The data were subjected to tests of proportions, contingency table, and chi-square statistical analysis.

The study revealed that 24.6% of west Tennessee households have NWR receivers, but only a third of those, or 8.1% of regional households, continuously monitor the service. A test alert message was broadcast on NWR just prior to the telephone survey. Based on the number of respondents who acknowledged receiving the message, only 6.4% of west Tennessee households can be expected to actually hear an emergency notification on NWR. Thus, as a general public warning and emergency communication service its effectiveness is limited, particularly among citizens of lower socioeconomic status.

A fundamental problem appears to exist in the way citizens with NWR receivers use the service. Most turn on their receivers only when they already know severe weather is in their area. The research supports the view of NWR as communication technology with a significant, though somewhat limited, direct niche audience. However, it should be recognized that NWR is but one part of the family of warning channels with which the public engages. Perhaps its most important function is not in direct warning to the public but in conveying warning information to other mass media and emergency responders who incorporate numerous other technologies (commercial radio and television, sirens, public address vehicles) to engage those in harm's way.

1. Introduction

Emergency services managers on the local, state, and national levels provide various vehicles for communicating with the public to warn of dangerous circumstances when public safety is at risk. The range of emergencies includes complex weather phenomena such as hurricanes and tornadoes, chemical accidents where toxic materials affect a particular area, fire, and earthquake crises. One fundamental communicative vehicle suggested for increased use by emergency managers is the National Oceanic and Atmospheric Administration (NOAA) Weather Radio network. At issue is whether NOAA Weather Radio (NWR) receivers are an effective way of communicating disaster information to the public during emergencies.

Communication has been defined, in its most elementary form, as a linear process requiring three elements: a sender, a channel through which to send the message, and a receiver (McQuail 1987, 43). Thus, merely sending messages by a selected channel (or set of channels) without a receiver is not communication. The receiver (intended audience) must be aware of the message being sent, engaged with the channel being used, and understand the sender's intended meaning for it to be an effective transmission from the point of view of the sender. Additionally, reaching a huge "mass audience" has become quite problematic in an increasingly fragmented media world of dramatically expanding channel options with which audiences may engage.

Clearly, people engage with media vehicles in highly variable ways, often reflective of their socioeconomic condition. It affects their ability to purchase the technological tools for the engagement (e.g., having a computer and modem is a prerequisite for being part of the Internet information network) and is often reflective of their culture. Research has demonstrated that variable uses evolve among socioeconomic groups in media-rich environments. McQuail (1987, 234) affirms this concept: "Thus, the causes of media use are held to lie in social or psychological circumstances which are experienced as problems and the media are used for problem resolution (the meeting of needs), in matters such as information seeking, social contact, diversion, social learning and development." The audience has become empowered with a landscape of wide choice and, thereby, more difficult for would-be message senders to gather into a particular channel. Rather than

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sender driven, the communicative process is receiver controlled. McQuail (1987, 242) also notes: "The motivations associated with media choice and the functions assigned to content by audience members are located within specific frames of meaning constructed by audiences." In other words, people engage, or disengage, with given media vehicles in proportion to the way they perceive it is useful for them to do so.

The NWR network signals can be monitored by scanners, marine radios, and other specialized receivers. Weather alert radios, some of which operate muted until a tone sent by the National Weather Service causes a loud alarm to be activated, are widely available through commercial electronics firms (*Consumer Reports* 1993). The basic home-use weather radio receivers are moderately priced, generally available for $25 or less. The special broadcasts to the radios are made from National Weather Service transmitters on frequencies above the commercial FM band at 162.40, 162.425, 162.450, 162.475, 162.500, 162.525, and 162.550 MHz. Each of the NOAA transmitters has a minimum range of approximately 40 miles (Gibian 1988). There were more than 386 such transmitters operating by 1994, covering approximately 75% of the U.S. population that owns the estimated 8 million radios capable of receiving NWR broadcasts (*Chicago Tribune* 1994).

Use of NWR as an emergency warning system for events other than weather phenomena or nuclear attack began with a White House policy statement issued 13 January 1975. Subsequently, during the Three Mile Island nuclear power plant crisis, one emergency response option considered by officials was to have the NOAA radio network in the vicinity of the power plant serve as "an additional tool to notify the public" (Brown 1979, p. A6). In 1981, the Georgia Power Company distributed "more than 2,600 radios to residences, schools and businesses within a 10-mile radius of Hatch nuclear station as part of the emergency plan" required by the Nuclear Regulatory Commission (*Nucleonics Week* 1981, 13). The plan included homes in a 20-mile radius of Hatch, where the warnings would be broadcast from a special transmitter. In 1988 the NWR system was used to warn residents near Alliance, Ohio, of a warehouse fire that generated toxic smoke. At that time, Ed Heath, meteorologist in charge of the National Weather Service office at the Akron–Canton Regional Airport office, suggested that "Weather radios are a perfect way to remain constantly alert for all kinds of emergencies," but at the same time emphasized that "Unfortunately, many people who own and use weather radios often turn them off during periods of non-stormy weather" (Gibian 1988).

Whether the NWR system actually communicates with those intended was cited as one of three factors in system effectiveness, along with forecasting and response, by NOAA Assistant Administrator for Weather Services Elbert W. Friday Jr. In September 1993, Friday testified before a U.S. House of Representatives subcommittee that "communication encompasses not only the wide variety of distribution methods used to reach as many people as possible but also their receipt and understanding of the message" (U.S. Congress 1993).

In April 1994, the federal government announced a plan to use the NWR network to expand the system to cover all types of emergencies for all but a fraction of the U.S. population. Following a Palm Sunday tornado outbreak that year in Alabama, Georgia, Tennessee, North Carolina, and South Carolina, in which 43 people were killed, United States Vice President Al Gore announced the NWR network would be expanded from covering approximately 75% of the U.S. population to 95% coverage (Hamburg 1994; *Sacramento Bee* 1994). During the spring 1994 tornado outbreak, the National Weather Service issued warnings approximately 20 min before the first tornado touched down. According to Vice President Gore, "The weak link in the chain was the inability to get that warning information to all of the people in the threatened area" (*Chicago Tribune* 1994). Gore pledged the NWR expansion program would aggressively pursue making NWR receivers as common as smoke detectors (*Washington Insider* 1994). The federal plan to expand the existing system includes adding 100 new transmitting stations at a cost of $35 000–$40 000 each. Three federal agencies are involved: the National Weather Service, the Federal Emergency Management Agency, and the Department of Agriculture (*Chicago Tribune* 1994).

Considerable research, as discussed specifically below, has focused on disaster warning systems, much of it specific to earthquake or nuclear power plant accident scenarios. Common elements of those two disaster categories, property destruction and loss of human life, extend to weather phenomena including tornadoes and hurricanes. The importance of accurate weather forecasting, and the subsequent transmission of forecasts to end users (emergency responders and the public at large), cannot be over emphasized.

Ayre et al. (1975, 83) determined that "A reliable method of reasonably precise prediction, with a low false-alarm rate, could lead to significant reduction in casualties." Among the factors in conveying information to the public, the researchers determined that an emergency message must be relayed promptly, contain essential and accurate information, and receivers of the message must be motivated to "take appropriate timely action" (Ayre et al. 1975, p. 111).

Additionally, Ayre et al. emphasized that for a warning system to be effective it must include "all of the information necessary to permit rapid, rational decisions," which seriously limits devices that only convey a sense of danger but little else, for example, sirens.

Further, Mileti (1975, p. xiii) argued that a warning system contains more than the actual warning and its effectiveness must be "assessed from an integrated perspective, including every stage of the total warning process from the first detection and forecast of a hazard threat through public response." Thus, the actions of weather forecasters analyzing meteorological phenomena as it develops—Mileti's "evaluation" phase—is interrelated to the communicating of the information to the public—his "dissemination" phase—and the subsequent actions taken by the public—his "response" phase (Mileti 1975, p. xiv). Ultimately, the effectiveness of any warning system centers on the accurate transference of meaning through various communications channels. Mileti (1975, pp. 18–19) adds that "From all past research efforts three important notions about how people respond to warnings have emerged: 1) even though people may be *listening* to the same warning message, everybody *hears* and *believes* different things; 2) people respond to warnings on the basis of how what they *hear* stimulates them to behave; and 3) people are stimulated *differently* depending on why they are, who they are with, and who and what they see." Clearly, as observed by Mogil (1980, p. 206), "Without adequate dissemination and user response, warnings, no matter how accurate and timely, become useless."

There is increasing potential, when relying on commercial mass media channels, for emergency information intended for one regional audience to be received as a false alarm by another regional audience. For example, a severe weather warning issued and broadcast by Chicago television stations could be seen by people living in Montana, where some cable television systems carry superstation WGN, "hundreds of miles from the originating station" (Mogil 1980, p. 210). Thus, as the mass media fragment into more origination sources, many of those geographically distant, the possibility of false alert messages is increased. Additionally, people tend to use their own senses as primary determinants of danger. Basically, seeing is believing. When emergency messages regarding weather phenomena are received, the natural impulse is to look outside. "People tend to act only when they receive very explicit information or personally observe dangerous conditions" (Carter 1980, p. 216). Other research (Leik et al. 1981, p. 27) has confirmed that "The initial response of the public to the receipt of hazard warnings is to seek additional confirming information." There is a possibility that that tendency may be enhanced in a world of distant mass mediated messages.

However, it must be emphasized that commercial mass media use of emergency messages is crucial to getting the information to the public. In a study conducted for the NWS on forecast dissemination it was determined that the public obtains its weather information primarily from commercial television (53.6%) and radio (35.8%) stations (National Weather Service 1981, p. 15). Further research (Leik et al. 1981, p. 19) has also determined that the "vast majority of the public receives warning directly or indirectly from the broadcast media." While the NWS study determined that only 14% of the public directly engaged with the NWR system, its indirect affect is substantial because commercial broadcasters frequently "obtain current weather information from NOAA Weather Radio" (Mogil 1980, p. 212), which they then convey to the public within the context of their programming.

It must also be recognized that commercial mass media have their own agendas, of which public service in emergency information dissemination is but one part. Thus, the news media will cover aspects of natural phenomena they determine to be in their best interests for attracting and maintaining an audience. Scanlon (1980) found that mitigation efforts, for example, may receive much less attention from commercial mass media than catastrophic events. And when natural disasters are covered, Scanlon (1980, p. 262) contends the media "Will ignore certain aspects of disasters, thus distorting the information that flows to policy makers, and . . . these distortions or omissions are duplicated by the official flow of information. The media, therefore, in many ways play a critical role in defining the disaster and appear to help shape the public conception of what the disaster involves." There is a serious question of how effective mass media warning messages are, in actually getting people to take action. Leik et al. (1981, pp. 27–28) found the messages broadcast by the commercial mass media "apparently do not motivate" people "to take immediate action," but "warnings received directly from local authorities facilitate the decision-making process."

The concept of audience fragmentation, which has evolved in communication theory as a result of the dramatic technological expansion of available mass media options in the 1970s and 1980s, poses serious questions for those interested in providing forecasts of natural disaster phenomena to a public no longer confined to a handful of television and radio options. The 15 yr from 1975 to 1990 saw a decline in the primetime viewing of the traditional television networks (ABC, NBC, CBS) from 92% of households using televisions to 62%. *TV Guide,* which listed 14 viewing options in the nation's largest cities in the mid-1970s, included 33 by the mid-1980s. By the end of the 1980s, national cable penetration exceeded 60% of homes, with 70% of households also owning a videotape recorder (Auletta 1991).

As commercial mass media fragmentation, as described above, was escalating, Leik et al. (1981) were conducting a 3-yr study of 22 communities determined to be maximally at risk to disasters including tornado, flash flood, hurricane, winter storm, and earthquake.

Leik et al. (1981, 21) determined that "Serious gaps exist in the communication systems currently in use" in the study sites and suggested a model of interrelated linkages among community organizations involved with a warning system. Those organizations include: local National Weather Service office, primary emergency service agencies, responding organizations, secondary emergency service agencies, broadcast media, and the general public (Leik et al. 1981, p. 16). Despite the linkages among a wide range of community groups, Leik et al. (1981, p. 22) concluded "Significant portions of the general public were unaware of any warnings at the height of the natural hazard threat."

Studies have demonstrated the cost-effectiveness of tone-alert radios compared to siren warning systems in communities around nuclear power plants (Sorensen 1982). However, regardless of the physical or technological means used, the success of any warning system rests on a single factor, whether people "believe the message" (Sorenson 1982, p. 16). Thus, no one emergency warning source appears to have a dominant role, but each functions as an element within a flow of messages that together may induce action on the part of receivers. And while tone-alert radios may improve existing warning systems, it is not clear if they are necessary to the function of it (Sorenson 1982, p. 48). What is clear from previous research on disaster warnings is that the most effective warnings come from a number of sources. This multiplicity of warnings appears to spur action by convincing receivers the warning is, indeed, real and of immediate danger. Mileti and Sorensen (1990, pp. 2–9) assert "A single warning is not sufficient to get people to believe and respond." Thus, "Whenever feasible, the warning system should use multiple channels to ensure overlap and comprehensive coverage" (Mileti and Sorenson 1990, pp. 3–16). Within information-rich environments receivers engage with numerous channels of communication. Therefore, note Mileti and Sorenson (1992, pp. 5–10), "Different members of a population belong to different communication networks and have access to different communication linkages to the outside world. Consequently, the number of people who hear a warning can be maximized by disseminating warning messages over the full range of public communication networks."

In an increasingly complex, technology-driven world there is a question whether messages sent through a specific channel will reach more than a narrow segment of society. The problem is particularly acute when senders attempt to communicate with all socioeconomic levels that may be engaged in a diverse arena of message channels. Tichenor et al. (1970) originally identified the potential for different social strata to become isolates within the larger collective due to a "knowledge gap" hypothesis. "As the infusion of mass media information into a social system increases, segments of the population with higher socioeconomic status tend to acquire this information at a faster rate than the lower status segments, so that the gap in knowledge between these segments tends to increase rather than decrease" (Tichenor et al. 1970, pp. 159–160).

The researchers supported their initial hypothesis with findings from a long-term study of mass-mediated messages regarding major controversies in 16 communities in Minnesota, ranging in population from 1000 to over 100 000 (Donohue et al. 1975). Two of the research conclusions are of particular interest to this study. First, "Where the issue appears to arouse general concern for a community as a whole, knowledge about that issue is more likely to become evenly distributed across educational status levels." Second, "Such equalization in knowledge is more likely to occur in a small, homogeneous community than in a large, pluralistic one" (Donohue et al. 1975, p. 21). Research has indicated that a key motivational factor in the adoption of new technology and information is whether the individual perceives a personalized need to acquire it (Severin and Tankard 1992). And for some members of society there is great competition for their attention and resources. Childers and Post (1975, 56) assert that fundamental information needs of the poor include the following primary concerns:

- How do I get my baby into a day-care center?
- Whom do I talk to to get rid of rats?
- Where can I get $10 to last until my welfare check comes in?
- I need enough food to get us through the weekend.

Preoccupation with such concerns may be a factor in slower knowledge acquisition of some social segments along with other factors. For example, those of higher socioeconomic status can be expected to attain new technology at a faster rate than those of lower socioeconomic status because "There is a difference in communication skills between those high and low in socioeconomic status. There is usually a difference in education, and education prepares one for such basic information-processing tasks as reading, comprehending, and remembering" (Severin and Tankard 1992, p. 234). Additionally, the research by Childers and Post (1975) indicates that when those of lower socioeconomic status engage with mass media, it is not so much for information acquisition as to escape from their problems. The typical socioeconomically disadvantaged American "watches many hours of television daily, seldom reads newspapers or magazines and never reads books" and "does not see his problems as information needs" (Childers and Post 1975, 42).

Thus, two things appear to be crucial in the effort to ensure effectiveness in communicating with widely diverse publics featuring disparate socioeconomic classes spanning rural and urban environments. First, there must be a clear and overpowering need to acquire the technology necessary for the communication that transcends class differentiations and the respective economic realities. Second, individuals must perceive a personal necessity to engage in such technology. Particularly among lower socioeconomic groups, "Motivation to acquire information may be the important variable in determining whether a knowledge gap widens or closes" (Severin and Tankard 1992, p. 240).

2. Methodology

As part of the March 1994 west Tennessee Severe Weather Exercise, conducted by the Tennessee Emergency Management Agency, a telephone survey was taken of west Tennessee residents to determine general emergency preparedness. Included in the telephone survey were several questions about NWR receiver possession and use within the region comprising the western third of Tennessee. The research design specified a large enough sample to provide an error rate of 5% or less.

Four issues regarding NWR in west Tennessee were included in the study design, each stated as a research question:

1) How many residences have NWR receivers?
2) How many of those are on continuously, monitoring for alert messages?
3) How many NWR receivers are not turned on unless the owner is aware there is severe weather potential?
4) Is there a relationship between family income and the availability of either battery-powered, commercial broadcast, or NWR equipment in the household?

A telephone survey, combined with an experimental NWR emergency message drill, was used with cluster random sampling based upon county of residence. Since west Tennessee is a region with diverse urban and rural areas, clustering of the regional population by county was implemented to ensure inclusion of all areas of the region as well as to provide comparative data based upon county of residence (Wimmer and Dominick 1987, p. 77). Emergency management in west Tennessee is provided through county directors. Thus, it is useful to have data reflective of that administrative level.

The 1990 U.S. census data were used to determine the population of the region and the 21 counties therein (U.S. Bureau of the Census 1990). Each county's percentage of the total regional population was then used to determine the number of respondents necessary from each county. The region has one large urban county, Shelby, and 20 mostly rural counties. In west Tennessee telephone exchanges are not defined by county boundaries. Telephone listings are broken down by community areas within county jurisdictions though actual telephone exchanges may span two or more communities. Thus, it was necessary to use local telephone books to select respondents rather than random digit dialing within exchanges that include portions of more than one county. The proposed regional sample to be drawn was factored by the county population percentages to derive the number of respondents necessary from each county. While it was recognized that each individual county would not have a sampling error rate of less than 5% with such a clustering scheme, the regional sampling error would remain within the research design specification. Because of the necessity of avoiding fractions of respondents in the stratification of the sample by county, the actual survey included 407 respondents for a regional error rate for binomial data of ±4.86%. The formula used to derive the regional error rate was based on a conservative 50/50 binomial distribution at the 95% confidence level. That formula is as follows: sampling error $\pm 1.96\ (0.50\ 0.50/N)^{1/2}$ (Weaver 1989, pp. 60–61). Table 1 provides the specific county breakdown of regional population and the number of respondents for each county cluster.

Prior to the survey, computer-generated random numbers were used to determine actual page numbers of local telephone books from which to draw prospective respondents in each county. The evening of the survey, each county field worker was given a set of code sheets with specific local telephone book page numbers. They were instructed to turn to the indicated

TABLE 1. County respondents: $N = 407$.

County	Population	Respondents (n)	County % of region
Benton	14 524	4	1.0
Carroll*	27 514	8	2.0
Chester	12 819	4	0.9
Crockett	13 378	4	1.0
Decatur*	10 472	3	0.7
Dyer	34 854	10	2.5
Fayette	25 559	8	1.8
Gibson	46 315	13	3.2
Hardeman	23 377	7	1.7
Hardin	22 633	7	1.7
Haywood	19 437	6	1.5
Henderson	21 844	6	1.6
Henry*	27 888	8	2.0
Lake	7129	2	0.5
Lauderdale	23 491	7	1.7
Madison	77 982	23	5.7
McNairy	22 422	7	1.7
Obion	31 717	9	2.2
Shelby	826 330	250	61.4
Tipton	37 568	11	2.7
Weakley	31 972	10	2.5
Total:	1 359 225	407	100.0

* Due to rural telephone exchange overlap, Carroll and Henry counties were combined with 16 respondents, while 2 from Henderson were called through Decatur directories.

telephone book page and select any residential number. It was suggested that field workers cover their eyes and select the number on the indicated page "blindly" to maintain as much randomness in final selection as possible. When calling, if the number was busy or the initial respondent declined to take part in the survey, field workers were instructed to dial the next residential telephone number on the same page. If a child answered, field workers were instructed to ask for an adult, but if none was available, to continue with the interview of the child. The rationale for including children home alone in the sample was that when disaster strikes such a child will, of necessity, have to react to the situation. Thus, unsupervised children are germane to the study of emergency information dissemination effectiveness.

As part of the 1994 West Tennessee Regional Severe Weather Exercise, the National Weather Service office in Memphis issued a severe weather test alert message at 1905 LST 3 March 1994. The message notified all receivers of National Weather Service emergency broadcasts that the message was a drill, followed by description of a tornado watch. The National Weather Service broadcast was specifically designed to test all NWR receivers in the 21-county region. It should be noted that no severe weather was actually in the area the evening of the drill.

The telephone survey was initiated following the severe weather test alert message the evening of 3 March 1994, between the hours of 1930 and 2200 LST. A total of 407 interviews were completed. Three techniques were anticipated to be of value in considering the data: tests of proportions, cross-tabulation of variables, and chi-square statistical analysis.

3. Results

The following discussion presents respondent answers to survey questions regarding NWR receiver possession and use in the order those questions were asked by field workers.

When asked "Do you have a NOAA Weather Radio," fewer than one-quarter of households (n = 100, 24.6%) indicated they possess such a receiver, while nearly three-quarters (n = 292, 71.7%) answered no. Eight respondents (n = 8, 2.0%) indicated they did not know whether such a radio is in their domicile. Those respondents who indicated they possess an NWR receiver were then asked how they use the receiver. One-third of those with an NWR receiver indicated they leave it on all the time (n = 33, 33.0%). Just over one-half (n = 51, 51.0%) reported they turn it on only when serious weather threatens. A small percentage of the NWR receiver owners (n = 16, 16.0%) indicated they rarely, or never, use it. Finally, the broadcast of a severe weather test alert just prior to the telephone survey provided an opportunity to determine the number of NWR receiver owners actually receiving messages through the technology. A substantial majority (n = 70, 70.0%) of those 100 individuals in the regional sample of 407 who reported having access to an NWR receiver did not hear the test alert message. Slightly more than one-quarter (n = 26, 26%) of NWR receiver owners confirmed they heard the test alert.

At the time the field survey was conducted not all areas of the west Tennessee region were fully covered by NWR transmitters. In July 1994, after this study was completed, R. I. Coleman, meteorologist-in-charge of the National Weather Service office in Memphis, Tennessee, submitted a plan to upgrade the NWR "all hazards warning capabilities" to reliable NWR broadcast coverage for 95% of the state population (Coleman 1994). That plan includes upgrading 11 NWR transmitters and/or antennas in the state as well as adding up to four new installations. The plan was based on 5-μV-receiver field tests of existing transmitters. Figure 1 is a map of the 5-μV penetration areas for the three NWR transmitters of concern to this study. West Tennessee features generally flat terrain that is conducive to greater broadcast signal reception than more variable geography. When respondent data from this study was sorted by county and tabulated according to the 5-μV field data, it produced mixed results. As is evident in Table 2, respondents in counties that have 50% or more of their geographical area outside the 5-μV signal area indicate significant ownership and use of NWRs. And in two of those counties, Gibson and Hardeman, the test alert message was heard by some respondents. Two counties provided no NWR ownership or use response: Henry and Weakley. All of Henry County and more than 75% of Weakley County lie outside the 5-μV area. All of Obion County is outside the 5-μV coverage areas. An Obion respondent indicated ownership of an NWR receiver but also indicated it was rarely used. Because of the low number of respondents in some of the rural counties, the data relative to the 5-μV broadcast area cannot be considered statistically significant. However, it does indicate interest in NWR throughout the west Tennessee region, not confined to areas with 5-μV signal strength, as well as the possibility of fringe area reception of NWR broadcasts.

Respondents were asked to reveal their age, within eight broad categories. Except for the first three groups, the age distribution was relatively evenly spread. A small number of respondents reported their age as 10 or under (n = 1, 0.2%), 11–15 (n = 11, 2.7%), or 16–21 (n = 30, 7.4%). Table 3 includes the distribution of ages in the sample.

Respondents were also asked to indicate their income within one of six brackets. As in the age question, distribution of respondents was relatively even across income brackets. There were two notable exceptions. Few respondents (n = 37, 9.1%) indicated annual incomes of less than \$10,000. And a small number reported being in the \$40,000–\$50,000 bracket (n = 27,

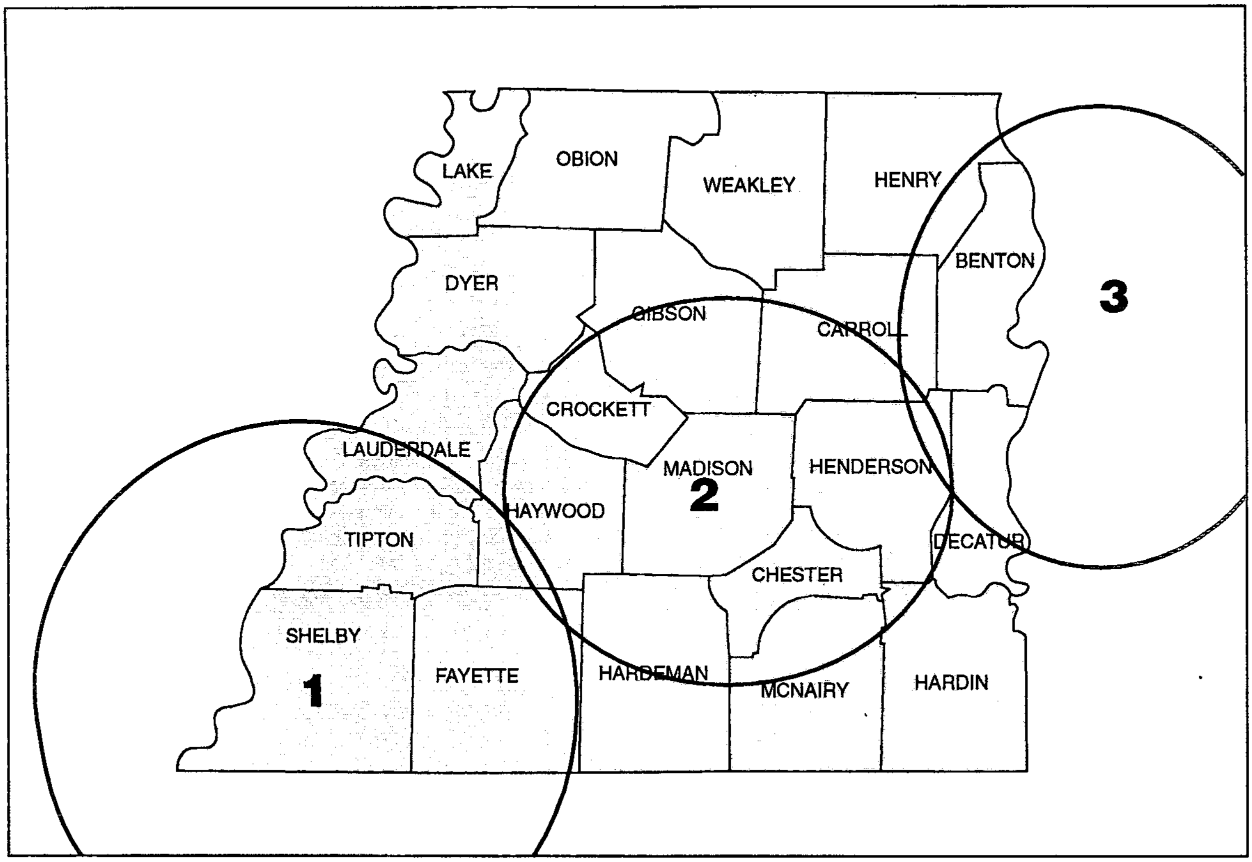

FIG. 1. The 5-μV penetration areas for NWR in west Tennessee. Transmitters: 1) Memphis, WXK-49, 162.475 MHz; 2) Jackson, WXK-60, 162.550 MHz; 3) Waverly, WXK-62, 162.400 MHz.

6.6%). Table 4 reflects respondent income brackets. It should be noted that several field workers indicated on their data sheets comments from respondents irritated at being asked income level with such notations as none of your business or what's my income got to do with disasters? Just over one-fifth of respondents did not answer the income question (n = 87, 21.4%).

a. *Test of proportions*

The test of proportions is useful for analysis of categorical variables since "the proportion is a mean—a mean of a dichotomous distribution" (Hopkins et al. 1987, p. 182). By determining the proportion of a sample, the corresponding proportion of the population can be estimated. Thus, variables produced by the field instrument were used to estimate the parameter in a population by the corresponding proportion in a sample (Glass and Hopkins 1988, p. 276).

Differences-of-proportions tests were performed on several items and are reported with the following information included in the parenthetical: the percentage of households, the z score produced by the test of proportions, and the probability of error (p). The z score was computed according to the following formula where P equals the proportion (or percentage) of cases in one category, Q equals $1 - P$ (or $100\% - P$), and N equals the number of cases in the sample: $z = (P_1 - P_2)/(PQ/N)^{1/2}$ (Stemple and Westley 1989, p. 79). For example, the following parenthetical (24.6%, $z = -23.796$, $p < 0.0001$) indicates that 24.6% of the household population can be expected to be included, based on a z score of -23.796, with a systematic error probability of less than 0.0001 in the statistical inference drawn from the sample data and applied to the population.

NWR receivers are located in slightly fewer than one-fourth of the region's households (24.6%, $z = -23.796$, $p < 0.0001$). Fewer than one-twelfth of west Tennessee households can be expected to be continuously monitoring NWR (8.1%, $z = -61.964$, $p < 0.0001$). Based on the results of the severe weather test alert message included in the study fewer than 1 in 15 households in west Tennessee (6.4%, $z = -71.876$, $p < 0.0001$)

TABLE 2. The 5-μV area ownership, use, and alert recognition.

County	Own NWR	Use NWR*	Alert heard
Benton**	X	X	
Carroll**	X	X	
Chester**	X	X	
Fayette**	X	X	
Haywood**	X	X	
Henderson**	X	X	X
Madison	X	X	X
Shelby**	X	X	X
Tipton**	X	X	X
Crockett***	X		
Decatur***	X		
Dyer***	X	X	
Gibson***	X	X	X
Hardeman***	X	X	X
Hardin***	X	X	
Henry***			
Lake***	X	X	
Lauderdale***	X	X	
McNairy***	X	X	
Obion***	X		
Weakley***			

* Includes those who monitor continuously and those who monitor only when serious weather threatens.
** 50% or more of county inside 5-μV area.
*** 50% or more of county outside 5-μV area.

can be expected to actually hear an emergency message sent via NWR broadcasts. It should be noted that no severe weather was in the west Tennessee region the evening of the severe weather test alert message. Thus, those individuals who do not turn on their National Weather Radio receivers unless they know actual severe weather is in their immediate area could not be expected to hear it. However, the test, then, provides a major indicator of the use of NWR, in its present form and with its current audience engagement habits, as an "all hazards" warning tool.

b. Contingency table analysis of key variables

The interrelationship of data categories often produces insight. For example, knowing whether individuals have special weather alert receiving radios does not indicate whether they actually use the radios or if they may be gathering dust on a shelf. Thus, it is valuable to know if the radios are present in the population, whether they are turned on, and whether those who claim to use them actually hear alert messages.

To investigate the relationship of variables in the West Tennessee Severe Weather Exercise telephone survey, questionnaire data were subjected to contingency table analysis, also known as cross-tabulation. The technique uses a matrix to cross index variables so the "joint occurrences of pairs of scores on two variables in a group" are readily apparent (Glass and Hopkins 1984, p. 99).

Contingency table analysis of the survey data included four steps. First, it was necessary to sort respondents into three categories: those with receivers, those without, and those indicating "don't know." Slightly fewer than one-quarter of respondents in west Tennessee said they have NWR receivers (n = 100, 24.6%). A clear majority of respondents (n = 292, 71.7%) said they do not have such receivers, with small percentages indicating they do not know (n = 8, 2.0%) or not answering the question (n = 7, 1.7%). Second, the 100 respondents of the sample who said they possess NWR receivers were sorted according to the way they use the receivers. In the survey they were asked if their radio is on all the time, is turned on only when serious weather threatens, or if they rarely, or never, use it. The third step in the contingency table analysis cross-tabulated the results of the two sorting procedures. Table 5 provides the contingency table for possession of

TABLE 3. Respondent age groups: N = 407.

Group	n	Percent
≤10	1	0.2
11–15	11	2.7
16–21	30	7.4
22–30	61	15.0
31–40	85	20.9
41–50	77	18.9
51–60	53	13.0
≥61	87	21.4
No age indicated	2	0.5
Total:	407	100.0

TABLE 4. Respondent income brackets: n = 407.

Bracket	n	Percent
≤10 000	37	9.1
10 000–20 000	74	18.2
20 000–30 000	82	20.1
30 000–40 000	45	11.1
40 000–50 000	27	6.6
≥50 000	55	13.5
Not reporting	87	21.4
Total:	407	100.0

TABLE 5. Respondents with NOAA Weather Radios cross-tabulated by type of use: n = 100.

	Radio is turned on			
	Always	Only when severe weather threatens	Rarely or never	Total
Own NOAA weather radio	33 (33.0%)	51 (51.0%)	16 (16.0%)	100 (100.0%)

TABLE 6. NOAA alert response (percentages indicate row percentages): n = 100.

Radio use	Alert message recognition: Heard alert	Did not hear alert	Do not know
On all the time	21 (63.6%)	10 (30.3%)	2 (6.1%)
On only when severe weather threatens	5 (9.8%)	45 (88.2%)	1 (2.0%)
Rarely or never on		15 (93.8%)	1 (6.3%)

an NWR receiver and the use of such a radio. One-third of those who have such receivers (n = 33, 33.0%) reported they are on all the time. Slightly more than half (n = 51, 51.0%) indicated they wait to turn them on until they know serious weather is threatening, while one-sixth (n = 16, 16.0%) reported they rarely or never use their NWR receivers.

The experimental element of the National Weather Service test alert sent to all NWR receivers in west Tennessee was compared to the way respondents reported using their receivers. Table 6 provides the cross-tabulation of the way those who have NWR receivers use them and whether respondents reported hearing the test alert message. Slightly fewer than two-thirds of those who have their NOAA radios on all the time heard the message (n = 21, 63.6%). Additionally, of

TABLE 7. County NOAA Weather Radio penetration: N = 407.

County	Population (1990)	Percentage of respondents with receivers
Shelby	826 330	20.2
Madison	77 982	56.5
Gibson	46 315	23.1
Tipton	37 568	54.5
Dyer	34 854	20.0
Weakley	31 972	0.0
Obion	31 717	11.1
Henry	27 888	0.0
Carroll	27 514	42.9
Fayette	25 559	25.0
Lauderdale	23 491	28.6
Hardeman	23 377	28.6
Hardin	22 633	42.9
McNairy	22 422	28.6
Henderson	21 844	50.0
Haywood	19 437	16.7
Benton	14 524	50.0
Crockett	13 378	25.0
Chester	12 819	25.0
Decatur	10 472	20.0
Lake	7129	50.0
Region population:	1 359 225	

TABLE 8. Age, information, and NOAA radio possession (positive response percentages): N = 407.

Age group	Information	NOAA radio
$\leqslant$10	0.0	0.0
11–15	18.2	36.4
16–21	33.3	16.7
22–30	23.3	14.8
31–40	27.7	17.1
41–50	32.9	29.7
51–60	37.7	34.6
$\geqslant$61	19.8	32.2

those who only turn the radios on when they know severe weather is in their area, just under 10% heard the message (n = 5, 9.8%). No respondents who reported rarely or never having their NWR receiver turned on heard the test alert message.

Those households that possess NWR receivers were sorted by county. Table 7 lists the west Tennessee counties by population density with the percentage of respondents who indicated they possess NWR receivers. The table illustrates that while the penetration of NWR receivers varies widely from county to county, it does not appear to be linked in a significant way to population density with similar penetration percentages across the range of populations.

The next sequence of cross-tabulations focused on the variables of age bracket and possession of an NWR receiver. The cross-tabulation is illustrated in Table 8. NWR appears to be of most interest to early teens and those over 40.

The final set of cross-tabulations sought to determine the effect of income level on NWR receiver possession. Ownership increased with income level, resulting in the highest number of positive responses in the three highest income brackets. Table 9 graphically illustrates the data.

c. Chi-square analysis

Chi-square statistical analysis provides the capability to compare nominal data to determine if there is a relationship (Wimmer and Dominick 1987, pp. 261–266; Glass and Hopkins 1984, p. 275). "The value of

TABLE 9. Income, information, and NOAA radio possession (positive response percentages): n = 320.

Income bracket	Information	NOAA radio
$\leqslant$10 000	13.5	8.3
10 000–20 000	23.3	17.6
20 000–30 000	28.4	21.0
30 000–40 000	28.9	31.1
40 000–50 000	29.6	23.1
$\geqslant$50 000	45.5	35.3

χ^2 increases as the observed proportions differ among the groups being contrasted" (Glass and Hopkins, 1984, p. 288). The greater the difference in proportions in cells of cross-tabulated variables, the stronger the relationship. In mass media research it is often of interest to use the observed frequencies of a variable to determine the frequencies that might be expected to occur or to be hypothesized. To perform a χ^2, the researcher must know the probability level desired and the degrees of freedom (df), the number of scores in any particular test that are free to vary in value. "If the calculated chi-square value equals or exceeds" the predetermined value for the probability level and degrees of freedom, "the differences in frequency are considered to be statistically significant at the predetermined alpha level" (Wimmer and Dominick 1987, p. 262). The equation for χ^2, where O_i = the observed frequencies and E_i = the expected frequencies, is as follows: $\chi^2 = (O_i - E_i)^2/E_i$.

Thus, along with contingency table analysis that indicates "joint occurrences of pairs of scores on two variables in a group" (Glass and Hopkins 1984, p. 99), chi-square provides a statistical tool to indicate whether those occurrences are related by more than simply chance. Chi-squares were computed to investigate possible relationships between the independent variables of age and income and the dependent variable of NWR receiver possession. The age-independent variable failed to yield significant chi-squares. However, NWR possession was significantly related to income level ($\chi^2 = 21.82$, df = 10, $p < 0.05$), as shown in Table 10. In the case of NWR receivers, the highest penetration is in the three highest income brackets (31.1%, 23.1%, and 35.3% in ascending order). Those making under $20 000 annually have less than a 20% chance of having such receivers in their possession.

The χ^2 analysis provides support for the argument that higher income is related to higher levels of disaster preparedness in terms of the ability to hear emergency information broadcast on NWR transmitters. Put another way, the individuals least likely to have, or to be able to receive via radio, emergency information from authorities during a disaster are those in the lowest socioeconomic strata of society.

d. Research question answers

The survey data and contingency table analysis provided the following answers to the research questions of the study.

1) How many residences have NWR receivers?

NWR is available to slightly fewer than one-quarter of west Tennessee residences (n = 100, 24.6%, $p < 0.0001$). Thus, 83 592 households have the technology providing accessibility to 334 369 people. The remainder of the west Tennessee population (1 024 856) does not have access, within their households, to the NWR technology.

TABLE 10. Chi-square for NOAA Weather Radio possession and income level (percentages indicate row percentages): n = 313.

Income level in dollars	Possession of NOAA Weather Radio receiver: Yes	No	Do not know
≤10 000	3 (8.3%)	33 (91.7%)	0
10 000–20 000	13 (17.6%)	57 (77.0%)	4 (5.4%)
20 000–30 000	17 (21.0%)	63 (77.8%)	1 (1.2%)
30 000–40 000	14 (31.1%)	31 (68.9%)	0
40 000–50 000	6 (23.1%)	18 (69.2%)	2 (7.7%)
≥50 000	18 (35.3%)	33 (64.7%)	0
$\chi^2 = 21.82$	df = 10	Significance = 0.01603	

2) How many of those are turned on continuously monitoring for alert messages?

One-third of those respondents who indicated they possess an NWR receiver (n = 100) leave it on all the time (n = 33, 33.0%). When factored into the total sample of 407 respondents, the percentage of west Tennessee households that are continuously monitoring the service and, thus, can be immediately alerted to potential disaster through NWR is only 8.1%.

3) How many NWR receivers are not turned on unless the owner is aware there is severe weather potential?

Slightly more than half of those respondents who own NWR receivers (n = 51, 51.0%) indicated they turn them on only when they know severe weather is in their area. No attempt was made in this research question to differentiate between those who have radios with a mutable tone-alert feature. The question sought to determine access to the NWR channel on a continuous basis regardless of whether severe weather was known to be in the area.

4) Is there a relationship between family income and the availability of either battery-powered, commercial broadcast, or NWR equipment in the household?

The data support the contention that those who are better off economically tend to adopt new technology more readily. There was a statistically significant relationship between increased income and NWR receiver ownership ($\chi^2 = 21.82$, df = 10, $p < .05$).

4. Conclusions

a. Problems with public use of NWR

The study revealed fundamental problems in the way the general public engages with NWR. Channel engagement is paramount to communication taking place. If both sender and receiver are not engaged with one another through the same communication vehicle, no communication exists. In the most elementary of terms, unless there is a listener to hear a broadcast, the broadcast is for naught.

It is significant that, based on the sample in this study, one-quarter of the households of west Tennessee can be expected to have chosen to purchase the necessary equipment to engage with the communication channel. The National Weather Service may view the percentage of west Tennessee households using the service as a gratifying statistic indicating that a substantial number of people monitor its broadcasts. However, it is a classic example of the maxim "Is the glass half full or half empty," with three-quarters of west Tennessee households not engaged directly with NWR. It is important to note that those who own the necessary receiving equipment, for the most part, leave it turned off unless they know there is severe weather in their area. For weather phenomena, which often includes watches and warnings issued to encourage the heightening of public awareness, such sporadic engagement by individuals with weather radio receivers may not pose a serious problem. It is possible that the use of the radio service in such a way increases its effectiveness because it is never a background noise, as it is only turned on when severe weather is anticipated. However, if NWR is to be used increasingly as an information tool in an "all hazards" approach, to include disaster phenomena that cannot be readily discernable by obvious changes in the sky, more continuous monitoring by the general public is essential.

Only one-third of those who own NWR receivers keep them turned on continuously, while half the receiver owners turn on their radios only if they already know there is a reason to monitor the channel. One-eighth of NWR-receiver owners rarely turn them on at all. Considering such a small percentage of regional households (a) continuously monitor NWR and (b) subsequently hear emergency messages broadcast by the service, it is considerably limited, by itself, as a general public emergency information vehicle for nonweather emergencies such as chemical spills. Indeed, one of its most effective roles may be that of notifying other mass media (commercial radio and television stations) and emergency response organizations, which then notify the general public.

b. *Lack of uniform tone-alert capability in receivers*

While some NWR receivers have a tone-alert feature that turns on the radio speaker only if there is an alert, others do not. In a spot check by the researcher of one of the largest electronics retailers in the nation, Radio Shack, it was determined several models of weather radio receivers were available but only one with tone alert. That model is a battery-powered portable pocket unit with an estimated battery life (if used for continuous monitoring) of approximately 60 h. None of the radios stocked by the retailer that operate on normal household electric power had the tone-alert feature. While tone-alert receivers may be available through other electronics retailers, the spot check of one of the nation's largest electronics retail chains underscores a possible variability problem with consumer availability of mutable NWR monitors. Monitoring the weather radio channel over an extended period of time, with its abundant messages that are not emergency in nature, may reduce an individual's sensitivity to the radio. And it is possible owners of radios without the tone-alert feature turn down the receiver volume over time to a level that renders their monitoring equipment ineffective. Thus, incorporation of tone alert for muted operation appears a possible factor in encouraging wider public monitoring of NWR.

c. *Socioeconomic factors in public engagement with NWR*

A significant relationship was found between increasing income levels and the possession of NWR receivers. Thus, in west Tennessee those with the most economic resources are the most well equipped with emergency communication technology. The implication is that other means are necessary for communicating natural disaster alert information, or information about services after such a disaster strikes, with lower socioeconomic groups.

d. *Increasing public and emergency services use requires more than more transmitters*

Recent popular literature indicates public officials, including the vice president of the United States, may assume the existing NWR system is an effective tool for a wide range of emergency notification needs including chemical or gas disasters. From a sender perspective, NWR provides abundant information to the general public. However, from the receiver's point of view problems in channel engagement discussed earlier seriously compromise the likelihood of emergency messages actually being heard by the intended audience. Efforts to substantially expand existing technology to improve public safety are illusory if not combined with an effective program to expand and continuously reinforce public awareness and effective use of that technology. The research supports the view of NWR as communication technology with a significant, though somewhat limited, direct-niche audience. Broadening that niche will take more than simply expanding the transmission and coverage capabilities of the existing system. An effective marketing program appears necessary to both increase the number of individual households with NWR receivers and to encourage proper monitoring of the communication channel.

e. *An expanded concept of "integrated warning"*

Based on the data from this study, weather forecasters and others using NWR to send information to intended audiences must be aware of its limitations as a direct communication device.

The concept of an integrated warning system—put forth by researchers including Mileti (1975) during the 1960s and 1970s—that focuses on bringing together all facets of the detection and forecast, warning, and response process must, in the new, fragmented mass media environment, be expanded to a concept of integration spanning multiple communication channels. NWR is but one part of the family of warning channels with which the public engages. Perhaps its most important function is not in direct warning to the public but in conveying warning information to other mass media and emergency responders who incorporate numerous other technologies (commercial radio and television, sirens, public address vehicles) to engage those in harm's way. As Mileti and Sorensen (1990, p. 5–6) emphasized, "It would be imprudent to presume that all members of a public would hear a warning just because one is issued." And further, "public warnings must speak to a diverse and heterogeneous public. The presumption of a simple stimulus-response model of public warning response is invalid and must be laid to rest" (Mileti and Sorenson 1990, pp. 7–13).

f. *Suggestions for further research*

The data support the need for a clearer picture of the kind of NWR-monitoring equipment being purchased by American consumers. For example, how many NWR receivers owned by Americans have tone-alert features that result in alarms sounding even if those radios are muted? This research implies tone alert may be significant in the use, or disuse, of NWR by the general public. There is no question a large percentage of current owners of NWR receivers within 5-μV NWR signal strength areas of west Tennessee do not hear all emergency broadcasts in their area. Research should be initiated to determine why this occurs.

There is a need for further research to determine why most people who own the radios keep them turned off most of the time. Two areas are suggested for consideration in future research into the way audience members engage (or may choose not to engage) with the channel. There is a possibility that once a consumer purchases an NWR receiver and begins to use it, too frequent use of the alert mechanism over too wide an area results in too many false alarms. Currently, NWR alerts are broadcast to groups of counties serviced by each National Weather Service transmitter. Thus, a thunderstorm alert sent for one county may set off radio alert alarms in unaffected counties, producing false alarms for those in the unaffected counties.

Investigation should also be conducted into the methods emergency agencies and their managers could use to increase immediate emergency message reception by lower socioeconomic groups. This research provides evidence that middle-class or higher economic groups are the most prone to practice emergency preparedness.

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REFERENCES

Auletta, K., 1991: *Three Blind Mice: How the TV Networks Lost Their Way.* Random House, 642 pp.

Ayre, R. S., D. S. Mileti, and P. B. Trainer, 1975: *Earthquake and Tsunami Hazards in the United States.* Program on Technology, Environment and Man, Institute of Behavioral Science, University of Colorado, 150 pp.

Brown, W., 1979: "A sea of problems flows beneath the evacuation plan in Pennsylvania." *The Washington Post,* 31 March, A6.

Carter, T. M., 1980: Community warning systems: The relationships among the broadcast media, emergency service agencies, and the National Weather Service. *Disasters and the Mass Media: Proc. Committee on Disasters and the Mass Media Workshop,* Washington, DC, National Academy of Sciences, 214–228.

Chicago Tribune, 1994: "Tornado tragedy sparks action: Washington moves to upgrade radio station alerts," April 1, p. 7.

Childers, T., and J. Post, 1975: *The Information-Poor in America.* Scarecrow Press, 182 pp.

Coleman, R. I., 1994: NOAA weather radio (NWR) state of Tennessee upgrade and enhancement plan. National Weather Service, Memphis, TN, 14 pp.

Consumer Reports, 1993: Bad weather turns on these radios. No. 52. September, 577.

Donohue, G. A., P. J. Tichenor, and C. N. Olien, 1975: Mass media and the knowledge gap: A hypothesis reconsidered. *Communication Research,* **2,** 3–23.

Gibian, J. J., 1988, June 5: Weather radios provide various warnings. Regional News, Ohio AM cycle, United Press International.

Glass, G. V. and K. D. Hopkins, 1984: *Statistical Methods in Education and Psychology.* 2d ed. Prentice-Hall, 578 pp.

Hamburg, J., 1994: Gore urges use of weather radios. *The Orlando Sentinel,* 1 April, A1.

Hopkins, K. D., G. V. Glass, and B. R. Hopkins, 1987: *Basic Statistics for the Behavioral Sciences.* 2d ed. Prentice-Hall, 309 pp.

Leik, R. K., and Coauthors, 1981: Community response to natural hazard warnings: Final report. University of Minnesota, Minneapolis, MN, 77 pp.

McQuail, D., 1987: *Mass Communication Theory: An Introduction.* 2d ed. Sage, 352 pp.

Mileti, D. S., 1975: Natural hazard warning systems in the United States. Program on Technology, Environment, and Man, Institute of Behavioral Science, University of Colorado, 97 pp.

——, and J. H. Sorensen, 1990: Communication of emergency public warnings: A social science perspective and state-of-the-art assessment. Oak Ridge National Laboratory, Oak Ridge, TN, 145 pp.

Mogil, H. M., 1980: The weather warning and preparedness programs: The National Weather Service and the mass media. *Disasters* *and the Mass Media: Proc. Committee on Disasters and the Mass Media Workshop,* Washington, DC, National Academy of Sciences, 205–213.

National Weather Service, 1981: *Public Requirements for Weather Information and Attitudes Concerning Weather Service.* MSI Services, 126 pp.

Nucleonics Week, 1981: Georgia power is distributing more than 2,600 radios. 18 June, p. 13.

Sacramento Bee, 1994: Storm warnings to expand. 1 April, A26.

Scanlon, J., 1980: The media and the 1978 Terrace floods; An initial test of a hypothesis. *Disasters and the Mass Media: Proc. Committee on Disasters and the Mass Media Workshop,* Washington, DC, National Academy of Sciences, 254–266.

Severin, W. J., and J. W. Tankard Jr., 1992: *Communication Theories: Origins, Methods, and Uses in the Mass Media.* 3d ed. Longman, 364 pp.

Sorensen, J. H., 1982: Evaluation of the emergency warning system at the Fort St. Vrain nuclear power plant. Oak Ridge National Laboratory, Oak Ridge, TN, 80 pp.

Stemple, G. H., and B. H. Westley, 1989: *Research Methods in Mass Communication.* 2d ed. Prentice-Hall, 418 pp.

Tichenor, P., G. Donohue, and C. Olien, 1970: Mass media flow and differential growth in knowledge. *Public Opinion Quarterly,* **34,** 159–170.

U.S. Bureau of the Census, 1990: 1990 Census of population and housing: Population and housing characteristics for census tracts and block number areas, Memphis. TN-AR-MS MSA, 303–332. U.S. Government Printing Office, Washington, DC.

U.S. Congress, 1993: House of Representatives, Subcommittee on Space, Committee on Science, Space, and Technology, September 14. Testimony of Elbert W. Friday Jr., Assistant Administrator for Weather Services, National Oceanic and Atmospheric Administration. Federal Document Clearing House, Washington, DC.

Washington Insider, 1994: NOAA radio will warn of accidents, weather disasters, Gore announces. 1 April, Bureau of National Affairs.

Weaver, D. H., 1989: Basic statistical tools. *Research Methods in Mass Communication,* G. H. Stempel III and B. H. Westley, Eds., Prentice Hall, 49–89.

Wimmer, R. D., and Dominick, J. R., 1987: *Mass Media Research: An Introduction.* 2d ed. Wadsworth, 514 pp.