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ABSTRACT

The Science Communication Interest Group section of the proceedings contains the following seven papers: "Using Television to Foster Children's Interest in Science" (Marie-Louise Mares and others); "Trends in Newspaper Coverage of Science over Three Decades: A Content Analytic Study" (Marianne G. Pellechia); "Media Framing, Expert Framing and Public Perception of the Population-Environment Connection" (Mike Maher); "Predictors of Channel Exposure and of Topic-Specific Attention to Messages about Risk" (Nandita Dhume and others); "Who's Listening? And to Whom? Worldviews of Biotechnology Executives and Scientists toward Public Relations and Communication" (b j Altschul); "The Life Course of an Environmental Issue: Claims, Frames, and Global Warming" (Craig Trumbo); and "Risk Perception in Community Context: Evaluating the Psychometric Paradigm and Its Relationship to Risk Amplification and Reported Communication Channel Usefulness" (Craig W. Trumbo). (RS)

PROCEEDINGS OF THE ANNUAL MEETING OF THE ASSOCIATION FOR EDUCATION IN JOURNALISM AND MASS COMMUNICATION (78th, Washington, DC, August 9-12, 1995). Science Communications Interest Group.

USING TELEVISION TO FOSTER CHILDREN'S INTEREST IN SCIENCE [1]

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Using television to foster
children's interest in science

In Study 1, we compared techniques for explicating a scientific concept in a children's television program. Subjects rated the program more positively, and learned more, when the scientific content was shown in the context of other material, illustrating that there are scientific aspects to everyday events. In Study 2, we assessed the effects of repeated exposure to the program. The results indicated that exposure to the program was positively correlated with a number of positive attitudes toward science.

Using television to foster children's interest in science

In recent years, the condition of science education in the United States has received considerable criticism. Consider the following findings: The 1992 International Assessment of Educational Progress found that American 13-year-olds rank among the lowest of students in 15 industrialized nations in science, finishing behind countries such as South Korea and Hungary (Allman, 1993). More than 50 percent of high school students abandon science courses as soon as they can -- only 40 percent of high school graduates have taken chemistry, and only 19% have taken physics (Fisher, 1992a).

Where U.S. students overall do badly in science, blacks, Hispanics, and girls tend to do even worse. Moreover, these gaps tend to increase with age. The 1990 Science Report Card of the National Assessment of Educational Progress found that 93 percent of white fourth-graders could understand simple scientific principles compared to 59 percent of black fourth graders. By the 12th grade, 53 percent of the white students could analyze scientific procedures and data; only 12 percent of black students could do the same tasks (cited in Fisher, 1992a).

The anticipated result of these trends is a shortage of American scientists and engineers. Moreover, this shortage is expected to be especially acute among females, blacks, and Hispanics. Walter E. Massey, director of the National Science Foundation wrote

> "of every 4,000 seventh-graders in school today, only six will ultimately receive a Ph.D. science or engineering. Of these six, only one will be a female. By the year 2000, minority students will account for 40 percent of our elementary and secondary school population. Yet 4 percent of undergraduate science and engineering degrees are awarded to minorities." (quoted in Fisher, 1992b).

A number of remedies were suggested in the 1993 report "Benchmarks for Science Literacy" written by the American Association for Advancement of Science. In particular, the report proposed that science curricula should move away from largely useless requirements, such as memorizing all 109 known chemical elements in the periodic table. Instead, teachers should focus on scientific skills and methods such as devising and testing theories, or drawing conclusions from data. For example, the Director of the National Science Teachers Association, Dr Aldridge, argued that a physics lesson on the properties of waves might begin with plucking the strings of a guitar. After observing the strings vibrate, students would slowly begin to apply names to phenomena they were witnessing, such as frequency and amplitude. Only after they fully understood these real life concepts would they move on to applying abstract terms and equations to the phenomena they had experienced (quoted in Allman, 1993).

This paper explores the possibility of using television to achieve some of the goals of science educators. In 1994, a new children's television program was funded, in part, by the National Science Foundation to be produced by Wisconsin Public Television for the children of Wisconsin. One of the aims was to

interest children in science, particularly those children who have traditionally discontinued their science education. A requirement of the funding was that the program be evaluated for its effectiveness in meeting these goals. At the same time, this allowed us to test the basic idea that a more applied approach toward science would attract children.

Get Real is targeted toward children between the ages of seven and ten. It uses a half-hour magazine format, in which the two hosts, a white girl and a black boy aged around ten cover stories about children in Wisconsin. For example, one story was about a boy who trained his own dog-sled team; another was about children who worked on prairie restoration programs. The program incorporates strategies that have previously been found to be effective in educational television, such as use of humor to attract attention (Zillmann, Williams, Bryant, Boynton, & Wolf, 1980; Zillmann & Bryant, 1989) and use of music (Wakshlag, Reitz, & Zillmann, 1982). Similarly, the use of same age peers to act as hosts on the show is based on research indicating that same-age models are more effective in bringing about behavior change and increasing self-efficacy than older models (Schunk, 1987; Schunk, Hanson, & Cox, 1987).

Science is covered in the program by what are known as "popouts" -- some aspect of a seemingly nonscientific story is used to illustrate a scientific principle. To give an example: a story is shown about children who are learning to ski in Northern Wisconsin. After it, the hosts ask "Do you know why we

shiver when we get cold?" The hosts explain the principles involved and conclude by suggesting several experiments that can be done at home. They urge the viewers to ask their teachers about more "cool stuff" on this topic.

The first study reported here was conducted specifically to evaluate the popouts. The second study looked at the effects of repeated exposure to the program on attitudes toward science.

Study I

There were several goals of this study. First, we wanted to assess whether the use of popouts was an effective way to teach science. The extent of learning from the combination of story and popout was compared with learning when the science content was presented without the preceding story. A third condition, in which children saw the story but not the popout, acted as a control.

Second, we wanted to investigate whether calling the popout "science" would affect learning (it was possible that children would stop paying attention when told that "science" was in the next segment). In one condition, the story was followed by a screen with the words "Cool Science Stuff," and then the popout; in another condition, the story was followed by the words "Cool Stuff," and then the popout. Learning was compared in these two conditions.

Third, we wanted to investigate the conditions under which children most enjoyed the science content and the program as a whole. Would the popout enhance enjoyment of the program, or

would children prefer to see the program without any science content? How would the labelling of the popout affect enjoyment?

Methods

Subjects

A total of 79 5th grade children in Madison at Thoreau Elementary School participated in this study (38 girls, and 41 boys). Written parental consent was obtained for each child before they participated in the study.

Design

This study used a between-subjects design with four conditions. In all conditions, the target material came after approximately ten minutes of the Get Real program, and was followed in turn by an additional five minutes of content.

In condition one, children saw the target story, followed by a screen with the words "Cool Science Stuff" followed by the popout. In condition two, children saw the target story, followed by the words "Cool Stuff," followed by the popout. In condition three, children saw the words "Cool Science Stuff" and then saw the popout without the related story. In condition four, children saw the story, but did not see the popout or the title screen. This last condition acted as a control for learning, and as a comparison group to explore the effects of science content on enjoyment.

Procedure

Children were randomly assigned to one of the four viewing

conditions. Children in each condition were assembled in different classrooms. There they met with an experimenter who introduced herself and said that she was interested in knowing how children liked different types of programs. The children were told that they were going to watch some television, and that then they would fill out a questionnaire about their responses. The experimenter then showed the children the stimulus tape which was approximately fifteen minutes long. After it was over, the experimenter handed out a questionnaire to each child and explained that she would read each question out loud. The children were supposed to read along with the experimenter and fill out their answers. After students had completed the questionnaire, the experimenter asked if there were questions about the program, then thanked the children for their help.

Materials

Overall, subjects saw approximately twenty minutes of programming. First they saw the opening credits for the program, then a segment describing a town in Wisconsin (hamburger-eating contests are held there every year) and asking children to identify it. In the first two conditions, subjects then saw the target story about an iceskater, then the title screen, then the popout. In the popout, the female host (Shannon) asked "Did you know that when Stephanie is skating she's floating on water?" The male host responded "Yes, ice is frozen water." Shannon then explained that when we skate, the pressure from the blades melts the water briefly, though it then freezes again. The two

hosts then discussed how the water moves along the blade of the boot, and the differences between a hockey-player's blades and an iceskater's blades. (The title screen did not appear at the end of this segment. In the final segment seen by viewers in this study, the hosts described the town in Wisconsin further, and then named it.

In the third condition where subjects did not see the target story about the iceskater, the first sentence of the popout was altered to delete references to the iceskater story. Instead of saying "Did you know that Stephanie is floating on water" the host said "Did you know that iceskaters float on water?"

In the fourth condition, subjects saw all the same stories as in the first two conditions, but did not see the popout (or popout title screen).

Measures

The first set of questions asked subjects about their academic prowess. Children were asked to indicate how good they thought they were at reading, math, and science, using a four-point scale where 1 was "not very good" and 4 was "very good." They also indicated how much they liked each subject, using a four-point scale where 1 was "not very much" and 4 was "very much."

The second set of questions were designed to measure attitudes toward science. Children were asked to say how much they agreed or disagreed with a series of nine statements about their attitudes toward science (e.g., "Science is boring.") The

children responded using a five-point scale, where 1 was "NO!!" and 5 was "YES!!" Reliability for the scale created by these nine items was .67.

The third set of questions asked about the students' responses to the program. They were asked to indicate how much they enjoyed watching the episode (using a 5-point scale, where 1 was "not at all," and 5 was "I loved it." Next, they reported how much they would like to see other episodes of *Get Real* (using 5-point scales). Subjects who saw the story about the iceskater were asked specifically how much they enjoyed watching it, and those who saw the popout were asked specifically about the popout. Students who saw the popout also indicated how much they would like to learn more about "what happens when we skate on ice." They were also asked whether they understood what the hosts were talking about during the popout. Finally, subjects were asked to indicate how often they had been iceskating before, so we could control for this variable

The final set of questions measured knowledge gain from the popout. The children were asked four short-answer questions about the material presented in the popout. These tested for ability to name the basic concept presented in the story (pressure), ability to explain pressure's effects on ice, as well as knowledge of some of the applied content such as the purpose of differently shaped skating-boot blades.

Results

Learning from the Science Segment

Children's learning from the popout was scored by summing their correct responses to four questions about the content of the popout. Results of a one-way analysis of variance indicated that there were significant differences in knowledge gain [$F(3,77)=14.50$; $p<.001$].

The means in each condition are shown in Table One. A couple of conclusions can be drawn. First, the results show that children who saw the popout had higher scores than those who did not see the popout. Second, they suggest that the combination of story with popout was more effective in teaching children, than showing the popout without the preceding story. Children who saw the story-popout combination labeled "Cool Stuff" learned significantly more than those who only saw the popout. Children who saw the story-popout combination labeled "Cool Science Stuff" scored in between -- slightly less than those in the "Cool Stuff" condition, and slightly more than those in the popout-only condition.

Enjoyment of the Science Segment

Results of a one-way analysis of variance indicated that there were significant differences in ratings of enjoyment of the popout between the three relevant conditions [$F(2,57)=3.43$; $p<.05$].

Table Two shows the means in each condition. The results indicate that enjoyment of the popout was highest when it was

combined with the story and labeled "Cool Stuff." Enjoyment was significantly lower when the popout was shown without the preceding story. As with learning, enjoyment in Condition 1, where the story-popout combination was labeled "Cool Science Stuff" fell in between the other two conditions, and did not differ significantly from either.

Analyses of levels of enjoyment of the main story of the episode (about the female iceskater) showed that there were significant gender differences in enjoyment of this segment of the program: Girls (mean=3.84; sd=1.06); n=38) reported enjoying this segment more than boys (mean=2.98; sd=1.11; n=41). Because of this, it was possible that there would also be gender differences in enjoyment of the popout (which also focused on skating). An analysis of variance was conducted to test for this possibility as well as the possibility of an interaction between condition and gender. There were no indications of gender differences in enjoyment of the popout, or of an interaction.

Enjoyment of the Episode

Results of a one-way analysis of variance indicated that there were significant differences in ratings of enjoyment of the episode between the four conditions [$F(3,78)=4.15$; $p<.01$]. The means in each condition are shown in Table Three. Enjoyment was highest in the condition where the story was combined with the popout labeled as "Cool Stuff." The second highest score was in the story-popout combination labeled "Cool Science Stuff." Scores were lowest in the popout-only condition.

There were no gender differences in enjoyment of the episode, nor was there any indication of an interaction between gender and condition.

Effects on Attitudes Toward Science

We assessed whether seeing the program once would affect children's attitudes towards science. After watching one of the four versions of the program, children were asked to indicate the degree to which they agreed or disagreed with nine statements about science (Attitudes toward Science scale). The results indicated that there were no differences between the four conditions. There were also no significant differences in children's ratings of how good they thought they were at science (p=.28) or how much they liked science classes (p=.82).

Discussion

The results of this study suggest that television programming can be used to teach children science content: Children learned from the popout. Moreover, they learned more when the popout was in the context of a story, than when it was shown by itself.

In addition, far from finding them repellent, children enjoyed the popouts, particularly when they were combined with the story and not labeled as science. Enjoyment of the program as a whole was greater when the scientific content was included than when it was not -- but only when the scientific content was in the context of a story, not by itself.

Study 2

The purpose of the second study was to examine whether there were long-term cumulative effects of exposure to Get Real on children's attitudes toward science. The first study had shown learning from the program as well as interest in seeing scientific content presented in popouts. However, the primary goal of the producers was to affect attitudes toward science rather than simply teaching basic science material. This second study was conducted to see whether repeated exposure to the program would bring about pro-science attitude shifts which were not found with the single exposure of the first study. Following the results of the first study, subsequent episodes of the program moved toward calling the popout "Cool Stuff" rather than "Cool Science Stuff."

Methods

Subjects

Students were recruited from 4th and 5th grade classes in two inner-city schools in Milwaukee. A total of 179 students from 8 classes participated in the project. The schools were chosen for the racial diversity of their student populations. One of the two schools was nearly evenly divided between whites, blacks, and Hispanics. The other school had a majority of blacks and Hispanics. The goal was to achieve equal representation of blacks, whites, and Hispanics in our sample. In fact, the final sample was unequally distributed, with an under-representation of whites: The sample consisted of 79 blacks, 35 whites, and 55

Hispanics.

Design

The experimental part of the study involved a between-groups comparison of students who were repeatedly shown episodes of the program in school with those who did not watch the program at school. Four classes were randomly assigned to view the program every week for seven weeks. The four other classes did not watch it in school, although students in those classes may have watched it at home. All students were interviewed during the eighth week, allowing for comparison of the two groups. In addition, students were given a questionnaire about home viewing patterns, including a measure of how many times they had watched Get Real! The number of episodes viewed was used to predict attitudes toward science.

Procedure

Those classes that were selected to watch the program saw one episode a week. The teachers were told they could show each episode at any time that was convenient for them. They were also instructed merely to show the program without expanding upon the content.

In the eighth week, five researchers visited each class participating in the project. Each class was divided into groups of four or five students, and one researcher worked with each group. The researchers did not mention that the study was about Get Real!. Instead, they explained that they were interested in learning about students' attitudes toward a variety of topics.

The researchers then gave a questionnaire to each student and read the questions out loud as the students followed along and filled in their answers.

The same questionnaire was used regardless of whether students had watched Get Real! in school. Students who had never seen the program (either at school or at home) were instructed to ignore the final set of questions, which asked specifically about reactions to the program.

The order in which various measures were presented in the questionnaire was counterbalanced, except that questions about Get Real were always asked last. In order to avoid confusions, students within each group worked with the same order of questions.

Measures

A variety of measures were used, and have been reported elsewhere (Mares, Cantor, & Steinbach, 1995). Only the relevant measures are described here. Students were asked to indicate how strongly they agreed or disagreed with seven items designed to measure a variety of attitudes toward science, including positive judgments about science, gender-biased attitudes toward science, and interest in science-related activities (such as getting a job working with plants and animals). The four items designed to measure positive attitudes toward science were combined to make a single scale ("Science is fun," "I like science class," "I'd like to study science in high school," and "Science is boring.") The negatively-worded item was reversed. The reliability for this

scale was .69.

A second set of questions asked students to indicate how often they watched a variety of programs at home, including the program of interest (Get Real!). Students' responses could range from 1 ("never") to 4 ("a lot or every time").

A third set of questions asked specifically about Get Real!. The students were asked how many episodes of the program they had seen altogether. They indicated whether they had seen Get Real! at home, at school, at both home and school, or whether they had never seen it.

Results

Episodes Seen and Attitudes toward Science

Children were asked to estimate the total number of episodes of Get Real they had seen (regardless of whether at school or at home). This estimate was then correlated with the scale measuring positive attitudes toward science [$r(173)=.22$; $p<.01$].

There was no significant relationship for "science is hard," or the two items aimed at measuring science-related interests: "I like learning how things work" and "When I grow up, I'd like to get a job where I could work with plants and animals."

The original goal of the study was to be able to observe the effects of the program by comparing children who saw the program in school with those who did not see it. However, as events transpired, many children who did not see the program at school did watch it at home. Although this was encouraging news in one sense, it effectively ruined our attempt at experimental

manipulation. Students who watched Get Real at school had seen an average of 7.5 episodes (some children had also watched at home). Students who were not shown the program in school had seen an average of 5.4 episodes. This makes it very difficult to assess the effects of the program without confounding the effect of selective exposure. However, we can report that those who watched the program in school did not differ significantly from those who watched the program at home, in their ratings of how much they liked science class, how much they intended to study science in high school, and their perceptions that science is fun. Therefore, the positive correlation between exposure and positive attitudes toward science was not caused solely by the self-selecting viewers who chose to watch at home and already had positive attitudes.

Effects of race and gender. Given the concern about girls, blacks, and Hispanics discontinuing science education earlier than other groups, we looked for interactions between the number of episodes seen and ethnic group, and number of episodes seen and gender. There were no significant interactions between race and the number of episodes seen in students' attitudes toward science. There were also no interactions between gender and number of episodes seen on six of the seven measures of attitudes toward science. However, there was an effect of gender on the seventh measure: the statement that science is "mainly for boys."

"Science is Mainly for Boys"

The seventh item asked students to agree or disagree with the statement that "science is mainly for boys." Overall, levels of agreement with this statement were low -- the mean was (1.99) out of a possible 5.0. However, there was a significant effect of gender such that boys gave more positive responses to this statement than girls (boys=2.30; girls=1.57). Responses ranged from one to four. Examination within gender showed that the distribution for girls was unimodal -- 69% of girls gave the lowest possible level of agreement. In contrast, the distribution for boys was bimodal -- 42% gave the lowest possible level, and 31% of boys gave a score of four (out of five). In total, 21% of children in the study gave a score of four to that statement that science is mainly for boys.

There was a significant interaction between gender and the number of episodes seen [F 1,171.=4.32; p<.05]. To investigate this further, correlations between episodes seen and responses on this item were calculated within gender group. Among girls, there was a significant negative correlation between the number of episodes seen and agreement that science is "mainly for boys" [r(75)=-.27; p<.05]. That is, the more episodes girls had seen, the less they agreed that science is mainly for boys. Among boys, there was a nonsignificant, weakly positive relationship between number of episodes seen and agreement [r(98)=.08; p=.41].

Although the above interaction appears to indicate that there was a more positive effect of the program on girls than on

boys, it is important to recognize that the meaning of this interaction is obscured by the fact that some viewers of Get Real were self-selected. As discussed above, it is unclear whether the correlation between viewing Get Real and less stereotypical attitudes among girls reflects a causal impact of the program or pre-existing characteristics of the types of girls who chose to watch Get Real.

There were no significant differences between racial groups in levels of agreement or disagreement with this item, nor was there a significant interaction between race and number of episodes seen.

Discussion

These studies suggest that programming with scientific content can be successfully aimed at children, whether success is measured in terms of children's enjoyment of the program, knowledge gained from the program, or positive attitudes toward science. The first study investigated the conditions under which children learn and enjoy science on television, and found that the key seems to be presenting the scientific content within the context of other material, showing that there are scientific aspects to everyday events. The second study investigated whether there were positive effects of repeated exposure to Get Real! on attitudes toward science. Although the first study had been encouraging in its suggestion that children enjoyed learning about science from Get Real, there was no effect of one-shot exposure on attitudes toward science (and indeed, it would have

been startling if there were.)

The second study provided some indication that repeated exposure was associated with more positive attitudes, although the weakness of the experimental manipulation and the lack of a pretest measure make it difficult to make strong causal claims. It is also worth noting that children who had just seen seven episodes of Get Real! were probably more aware that the socially desirable answer to our questions was to profess a love of science, than those who were not exposed to the program in school. More behavioral measures such as willingness to enroll in extra-curricular science activities would have greatly strengthened the study.

The results of the second study also indicate that there are some children who believe that science is chiefly a boys' topic, and that boys are more likely to believe this than girls. Further work is currently being conducted to examine the possibility raised in the second study, that girls' attitudes are more likely to be changed by counterstereotypical portrayals than boys' attitudes.

Table 1
Effects of Story/Popout Combination on Learning from the Popout

1. Story, Cool Science Stuff, Popout	2.35_b
2. Story, Cool Stuff, Popout	3.11_c
3. Cool Science Stuff, Popout	1.84_a
4. Story (Control)	0.53_a

Scores could range from 1 to 5. Post-hoc comparisons were made using the Scheffe procedure. Means with different subscripts are significantly different using $p<.05$.

Table 2
Effects of Story/Popout Combination on Enjoyment of the Popout

	Enjoyment of the Popout
1. Story, Cool Science Stuff, Popout	2.95_{ab}
2. Story, Cool Stuff, Popout	3.61_{b}
3. Cool Science Stuff, Popout	2.63_{a}

Scores could range from 1 to 5. Post-hoc comparisons were made using the Scheffe procedure. Means with different subscripts are significantly different using $p<.05$.

Table 3
Effects of Story/Popout Combination on Enjoyment of the Episode

	Enjoyment of the Episode
1. Story, Cool Science Stuff, Popout	3.28_{ab}
2. Story, Cool Stuff, Popout	3.94_{b}
3. Cool Science Stuff, Popout	2.84_{a}
4. Story	2.95_{a}

Scores could range from 1 to 5. Post-hoc comparisons were made using the Scheffe procedure. Means with different subscripts are significantly different using $p<.05$.

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Trends in Newspaper Coverage of Science Over Three Decades: A Content Analytic Study

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A content analytic study

Trends in Newspaper Coverage of Science Over Three Decades: A Content Analytic Study

Through the decades, science and scientific research has had a growing impact, both directly and indirectly, on public life. As a result, the general public has shown signs of a growing interest in science and science policy. Nunn (1979) found that newspaper audiences had a high level of interest in science news, particularly among young adults. Miller (1986) also found interest in science high, with 40% of American adults expressing interest in science and science policy. It is of interest to know, then, how scientific information and the results of scientific research have been reported to the general public. This issue is the central concern of this paper. After a brief survey of the relevant literature, a content analysis of science articles in three major daily newspapers over three decades will be described. The results of this study shed light on some of the trends that have occurred in science news reporting through the years.

Today the popular press is paying increased attention to science and technology. There has been a movement among the mass media to serve the public's interest in science, with a growing number of newspapers featuring weekly science sections and/or employing full time science writers to write for their daily editions (Bader, 1990; Scientists Institute for Public Information, 1986) as well as the emergence of 17 television shows, 15 magazines, and 18 newspaper sections devoted to science between the years 1974 and 1984 (Lewenstein, 1987). This mass media and news coverage of science has become increasingly important, as it can influence both the public's knowledge and attitudes about a wide variety of scientific issues. That is, today's science journalists report on an extensive range of subjects, including the latest advancements in medicine, energy, environmental issues, and technological developments. This variety in subject areas should not be surprising when one considers that the field of science has become increasingly diversified through the years.

Many researchers have examined various aspects of science news. While studies have been done on various media forms including magazines (Borman, 1978; Lundberg, 1984; Rich, 1981) and the network news (Moore & Singletary, 1985) most studies have focused on science news reporting in newspapers. Newspapers are an important medium to study for a number of reasons. While a study of young adults conducted by Patterson (1982) found that people learn most of the latest science news through newspaper accounts, more recent research (Howard, Blick, & Quarles 1987; Scientists' Institute for Public Information 1993) has shown that television may be replacing newspapers as the preferred source for science news. Still, when one considers that a national survey of scientists revealed that 76.6% of the respondents who had participated in an interview had done so with newspapers (DiBella, Ferri, & Padderud, 1991), the importance of newspapers as a source of science news cannot be denied. Such aspects of science reporting as accuracy (Pulford, 1976; Ryan, 1975; Tankard & Ryan, 1974; Tichenor, Olien, Harrison, & Donohue, 1970), comprehensiveness (Freimuth, Greenberg, DeWitt, & Romano, 1984; Sullivan, 1985), and sensationalism (Glynn, 1985; Glynn & Tims, 1982) have all been examined as components of newspaper accounts.

Accuracy is the primary concern of scientists, but the technical nature of science reporting may make it more prone to error than news reports about other topics. Studies investigating the accuracy of popularized accounts of science revealed that scientists often consider inaccuracy to be the major problem with science reporting. Tankard and Ryan (1974) found that when evaluated by scientists, only 8.8% of science articles were judged to be error free compared to rates of 40 to 59% for other news stories. However a follow-up study by Pulford (1976), using a shorter checklist of possible errors, found 29.4% of articles were judged to contain no inaccuracies. Tichenor, Olien, Harrison, and Donohue (1970), found that slightly more than 40% of scientists surveyed disagreed with the statement that science news is generally

accurate, whereas Dunwoody and Scott (1982) found 51% of the scientists surveyed criticized science reporting for inaccuracy or distortion. However, while scientists are critical of science reporting in general, the same scientists tend to be more favorable when it comes to evaluating the accuracy of news stories about their own work (Dunwoody & Scott, 1982; Pulford, 1976; Tichenor, Olien, Harrison, & Donohue, 1970).

One potential problem with such studies, however, is that they have focused on accuracy as perceived by the scientists, and are therefore limited by subjectivity. That is, according to McCall (1988) accuracy research that is based on the perceptions of the source is limited by the subjective nature of the task. To overcome this limitation and to investigate the common errors of science reporting, Singer (1990) compared news reports of scientific topics from a variety of media (i.e., newspapers, newsmagazines, and television) to the original research reports appearing in the scientific literature. Out of the 42 articles studied, only 7.1% were found to contain no inaccuracies. Common errors found in the accounts analyzed included omission of qualifying statements (found in 60% of the accounts), a lack of discussion of the methodology followed (48% of the accounts), a "change of emphasis" (45% of the accounts) and an overstatement of the generalizability of the research results (36% of the accounts).

Inaccuracies such as those cited by scientists in accuracy studies and uncovered by Singer (1990) are primarily subjective inaccuracies which Dunwoody (1982) defines as errors in meaning. In contrast to objective inaccuracies, such as incorrect statements or errors of fact, subjective inaccuracies are dependent on an individual's interpretation and thus are not always recognized by all parties. Indeed, numerous studies have shown that when scientists say a study is inaccurate, they are really referring to errors of omission and misemphasis (Dunwoody & Scott, 1982; Pulford, 1976; Tankard & Ryan, 1974; Tichenor, Olien, Harrison, & Donohue, 1970). Of these two subjective errors, the most commonly cited throughout the accuracy studies

is omission of information. Scientists main complaint of journalistic accounts of scientific research is that such accounts are incomplete because they lack relevant and important information (Borman, 1978; Dunwoody, 1982; Pulford, 1976; Rich 1981; Tankard & Ryan, 1974), information needed by the public to make informed judgments. That is, "the requirement of substantial completeness is satisfied if adequate information is published or broadcast to meet the needs of an intelligent nonspecialist who wants to evaluate the situation being reported on" (Klaidman 1990, p. 120). Thus, this can be viewed as more of an issue of the completeness or comprehensiveness of such accounts rather than of accuracy.

One of the most common omissions is the omission of important details of methodology (Dunwoody, 1986; Goldstein, 1986). In the study by Tankard and Ryan (1974), the scientists surveyed ranked "relevant information about the method of study omitted" as the most serious problem of newspaper accounts of science. The more objective findings of Singer (1990) support this view, with 48% of the 42 articles studied having no mention of research methods at all. Furthermore, of the studies that did mention research methods, 15 or 35% gave what was considered inadequate information, while 3 or 7.1% gave erroneous information. Similar results were found in a study comparing science reporting in both the prestige and national tabloid presses (Evans, Krippendorf, Yoon, Posluszny, & Thomas, 1990). Of the newspaper accounts analyzed, only 36.2% of the articles in the New York Times and Philadelphia Inquirer and 19.8% of the tabloid articles contained a "more than minimal" discussion of the research design, leading the authors to conclude "that at neither the prestige nor the national tabloid newspapers is it common practice to include methodological details." Molitor (1994) found that five major national newspapers gave an incomplete description of what turned out to be a highly unrepresentative sample used in an aspirin and heart attack study (reported in the New England

Journal of Medicine), information that was necessary to interpret the generalizability of the study's findings to the general public.

Other common omissions include criticism of the research and theory by other scientists, qualifying statements and/or other information that would limit the findings or conclusions of the research (Dunwoody, 1986; Goldstein, 1986). However, it is important to note that though science journalists increasingly recognize the need to use qualifying or cautionary language in their copy (Burkett, 1986; Gorchow, 1990, Perlman, 1974), and thus may write using such cautionary phrases as "preliminary" or "early results, "many readers do not recognize the implications of these words (Gorchow, 1990).

Another commonly recognized problem with science news reporting is that previous research is often ignored. This omission can lead to misemphasis within science stories and sensationalized accounts of new developments, with research findings presented as discrete events or "breakthroughs" and tentative findings treated as scientific fact (Freimuth, Greenburg, DeWitt, & Romano, 1984; Goodell, 1985; Greenburg, Freimuth, & Bratic, 1979; Molitor, 1994; Trachtman, 1982). Indeed, the scientists in the Tankard & Ryan (1974) study cited "continuity of research with earlier work ignored" as one of the 9 major problems of science reporting. Thus, it has been asserted that science should be treated as "more of a motion picture instead of a snapshot" (Bodde, 1982) as there is as much a need for the general public to understand the internal processes by which scientific knowledge is generated and validated as there is the content of the specific areas of science (Millar & Wynne, 1988). LaFollette (1995) echoes this view, asserting that

> Effective modern citizenship demands a higher level of 'knowing about' science...Acknowledgment that all sciences have histories is part of this type of knowledge. Research knowledge about any one subject at any one time represents an accumulated body

of information, as science continually reconstructs itself. To 'know about' science than is to know about that reconstruction and reconstitution (p.235).

Though opinions are often expressed about the adequacy of various kinds of coverage by facets of the media, this presents a problem when casual observation, rather than careful documentation, becomes a basis for serious suggestions for major changes in the mass media (Stempel, 1981). The issue of the quality of newspaper coverage of science can be looked at in this framework. While scientists' impressions indicate a lack of comprehensiveness in many respects, formal documentation is needed. In addition, differences of opinion exist on whether the rise of the professional science writer or journalist, which began in the 1920s-1930s, has been associated with an improvement in the quality of science reporting (Burkett, 1986; Burnham, 1987). Though it has been suggested that because these journalists are trained in science many may adopt the values of scientists and lose their ability to be critical (Cole, 1975; Nelkin, 1987), others associate the rise of the professional science writer with improvements in the comprehensiveness of science reporting (Burkett, 1986; Perlman, 1974).

Focus of Present Study

According to Elliott and Rosenberg (1987), many models have been utilized to study the communication of scientific information. Some of these approaches, including coorientation, knowledge gap, and agenda setting "have focused on specific media or process effects" of science communication (Elliott & Rosenberg 1987, p. 168). For example, Mazur (1981) found that with increased media coverage of a controversial science and/or technology issue public opinion tended to indicate that people not only were inclined to recognize the controversy but also that there tended to be increased opposition to the technologies in question as well. This then provided support of an agenda setting effect of the media in terms of science news. However theories or models such as agenda setting do not appear to enlighten the issue of

the content of science articles or to make specific predictions about the content and quality of such communications and how these may have changed through time.

We may, however, have some pretheoretic conceptions about newspaper coverage of science and some expectations about how this coverage may have changed through time based on prior research reviewed earlier. Content analysis is useful and valuable in analyzing trends and changes in content over time (Ogles, 1985) and thus it is a useful technique for examining changes in newspaper coverage of science. In this study, content analysis was used to compare and uncover trends in science coverage in three major daily newspapers over the three time periods of 1966-1970, 1976-1980, and 1986-1990. While this study attempts to address a number of issues surrounding science news reporting, the primary focus of this content analysis is on the omission of important and relevant information from journalistic accounts of science. This area was emphasized because many of the discrepancies both cited and observed in science reporting in past studies (Singer 1990; Tankard and Ryan 1974) involve omissions of such critical information as qualifying statements (for example indicating limitations in the research), methodological details, or significant findings. The importance and implications of the omission of such critical information cannot be overlooked. That is, in the words of Singer (1990)

> Whether such omissions and alterations should be regarded as inaccurate reporting depends on how we define accuracy. If readers and viewers are not made aware of [any] contingencies, if mass media accounts do not reflect limitations in the data or research methods used, and if conflicting findings are presented without interpretation or evaluation, then flaws exist in the communication process, whether we call these flaws 'inaccuracies' or not (p. 114)

With this in mind, this study attempted to answer three questions:

1) Has overall coverage of science by newspapers become more frequent and does it cover a broader range of topics? Because public interest in science has increased and the

scientific community has become more diversified, one might expect to find broader and more regular coverage during the latter periods.

2) Have articles become more complete and comprehensive as time has progressed? In this study comprehensiveness concerns the inclusion of pertinent factual information. Since more reporters covering science are professionally trained science writers, it may be expected that more comprehensive articles appear in the latter time frames.

3) Do "methodological citations" (Caudill & Ashdown, 1989) or descriptions of the research design employed, appear more frequently? Are these citations more thorough in articles from particular time frames? As lack of "relevant information about the method of study omitted" was ranked as the most serious problem by the scientists surveyed in the Tankard and Ryan study (1974), this seems to be an especially significant area to analyze. Such statements of methodology would influence opinion about the merits of the study and provide readers with enough information to assess the validity of the research for themselves. It may be expected that such methodological citations appear more frequently in articles in the latter time periods.

The three time periods examined in this study were chosen because they reflect periods marked by a growing interest in science and technology in the general public, as well as an increased effort by the mass media in general and newspapers in particular to meet those interests. It was during the period of the 1960's that an increase in the public interest in science and technology can be readily seen. For example, Swinehart and McLeod (1960, cited in Elliott & Rosenberg, 1987) found increased interest in science and technology following the launch of the first space satellite, Sputnik I, in 1957. This interest continued to grow throughout the 1960's and the so called space race era. The period of the middle to late 1970's then saw the breakthrough of popular science into the media including the development of specialized science sections in a number of major daily newspapers (Lewenstein 1987). This, according to

Lewenstein can be attributed in part to maturation of the World War II baby boom generation which grew up "with Sputnik, the environmental movement, the war on cancer, the Space Program and the energy crisis" and thus had "an explosive hunger for more information on science and technology" (Lewenstein, 1987, p. 30). Finally, the period of the middle to late 1980's still saw a strengthening of weekly science sections in newspapers, with a threefold increase in the number of such sections from 1984-1986 (Lewenstein, 1987).

METHODOLOGY

According to Stempel (1981) and Ogles (1985), analysts should employ coding systems already developed and previously used by other researchers, as some measure of their usefulness will be known and this was the approach used in this study. A coding scheme to answer all three questions was developed using schemes from four previously published studies (Caudill & Ashdown, 1989; Cole, 1975; Evans, Krippendorf, Yoon, Posluszny, & Thomas, 1990; Hinkle & Elliott, 1989) all of which used content analysis to investigate various aspects of science reporting in newspapers.

Coding Scheme

Cole's (1975) definition of science news was used in this study to identify those stories to be analyzed. Using this definition, science news was defined as all news stories that have substantial subject matter concerning the results and interpretation of empirical research in the sciences, applied science or development, technology, engineering, medicine, and public health. Stories provided by staff writers, news services, and wire services were analyzed. Stories by syndicated or local columnists, editorials, or other articles printed on the opinion-editorial page were not considered to be science news.

To further clarify what constitutes scientific research, the scheme of Evans, Krippendorf, Yoon, Posluszny, and Thomas (1990) was applied. Thus, an article was considered to deal primarily with scientific research "if its major focus was on specific findings of a scientific research endeavor." According to this scheme then, while an article may merely cite a scientist, or may incidentally report on the planning of scientific projects, it was not coded as science news unless it discussed specific research findings. As in the Evans, Krippendorf, Yoon, Posluszny, and Thomas (1990) article, only articles that focus on the results of completed scientific studies were analyzed. Stories identified as science news were divided into three categories:

1) Medicine and Health: Stories in this category include news of research in health related areas. Examples of items in this category include research on new drugs, surgical procedures, and diseases, as well as research in health, nutrition and fitness. Articles on psychology were also included if they were the result of scientific research conducted by a researcher affiliated with a hospital or university.

2) Technology: This category included stories that focused on developments in the fields of engineering and applied sciences. Stories falling in this category included news of the space program, computer technology, and superconductor research.

3) Natural and Physical Science: Stories included theoretically oriented stories from the areas of astronomy, physics, chemistry, biology, zoology, marine biology, and environmental science.

Question 1, which focuses on the amount of science coverage in the different time frames and the range of topics covered, was investigated by answering the following questions:

a) Are there differences in the types of science covered by the newspapers during the periods analyzed? Differences were determined by comparing the number of stories falling under each category.

b) Do newspapers in the different time periods differ in the amount of science covered? Differences in amount of coverage were indicated by differences in the number of science stories per issue.

c) Do the newspapers from the different time periods differ in the emphasis they place on science stories? Following the coding scheme of Hinkle and Elliott (1989), "emphasis" was operationally defined as the percentage of science stories as a percentage of all news stories.

To determine this percentage, all news articles in each of the newspaper issues analyzed were counted. To be counted as an article, a news story had to be at least 75 words in length. The following items were not counted as news articles: obituaries, social and business announcements (i.e., engagements, weddings, promotions, etc.), pieces on the opinions and editorial pages, stockmarket listings, calendars of events (or other announcements of such things as meetings, recitals, lectures, etc.) any weekly or otherwise regular column and any reviews.

To answer question 2, concerning the comprehensiveness of accounts, all science news articles contained in the newspapers analyzed were coded for a variety of content. Many of these features have been identified as important for media coverage of science and include

- depth of coverage. This is operationalized as the number of lines and number of words per science story (Hinkle & Elliott, 1989).

- identification of the original forum or source of the research, such as journal article, conference or symposium paper, book, etc. (Evans, Krippendorf, Yoon, Posluszny, & Thomas, 1990);

- identification of the researcher(s) by name (Borman 1978; Lundberg 1984);

- identification of the researcher(s)' institutional affiliation(s) (e.g., university, government, hospital, private firm, etc.);

- frequency of comments from the researcher(s) who conducted the study(ies);

- frequency of comments from other scientists, in support of the findings (Perlman, 1974);

- frequency of comments from scientists with opposing viewpoints (Perlman, 1974);

- contextual factors. According to Evans, Krippendorf, Yoon, Posluszny, and Thomas (1990) these include comments that place the research in context with prior research, as well as comments regarding the limitations or generalizability of the research findings.

According to a 1986 survey by the Scientists' Institute for Public Information, while the New York Times was the only newspaper that had a weekly science section in 1978, by 1986 66 daily newspapers had added weekly science sections, and more than 80 started shorter science pages (Scientists' Institute for Public Information, 1986). The introduction of such sections has been found to affect newspaper science coverage, by increasing both the number of science stories and length of such stories elsewhere in the newspaper as well (Bader, 1990). Therefore, individual articles were also coded for the following:

- news source of article (i.e., wire, staff writer, etc.)

- appearance in weekly science section or in other section.

Question 3 investigates differences in the appearance of methodological citation, or a statement of the research design, used in the study being discussed. Therefore the unit of analysis was "statement of methodology." Using the scheme developed by Caudill and Ashdown (1989), statements of methodology were analyzed by counting the number of words used to explain the research method. As operationalized by those authors, an explanation of less than 30 words or less was considered brief, and thus inadequate. In addition, methodological

citations were also be coded for the manner in which the statement characterizes the research, for example "method specific" (referring to a specific research methodology such as experiment, survey, etc.) or method nonspecific (for example phrases such as "study," "research," or "report").

Sampling

Three major daily newspapers, The New York Times, The Chicago Tribune, and The Washington Post were analyzed in this study. These newspapers were chosen because they are widely distributed on a national level. A constructed week for each of the three time periods being examined was generated using a computer program written in MicroSoft Quick Basic. In addition to this constructed week, a random Tuesday from each of the time periods was also generated using the same program. This was done to increase the number of science news articles to be analyzed, as Tuesday is the day that science sections appear in many newspapers. Thus, a one-week plus one day period for each of the three time periods was analyzed for each of the three newspapers. This resulted in a sample of 72 newspapers and 107 individual articles to be coded.

Coding

Each newspaper edition in the drawn sample was coded by a primary coder. Furthermore, a randomly selected subset representing ten percent of the newspaper editions and of the science articles was coded by a trained coder to determine intercoder reliability.

RESULTS

Research Question One: Amount and Range of Coverage

The results show that although science makes up a small percentage of articles in each period, there was an increase in emphasis on science issues in the later decades. As can be seen in Table 1, the percentage of science articles increased the later the time period. That is, in

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Insert Table 1 about here

1966-70, science articles made up 0.42% of the week's articles. This increased to 1.42% in 1976-1980, and finally 2.04 % in 1986-1990.

To determine if there are differences in the types of stories covered during the different periods, categories of science articles were analyzed (Table 2). In terms of the diversity of

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Insert Table 2 about here

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coverage, there was little difference in the range of topics covered in each of the three periods. Rather, coverage was very similar in each of the time frames studied, with an emphasis on medical and health related issues. More than 70% of the articles in each period were classified as dealing with medicine and health (72.22% in 1966-70, 75.76% in 1976-80 and 71.43% in 1986-90). Articles on natural and physical science were the next most frequent article type, accounting for 16.67% of the articles in 1966-70, 24.24% of those in 1976-80, and 25% of the

articles from 1986-90. Articles dealing with technological issues and developments were the least frequent in all three time periods (making up 11.11% of the articles in 1966-70, versus 0% of those in 1976-80 and 3.57% of those in 1986-90). There was no significant difference between the three time periods in terms of the of the subject matter covered in the articles analyzed ($\chi 2$ [4, N=107] = 4.42, $p > .05$). Scott's pi for the measure of story type was 0.80.

Considering the growing diversity of the scientific community, such similarity in coverage across the three time periods is contrary to what might be expected. Rather, based on these results, science reporting over the decades has not reflected this increased diversification. However, the emphasis on medicine and health issues should not be surprising, considering that biomedical issues have been a dominant theme in the newspaper coverage of science (Meadows, 1986). These findings then, are in agreement with those of Hinkle and Elliott (1989) who found an emphasis on medicine and health related issues in their analysis of three newspapers and three tabloids.

Research Question Two: Comprehensiveness of Science Articles

Articles were coded for a variety of content that reflect the comprehensiveness of the coverage. These measures reflect content that has been identified in past research as necessary features of a complete, comprehensive, and accurate journalistic account of science. Table 3 contains the information on these various article measures for each of the three time periods.

Insert Table 3 about here

To get an indication of the depth of coverage, articles in each time frame were coded for both the number of lines and the number of words contained in the story. Articles in each of the three time periods contained a similar number of lines per article. In 1966-70, the average number of lines per article was 108.83, versus 100.58 lines in 1976-80 and 117.70 lines in 1986-90. A one-way ANOVA revealed no significant difference among these means ($F [2, 104] = 0.38$, $p > .05$). However, the number of words in articles increased the later the time period. In 1966-70, the mean number of words was 487.09. This increased to 561.75 words per article in 1976-80 and 607.50 words in 1986-90. Though the number of words increased, a one-way ANOVA revealed no significant difference among these means ($F [2, 104] = 0.49$, $p > .05$). The percentage agreement for number of lines per article was 99% and for words per article was 98%.

Articles were additionally coded for a variety of other variables. These variables reflect what have been referred to by Evans, Krippendorf, Yoon, Posluszny, and Thomas (1990) as "minimal details" that should be included in science news accounts. In terms of identification of the original research source (i.e., a journal article, conference presentation, etc.), there was no significant difference among the three time periods for inclusion of such information ($\chi 2 [2, N=107] = 1.28$, $p > .05$). That is, in all three time periods, the percentages of articles that identified the research source were similar (72.22% in 1966-70, 60.60% in 1976-80, and 69.64% in 1986-90). Scott's pi for this measure was 0.80.

In another measure of comprehensiveness of reporting, articles were coded for whether the researchers who conducted the study were clearly identified in the article by name (Scott's $pi = 1.00$). There was a significant difference among the three time periods in the tendency to include this information ($\chi 2 [2, N=107] = 7.41$, $p < .05$) For the period of 1966-70, 94.44% of the articles identified the researcher(s) whereas in 1976-80 only 72.73% of the articles

included this information. This percentage rose to 89.29% during 1986-90. Scientists have cited the omission of researchers' names as a relatively common characteristic of print coverage of scientific research (Borman, 1978; Tankard & Ryan, 1974). Indeed, Evans, Krippendorf, Yoon, Posluszny, and Thomas (1990) found that only 70.3% of articles from the New York Times and Philadelphia Inquirer analyzed identified any researchers by name. While the majority of articles in this study tended to include this information, there was a decline in this practice during the period of 1976-80 in the articles analyzed.

Additionally, chi square yielded a significant ($\chi 2$ [2, N = 107] = 29.41, $p < .05$) difference between the time periods for identification of the researcher(s)' institutional affiliation (Scott's pi = 0.80). In the period of 1966-70, 100% of the articles contained such information, compared to only 69.70% of the articles in the period 1976-80. In 1986-90, 94.64% of the articles contained this information. Once again there was a decline in the percentage of articles including this information during the period of 1976-1980, and a subsequent rise during 1986-90. The reasons behind such a pattern of results remain unclear.

Articles were also coded for the presence of comments made by the researcher(s) who conducted the study. A one-way ANOVA yielded no significant difference in the number of comments from the researchers contained in the article (F [2, 104] = 0.58, $p > .05$). The mean numbers of researcher(s)' comments in articles from 1966-70 were 4.11, compared to a mean of 3.73 for those articles in 1976-80 and 4.05 for those in 1986-90. Percentage agreement for this measure was 80%.

In addition to comments of the researchers, it has been asserted that one of the ways science writers can exercise "clinical judgment" in the stories they cover is to include comments from other scientists who are unconnected to the reported research (Perlman, 1974). Thus, any complete and comprehensive journalistic account of science should also contain comments from

other scientists who support the research findings, as well as from those who are critical of the findings. Such unfavorable comments are especially important, since they act as disclaimers and thus can often serve to qualify the findings. In light of this then, articles were coded for the presence of both favorable and unfavorable comments from other scientists, in regard to the research. A one-way ANOVA revealed no significant difference between the number of favorable comments from other scientists included in articles from the three time periods ($F [2,104] = 1.29, p > .05$). However, in terms of including comments from scientists critical of the research being discussed, there was a significant difference ($F [2, 104] = 3.62, p > .05$) between the time frames. That is, in 1966-70, the mean number of comments was 0, versus 0.15 comments in 1976-80 and 0.71 comments in 1986-90. Thus, in terms of including such important "qualifying" comments, coverage has improved over the three decades. Percentage agreement for these two measures was 67%[1] and 86% respectively.

One important characteristic of scholarly science writing is that research results are reported in terms of whether they are in accordance with or deviate from, previous findings. In addition, suggestions for future research endeavors are often proposed, based on the obtained results. One consequence of such an approach is that scientific inquiry is acknowledged to be an ongoing process where results are continually scrutinized and validated, rather than one where isolated findings immediately become "facts." Because it has been asserted that the tendency in the media to treat tentative findings as "breakthroughs" results in sensationalized accounts of new developments, the inclusion of such contextual information becomes a critical feature of science news articles.

Among the articles in the three time periods, there was no significant difference in the tendency to include such contextual information (Scott's pi =0.80). Of the articles analyzed, 55.55% of those from 1966-70, 51.52% of those from 1976-80, and 44.64% of those from

1986-90 had any mention of prior and/or future research studies ($\chi 2$ [2, N = 107]) = 0.44, $p > .05$). Additionally, there was no significant difference among the articles in the three time periods in terms of including comments regarding the limitations or generalizability of the research findings ($\chi 2$ [2, N = 107] = 0.81, $p > .05$). In the period of 1966-70, 38.89% of the articles contained such comments, compared with 48.48% of those articles from 1976-80 and 41.07% of the articles in 1986-90. Thus in all three time frames, less than 50% of the articles analyzed contained any statements that express any limitations to the research being reported and the generalizability of the results to the public. Scott's pi for this measure was also 0.80.

The importance of such information cannot be underestimated, as it is the omission of this kind of information that may lead to the misemphasis and sensationalism in science stories so often complained of, as well as to a misunderstanding of any implications the results may have for the general public (Freimuth, Greenberg, DeWitt, & Romano, 1984; Greenberg, Freimuth, & Bratic, 1979; Molitor, 1994; Trachtman, 1982). However, these results suggest that this important feature of science stories, has failed to become more prominent during the last three decades, at least in the three newspapers analyzed.

Research Question Three: The Presence of Methodological Citations

A one-way ANOVA was performed to determine if differences exist in the adequacy of methodological citations, as a function of the number of words employed, appearing in science news articles.. Results indicate that there is no significant difference among the articles in the three time periods in the number of words utilized in such methodological descriptions (F [2, 104] = 0.86, $p > 0.05$). The mean was 30.50 words for those articles from 1966-70, compared to 19.09 words for articles from 1976-80 and 22.25 words for those articles from 1986-90. It is interesting to note that only the mean from the earliest time period analyzed meets the 30 word operationalization employed as an "adequate" description (Caudill & Ashdown, 1989). The

means from the two later periods fell well below this standard. Percentage agreement for the number of words in the methodological descriptions was 97%.[2]

Furthermore, there was no significant difference ($\chi 2$ [2, N=107] =2.00, $p > 0.05$) among articles in the three time periods in terms of including such "adequate" research descriptions. Of the articles analyzed, only 44.44% of those from 1966-70 contained descriptions of 30 or more words, compared with 33.33% of those in 1976-80 and 26.79% in 1986-90.

Methodological descriptions were also coded to see if method specific terms (i.e., experiment, survey, etc.) or method-non-specific terms (i.e., study, research, report, etc.) were used to characterize the research endeavor. There was no significant difference ($\chi 2$ (4, N=107) =7.63, $p > 0.05$) among the articles from three time periods in their utilization of such terms. That is, the majority of articles in all three time frames characterized research designs primarily using method nonspecific terms instead of method specific terms (50% versus 38.89% for 1966-70; 75.75% versus 18.18% for 1976-80; 75.00% versus 12.50% for 1986-90). Scott's pi for this measure was 0.80.

DISCUSSION

Overall, the results show that, at least in the three major daily newspapers analyzed, newspaper coverage of science over the last three decades does not differ substantially in terms of the range of topics covered, as well as information that has been both included and omitted from science news accounts. Although science articles represent only a small percentage of the total number of articles in the newspaper, this percentage has steadily increased with each time period.. This increased coverage by newspapers might be in response to, as well as reflect, the public's growing interest in science (Miller, 1986; Nunn, 1979). In terms of the diversity of

coverage, however, there was little difference in the range of topics covered in each of the three periods. Rather, the range of topics covered was very similar in each of the time frames studied, with a large percentage (i.e., 72-75%) of the articles covering medicine and health related issues. Natural and physical science accounted for 17-25% of articles in each of the time frames. Technology was clearly the least covered category, in all three time periods.

In terms of the comprehensiveness of science articles appearing in the three newspapers analyzed, it appears that coverage in general has not become more rigorous with the passage of time. While a number of variables were coded for in this study, it seems especially significant that two features recognized as crucial to any complete journalistic account of science, that is contextual factors and methodological details, are still frequently omitted.

The fact that there is no significant difference between articles in the three time periods in terms of the inclusion of these two types of vital information can be viewed as problematic. Indeed, Burnham (1987) has argued that the mass media tends towards a "bits-and-pieces" approach to popularizing science, presenting uncontextualized facts and paying little attention to the process of scientific research. This apparently has not changed significantly over the three time periods analyzed, as these results suggest that newspapers still tend to report primarily on the findings of scientific research without mention of relevant contextual factors. This may be cause for concern considering it has been asserted that a "contextual approach to science communication has never seemed more important for developing public support for and intelligent use of science" (LaFollette, 1995 p. 236).

It is also noteworthy that in over three decades of coverage, at least in the three newspapers analyzed, there has been little change in the inclusion of methodological details. This seems especially significant when one considers that a survey of scientists conducted over twenty years ago (Tankard & Ryan, 1974) listed the omission of information about the research

method as the most serious problem with newspaper accounts of science. Based on the results of this study, this problem has not been remedied.

According to Evans, Krippendorf, Yoon, Posluszny, and Thomas (1990), the image of science presented in the press is one of a "disembodied enterprise," with accounts containing very little discussion of research procedures, reported findings rarely linked to other findings, and limitations of those findings rarely noted. This study suggests that this has been the case during the last three decades of science news reporting. While there has been a movement among newspapers to include science and health related information as part of regular news coverage, it is surprising to see so little change in the way science has been and continues to be reported.

Obviously it is hard to generalize about trends in all newspaper coverage of science based on this limited sample of articles from only three newspapers. And while admittedly it is difficult to assert with definite certainty that the trends uncovered in this study can be generalized to coverage in all newspapers, the results do suggest that while there has been an increase in the amount of science coverage, there has not been a concomitant improvement in the completeness and comprehensiveness of this coverage.

It would be interesting if additional analysis on an expanded sample of newspapers and articles uncover the same results as this study. Additionally, research into the effects of specific article features on readers may have important implications for journalistic coverage of science. That is, while many studies stress the importance of including such pertinent information as discussions of methodology and qualifying statements, few have looked at how the inclusion of such components affect individuals' understanding of the information and issues involved, as well as their perceptions of the scientific process. Research into science news may need to not only analyze the content of these journalistic accounts but also look at the potential effects of

these features on readers' in order to uncover what makes a truly accurate, complete, and effective science news story.

CONCLUSION

News coverage of science has become increasingly important, as it can influence both the public's knowledge and attitudes towards science. There is no question that science continues to make local and national headlines, with newspapers carrying reports on the latest developments in medical research, to news on the environment, to the latest in computer technology. While the public has shown a growing interest in science and science policy (Miller, 1986; Nunn, 1979), many individuals lack a functional knowledge of these issues. Indeed Miller (1986) asserts that any measures that can be taken to raise the level of scientific literacy and to foster informed and intelligent participation in science policy issues "will improve the quality of both our science and technology and our political life" (Miller, 1986). It is here, then, that the press could play an important role. That is, according to Nelkin (1987a)

> The press should provide the information and the understanding that is necessary if people are to think critically about decisions affecting their lives. For most people the reality of science is what they read in the press...Good reporting can be expected to enhance the public's ability to evaluate science policy issues and the individual's ability to make rational choices; poor reporting is cause for alarm (p. 2-3).

However, it has been asserted that the tendency to deliver scientific research as "important snippets of news" (Burnham, 1987), omitting many important details in these accounts, results in both a trivialization and misunderstanding of specific research results, as well as science in general. While it remains to be seen if this is actually the case, it appears that,

at least over the last three decades in these three major daily newspapers, science news reporting has not taken the necessary steps to improve the comprehensiveness of these accounts.

Notes

1) Work is currently underway to improve the percentage agreement on this measure.

2) Percentage agreement was calculated for the overall subsample. However, if you examine each article separately, percentage agreement for this measure is considerably lower on average (only 45%). Work is currently being done to improve the reliability of this measure.

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Table 1

Total number of news articles, science articles, and percentage of science articles

Time Period	Total articles/issue	Total science articles	Percentage of science articles as % of all articles
1966-1970	3478	18	0.42
1976-1980	2709	33	1.22
1986-90	2741	56	2.04

Table 2

Categorization of science articles

Category	1966-1970	1976-1980	1986-1990
Medicine & Health	72.22%	75.76%	71.43%
Technology	11.11%	0	3.57%
Natural/Physical Science	16.67%	24.24%	25.00%

Table 3

Comprehensiveness measures for individual science article

Comprehensiveness Measure	1966-1970	1976-1980	1986-1990
Mean lines/story	108.83	100.58	117.70
Mean words/story	487.09	561.75	607.50
% identifying source of research	72.22	60.60	69.64
% identifying researcher(s) by name*	94.44	72.73	89.29
% identifying researcher(s)' institutional affiliation*	100	69.70	94.64
Mean comments from researcher	4.11	3.73	4.05
Mean comments from other scientists (favorable)	0.16	0.36	0.64
Mean comments from other scientists (critical)*	0	0.15	0.71
% articles citing prior research	55.55	51.52	44.64
% articles citing limitations in research	38.89	48.48	41.07

*$p < 0.05$

Table 4

Methodological citation measures

Measure	1966-1970	1976-1980	1986-1990
Mean words in description of method	30.50	19.09	22.25
% articles having "adequate" (i.e. >30 words) description	38.89	33.33	25.00
% articles using method non-specific terms to describe research	50.00	72.73	76.79
% articles using method specific terms to describe research	38.89	15.15	12.50

Media Framing, Expert Framing and Public Perception of the Population-Environment Connection

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Media Framing, Expert Framing and Public Perception of the Population-Environment Connection

Abstract

Media framing may keep Americans from connecting population growth to the problems it causes. Both environmentalists and development economists agree that population growth precipitates environmental change, but media coverage seldom acknowledges this. This paper analyzes how a newspaper framed causality across 23 weeks' coverage of an environmental issue. Then it measures public opinion of causality. Both media coverage and public opinion emphasize proximate causes like developers and polluters, and neglect population growth.

Media Framing, Expert Framing and Public Perception of the Population-Environment Connection

Introduction

As an environmental issue, population growth has had boom and bust times, all the way back to Malthus (Teitelbaum and Winter, 1993; Ness, 1993). But concern about population remains a central tenet of modern environmentalism. A number of recent books have drafted agendas for a sustainable environmental future, and population stability is almost invariably mentioned. Examples include the Brundtland Commission report, *Our Common Future* (1987), which is widely regarded as the first planetary blueprint for a sustainable future. In their book, *Environmental Policy in the 1990s*, Vig and Kraft (1990) included among their goals for the future a stable world population. Raven, Berg and Johnson's (1993) textbook, *Environment*, listed population stability as the first of its 10 agenda items for the environment. In *Earth in the Balance*, the current Vice President of the United States, Al Gore, noted of his agenda for the environmental future, "The first strategic goal should be the stabilizing of world population..." (p. 305). Many other environmental writers, expert commissions and scientific organizations have urged a stable population; some will be discussed later.

Environmentalists who were concerned about the population-environment connection felt their time had come in the late 1980s. Having been swept under the carpet during the Reagan years, environmental issues made a strong comeback through national media coverage of global deforestation, thinning of the ozone shield, global climate change, polluted beaches, hazardous waste, garbage, and endangered species.

In recognition of the world's deepening environmental problems, in January 1989 *Time* magazine substituted a "Planet of the Year" for its annual Man of the Year cover story. The issue

described the earth's leading environmental problems, and population growth was among them.

Environmental writers were delighted about the *Time* coverage. For example, Raymond Fosberg, botanist emeritus at the Smithsonian Institution, exulted in the journal *Environmental Conservation:*

> This was, in my opinion, the most complete, effective, hard-hitting, statement of the fix we are in, globally, that has ever been written....Now at last we are talking to the unconverted—millions of them. They have no longer any excuse to be apathetic. They have every reason to be afraid, indeed downright scared! There it is, laid out as it is coming—the appalling effect of too many and too profligate people....The miracle has happened! At last the truth has surfaced and been given, with no punches pulled, to millions of those who should hear it and act! (1989, p. 353)

Fosberg seemed to feel that, following the *Time* coverage, the scales would soon fall from humanity's eyes and people would begin to take bold steps to conserve the environment, steps that included halting population growth.

Fosberg was one of many writers who felt that finally environmentalism had achieved a head of steam, a momentum of public support. Finally, it seemed, Americans were willing to address fundamental environmental problems like population growth, rather than dabbling with incremental command-and-control regulation of polluters, as they had done in the previous 20 years. One of these environmental optimists, Rosenbaum, claimed that the United States entered "its second environmental era" in the late 1980s, an era characterized by "a sharp mood shift, a more expansive sense of scale and causality, a new vocabulary bespeaking an altered agenda, and a pervasive somberness quite unlike the style of the nation's first environmental era" (1991, p. 4).

Caldwell (1990) also claimed that Americans had just entered a new era of public consciousness, in which "the true nature of the environmental question, and its interrelationship with almost every major area of international politics—food, energy, trade, population, and defense—is beginning to be understood" (p. 305).

Nicholas Polunin, who edited the journal *Environmental Conservation*, felt that people were finally becoming concerned about population growth: "I would cite the growing realization at last that there are coming to be *far too many human beings on our limited Planet Earth*..." (1989, p. 193; Polunin's italics).

Dunlap and Mertig (1992) noted that the environmental movement had been galvanized and invigorated in its opposition to the Reagan administration's anti-environment initiatives. And according to Mann (1991):

> Clearly, nations have come to agree on a wide spectrum of environmental issues, and the prospects are positive for the future. The conditions that make such agreements possible are both general—scientific knowledge, increasing public awareness and the activities of environmental groups—and specific—the characteristics of the problem, the organizations involved and perceptions of the various parties involved. (pp. 321-322)

These and many other optimistic predictions (see also Corner and Schlesinger, 1991; Paehlke, 1990; Vig and Kraft, 1990) flourished during the late 1980s and early 1990s. Environmentalists felt that finally their issues were on the agenda, and finally the public understood environmental causality and was prepared to take bold action to ensure a sustainable environmental future.

Then in 1992 three prestigious scientific bodies issued strong statements urging sweeping changes to ensure a stable environmental future. The National Academy of Sciences and the British Royal Society warned world leaders that if nothing were done to brake population growth, "science and technology may not be able to prevent either irreversible degradation of the environment or continued poverty for much of the world" (Royal Society and National Academy of Sciences, 1992, p. 375).

Later that year, the Union of Concerned Scientists, a group of more than 1,500 scientists (including 99 Nobel laureates) signed a "Warning to Humanity" telling *Homo sapiens* that it must take quick and decisive measures to stabilize population and halt many forms of environmental destruction (Detjen, 1992).

Another even stronger statement on population had come earlier from the Club of Earth, a subset of the U.S. National Academy of Sciences and the American Academy of Arts and Sciences: "Arresting global population growth should be second in importance only to avoiding nuclear war on humanity's agenda" (Ehrlich and Ehrlich, 1990, p. 18).

Scientists are ignored; optimists erred

But by now it seems clear that the environmental optimists were wrong, and the urgent

warnings of the world's leading scientists have been ignored. Despite Mann's prediction that nations would agree on a broad spectrum of environmental issues, in 1992 the Vatican and other pronatalist forces were able to keep population off the agenda at the United Nations Conference on Environment and Development, the largest environmental summit in history. Contradicting Rosenbaum's prediction that Americans had achieved a new sense of scale and causality, and thwarting Caldwell's claim that Americans understood the true interrelationship between environment and population, and deflating Polunin's prediction that there was a growing concern about overpopulation, a Gallup Poll (Newport and Saad, 1992) revealed that Americans were in fact *less* concerned about the U.S. population in 1992 than they had been during the 1960s and 1970s! This poll showed that the percentage of Americans who perceive population growth to be a problem diminished, rather than increased, from 1971 to 1992.

The 1992 Gallup poll also showed that Americans' awareness of population growth as a problem had diminished. According to Newport and Saad (1992), a 1963 Gallup poll (taken five years before Ehrlich's *The Population Bomb*) showed that 68 percent of Americans were aware of "the great increase in population which is predicted for the world during the next few decades?" (p. 36). But by the 1992 poll, Americans' awareness level of worldwide population growth had diminished to 51 percent. Further, the number of Americans who felt that population growth within the U.S. was a major problem had diminished from 41 percent in 1971 to 29 percent in 1992. Less than half of the Americans polled by Gallup in 1992 felt that population would be a problem by the year 2000. And only half of the sample felt the United States should help other nations slow their birthrates.

Another survey from an earlier era done by Simon (1971) showed that American concern about domestic population was higher a generation ago than it is now. In that study 66 percent of a sample of Illinois residents felt that the U.S. population was growing too fast, and 67 percent said that world population was growing too fast. This complements the Gallup findings.

In another recent national poll of 2,080 Americans, respondents ranked rapid population growth sixth out of seven environmental issues, behind toxic waste, water pollution, loss of rain forests, air quality, and overconsumption of resources, but ahead of global warming/ozone depletion. Surveyors measured this ranking with the following question: "Thinking specifically about *global environmental* issues, please tell me how serious a problem you think each of the following is. Use the 1 to 10 scale again where one means something is not a problem at all, and 10 means

it is a very serious problem" (Pew, 1994, questions 19-25, italics in the report). When asked whether population growth is "likely to *improve* the quality of life for you and your family, *worsen* it, or have no impact on your quality of life? Is that very much or somewhat?" Some 52 percent of respondents felt population growth would worsen the quality of their lives, while 44 percent said it would have no impact or improve their lives, and 4 percent didn't know (Pew, 1994, question 44, italics in the report). This is a lukewarm indicator at best, and consistent with the 1992 Gallup poll finding that about half of Americans favor action on curbing population growth.

In addition to survey data, recent political reality has also shown that Americans are not concerned about population, despite the hopeful predictions of many environmental writers. Three years after the National Academy of Science urged dramatic steps be taken to curb world population, and less than a year after the third International Conference on Population and Development urged dramatic increases in funding to promote world population stability, Congress is considering cuts, rather than increases, to U.S. support of family planning programs. Very few of the other basic changes urged by science groups and predicted by environmental optimists have since come to pass. In 1993, for example, the Clinton administration's BTU tax, which would have created economic incentives to conserve energy resources, was soundly thrashed by Congress. And the same 1995 Congress that will likely cut family planning funds will also gut provisions of the Endangered Species Act.

How could so many experts have been wrong in their optimism about Americans' environmental resolve? And how can strongly worded statements by prestigious science groups have so little effect on public opinion and policy? Since many authorities consider population growth one of the prime movers of environmental degradation, how could Americans' concern about population be waning (as comparative Gallup polls show), when population-driven issues like global climate change and deforestation and water shortages and endangered species commanded so many headlines?

To add to these paradoxes, a 1991 Gallup poll (Hueber) showed that 78 percent of Americans consider themselves environmentalists! In fact, 71 percent of Americans surveyed in this poll favored protecting the environment, "even at the risk of curbing economic growth" (p. 6). How can Americans consider themselves environmentalists, yet remain so unconcerned about population, a core issue of environmentalism?

Not making the connection

A possible answer to these conundrums is that Americans aren't making the connection between population growth and environmental degradation. They are concerned about the *effects* of population growth (and therefore consider themselves environmentalists), but they are not linking those effects to one of their basic causes: growing human numbers. Indeed, the percent of Americans who said population growth will *not* become a problem in America almost *doubled* from the 1971 to the 1992 Gallup polls. In 1991, 13 percent of those surveyed felt that population growth would not be a problem in the future, while in 1992, 24 percent said they did not expect population growth to become a problem (Newport and Saad, 1992).

Americans' knowledge of environmental causes and solutions has never been stellar. An early study of environmental concern (Murch 1971) showed that the public was deeply troubled about environmental problems, but had "no clear idea of what the solution might be" (p. 106). More recently, a nationwide series focus groups on population growth suggested in 1993 that Americans are making little connection between expanding human population and diminishing nature. The study, conducted by three research firms for the Pew Global Stewardship program, sought to determine attitudes on population among 10 different voting groups: environmentalists, persons active in international affairs, mainstream Protestants, Jewish groups, Catholic Anglos, Catholic Hispanics, fundamentalist Christians, Republican women, African Americans, and young people. Researchers used 18 focus groups conducted in 10 cities across the U.S. Each group had 10 to 12 participants, who were asked open-ended questions.

One segment of this study addressed "the salience of the key issues of population, environment and consumption: How important are they?" (Pew, 1993, pp. 19-28). The researchers found that only the environmentalists and internationalists were concerned about population. "Other constituency groups in our discussions found little salience among population issues," the summary report noted. "The issue of population is not invisible but most often it is a weak blip on the radar screens for most of the voting groups—with the exception of the committed environmentalists and internationalists" (p. 22).

Focus groups are ideal for getting beneath the surface of public opinion, for finding our why people think what they think. And most tellingly, when the Pew-sponsored focus groups were evaluated on whether participants could connect population growth with environmental degradation, environmentalists and some of the internationalists and Jewish men's groups could make

the connection, "but overall *most of the others do not make many direct, unaided connections between population and environment*," the 1993 Pew report stated (p. 26, italics in the original report).

The Pew-sponsored focus group study strongly suggests why Americans can consider themselves environmentalists, yet remain unconcerned about population: Americans don't associate population growth with the problems it causes. But the Pew study falls short of suggesting *why* Americans cannot connect environmental problems to population growth. And because focus groups do not represent a probability sample, the Pew study lacks generalizability.

But qualitative research has traditionally pointed out interesting problems and variables for quantitative approaches. This study examines public opinion of environmental causality by using a probability sample, and it also seeks to link public opinion about environmental causality to media framing. Methodologically it combines framing analysis of newspaper coverage with a follow-up telephone survey. The test case for this study is a classic environmental problem: the Barton Creek development controversy in Austin, Texas.

The Austin environment

Austin is an ideal site for such a study, blessed as it is with a bounty of population-driven environmental problems. During the 1980s, Austin was the fastest-growing city in Texas (Jones, 1993), growing 45.6 percent—from 345,000 to roughly 500,000. Austin accelerated that population growth even faster in the 1990s. As a result, subdivision demand jumped 204 percent between 1990 and 1993 (Breyer, 1993a). Austin's economic growth during the three years preceding this study was the highest in the nation (Tyson, 1993). Between November 1992 and November 1993, the Austin area added 13,600 jobs (Breyer, 1993b).

A growing *affluent* population like Austin's drives the process of environmental change even more rapidly—because these growing numbers can afford to consume more land per capita by purchasing large subdivision lots. In the path of Austin's sprawl are more endangered species than exist near any other major city in the United States (Kay, 1993). One source (Kay, 1993) listed nine endangered species—two songbirds and seven invertebrates. Another (Haurwitz, 1993a) said that 44 endangered or rare songbirds, salamanders, shrubs, wildflowers and invertebrates live in vicinity of Austin.

Also directly in the path of Austin's development is the Barton Creek watershed. Barton Creek drains 354 square miles southwest of Austin (Haurwitz, 1994). The creek flows directly into the Barton Springs Pool, a dammed-off old-fashioned swimming hole near the city center, less than two miles from the Texas Capitol. The three-acre pool is fed not only by the creek, but also by springs that generate more than 32 million gallons of water a day. The 68-degree water has cooled area residents long before the Europeans came (Acker, 1994).

The Barton Springs Salamander, whose sole habitat is the springs and the swimming pool, has been proposed for the endangered species list (Haurwitz, 1994). Austinites vigilantly guard the environmental quality of Barton Creek and the Barton Springs Pool. Proposed development in the Barton Creek watershed has been a major source of conflict, since it threatens this water quality with pesticide and fertilizer runoff from lawns and golf courses, chemical runoff from roadways, and accidental spills of hazardous chemicals from trucks.

Much of the continuing coverage of Barton Creek concerned negotiations between developers, environmentalists, and the Austin City Council over the extent of planned development in the Barton Creek watershed. One of the chief developers, Freeport-McMoran (through its subsidiary FM Properties), had proposed to build 5,100 residences and up to 5 million square feet of commercial development on 4,000 acres of its property southwest of Austin, within the Barton Creek watershed. Environmentalists sought to minimize that development, despite the developer's offer to set aside or sell thousands of its acres for park land and green belts in exchange for development rights. Negotiations collapsed in November 1993, after voters turned down a $48.9 million bond issue to purchase tracts of land for wildlife habitat (Todd, 1993). Previous bond issues for $22 million and $20 million had passed by wide margins in 1992, however (Haurwitz, 1993b). Barton Creek was so well-covered a controversy that it became the top Austin issue of 1993, according to a year-end review by the *Austin American-Statesman* (Phillips, 1993).

Transfer of framing

A basic agenda-setting approach would compare media content with public opinion, and would likely confirm that media salience made Barton Creek the most important problem in Austin, as revealed by a survey. But the basic agenda-setting hypothesis is no longer in doubt: More than 200 agenda-setting studies have shown how and why the media succeed in telling us

what to think about (Rogers, Dearing, and Bregman, 1993). Agenda-setting scholars have recently suggested that the media also tell us how to think about issues (McCombs, 1992; McCombs and Evatt, in press). That is, media messages may be capable of alerting the public not only to the most important issues of the day, but also to different attributes of those issues.

Studying agenda-setting beyond the issue level heeds Kosicki's apt criticism (1993) that traditional agenda-setting research often conceptualizes issues as homogeneous and devoid of controversy. Benton and Frazier (1976) extended agenda-setting into the realm of causes and solutions, but few subsequent studies have followed this model. One recent study by Takeshita and Mikami (in press) deals with "subissue salience" of attributes of the Japanese general election of 1993. They acknowledge only a handful of studies have explored agenda-setting beyond the general issue level.

Essentially this study seeks to determine whether media framing of environmental causality diverges from expert framing, and whether public opinion tracks media framing or expert framing.

Framing Theory

Quite a few scholars have begun to use the term *framing* in discussing media effects, and indeed, the term has escaped into the general parlance of the media-savvy.

Bateson (1972) and Goffman (1974) were the first to use *frame* as a construct for how the individual organizes experience. Bateson noted that psychological frames organize and explain their contents, much as a picture frame does. Frames also imply premises for inclusion and exclusion. Goffman added the concept of the "strip," the slice of everyday experience that individuals organize by using frames.

Tuchman (1978) popularized framing in media analysis, porting over some of Goffman's ideas and terms into the realm of how meaning is created by the media, rather than interpreted by the individual. Her work was expanded by Gitlin (1980), who applied the concept of framing throughout *The Whole World is Watching*, to explain how the SDS was marginalized by media coverage during the 1960s and '70s.

Williams, Shapiro and Cutbirth (1983) linked framing with agenda setting. They found that stories having an overt political frame had a much stronger media-to-audience agenda-setting effect than did stories without a political frame.

Another frequently cited work on framing is Gamson and Modigliani's (1989) study of how the media framed nuclear power. They employed the term "media package" to describe seven ideal types of media discourse about nuclear power, and traced the history of those packages over time. Their approach has important implications for public opinion research, in that they showed that such research often ignores the issue culture from which public opinion emerges. Pan and Kosicki (1993) offered a constructionist approach to framing similar to that of Gamson and Modigliani, but they suggested that framing be measured differently. They took a "micro" approach in their study, analyzing a single article across four structural elements: syntactic, script, thematic, and rhetorical.

Several recent scholarly articles affirm one of the chief premises of this study, that causal attribution is a main function of news framing. Iyengar's recent studies (1989, 1991) dealt directly with news framing and public perception of causality. He showed that news framing will affect whether people perceive certain social problems (e.g., poverty, terrorism) as the responsibility of society, or of the individual poor people or terrorists. The public's attribution of causes leads to their perception of what should be done to cure social problems. Also noting the relation of framing to causes and solutions Entman (1993) noted:

> Frames, then, *define problems*—determine what a causal agent is doing with what costs and benefits, usually measured in terms of common cultural values; *diagnose causes*—identify the forces creating the problem; *make moral judgments*—evaluate causal agents and their effects; and *suggest remedies*—offer and justify treatments for the problem and predict their likely effects. (p. 52, italics Entman's)

Pan and Kosicki (1993) arrived at a similar conclusion in their summary of framing:

> Within the realm of news discourse, causal reasoning is often present, including causal attributions of the roots of a problem as well as appealing to higher level principles in framing an issue and in weighing various policy options. (p. 64)

In framing environmental stories, journalists can include any of a number of causes. But to evaluate journalistic framing, we should first examine expert framing.

How experts frame causality in environmental problems

In laying out baselevel causality for environmental problems, Ward and Dubos (1972), Ehrlich and Ehrlich (1990), Commoner (1990) and Harrison (1992) argued that environmental

damage results from three primary determinants: population, consumption level (sometimes expressed as economic level or affluence) and technology (or resources).

With specific reference to habitat loss, Sears (1956), Jackson (1981), Myers (1992), Ehrlich & Ehrlich (1990), Harrison (1992) and many others showed that population growth pushes people into the natural world. Endangered species problems are frequently the flip side of this coin: when people convert wildlife habitat to their own habitat, they bulldoze trees, introduce chemicals, channelize streams, build dams, alter the water table, and disrupt habitat in numerous other ways.

While it is well known that environmentalists and expert commissions connect environmental degradation to population growth, it is less well known that *land developers* are equally straightforward in implicating population growth as a causal agent for turning wildlife habitat and farmland into subdivisions. The how-to manuals for real estate development are very straightforward about the critical role of population growth:

> The two primary determinants of the need for home and commercial construction are population growth and the demolition and retirement of existing facilities....Growth in population creates a need not only for housing but also for supporting real estate facilities such as shopping centers, service stations, medical clinics, schools, office buildings, and so on. (Goodkin, 1974, p. 14)

> The main idea to keep in mind as you search for rewarding corporate realty investments is that in general, land prices are the resultants of population. As more people come on a given section of land, whether to build homes, to work in stores, office buildings, factories, financial institutions, or supermarkets, they create a demand for living space, land and structures. This demand, except during a recession, seems likely to expand indefinitely. (Cobleigh, 1971, p. 10)

> Demand for real estate at the national level is influenced by national population growth and demographic change, coupled with expanding employment opportunities and rising per capita incomes. (McMahan, 1976, p. 76)

Naturally, they frame the results with different language: What developers might call "conversion of raw land to happy communities" could be the same phenomenon that environ-

mentalists would call "loss of critical wildlife habitat." But basically, experts from both environmentalism and from development economics agree that population growth is a chief force driving the process of land conversion. Land conversion, in turn, is frequently the chief cause of species decline and urban sprawl. Expert framing of a habitat-loss or urban sprawl problem, therefore, would acknowledge the causal role of population growth.

Hypotheses

In contrast to expert framing, media framing of environmental problems usually ignores population growth, and instead emphasizes personal agents—often land developers—in explaining the causality of environmental degradation. Using a national sample of Lexis-Nexis stories about population-driven environmental problems, Maher (1994) showed that roughly 90 percent of news stories omitted population growth from the story frame as a cause, and only one story in 150 suggested population stability might be a solution. This pattern of media framing, and the proven agenda-setting power of the media, leads this research to two hypotheses:

H_1: Media framing of environmental causality will diverge from expert framing by emphasizing developers and other proximate causes, and by ignoring the causal role of population growth.

H_2: Public opinion about environmental causality will track media framing rather than with expert framing.

In operational terms, framing analysis of the *Austin American-Statesman* coverage of the Barton Creek issue is expected to reveal that developers and other causes are mentioned much more frequently than population growth. To test H_2, a survey of Austinites is expected to yield many more mentions of developers than of population growth, when Austinites are asked about causality of the Barton Springs controversy.

If newspaper framing and public perception both ignore population growth, this would show that public opinion tracks newspaper framing rather than expert framing. It would also suggest why Americans remain unconcerned about population—the source of many of their environmental problems—while they worry about the problems population growth causes.

Method

To test the hypotheses, this study combines framing analysis with survey research. Framing analysis seeks patterns in newspaper depictions of causality: what agents were included in the

story frame in news coverage of the problems at Barton Creek? Of the possible factors, which ones received the most news coverage during the study period? Was population growth—by expert agreement an ultimate cause of the problem—included in the story frame? How frequently?

Public perception was measured through respondents' answers to an open-ended survey question about causality of the Barton Creek problems.

Framing analysis. The *Austin-American Statesman* was examined for the 23 weeks preceding and including the survey period (October 1, 1993, through March 12, 1994). Articles were downloaded from a keyword-addressable database containing all *American-Statesman* stories. The keywords "Barton Creek" and "Barton Springs" yielded 82 articles within the study period. This average of 3.6 articles per week indicates the high salience that the Barton Creek controversy held during this period.

Framing was measured by determining whether a given causal agent was included the story, or was omitted. Coders examined each story for the presence of four causal factors: developers (or development), polluters (or pollution), growth (in the sense of physical urban expansion or construction, without mention of people), and population growth. Any story could mention all causal agents, or none at all. This framing analysis did not categorize a given story as "pro-development" or "anti-polluter." It simply sought to measure the frequency of mention of different causal agents for all coverage during the study period. Because coders were measuring discrete variables—the presence or absence of a causal factor—coder reliability was 94 percent, using Holsti's formula. Results are presented in Table 2 (page 17) in the left column.

Survey. A team of journalism students from the University of Texas surveyed by telephone a probability sample of Austinites during the first two weeks of March 1994. The survey population was roughly 500,000. Surveyors used Austin-area telephone owners as the sampling frame, and sought to reach male or female heads of household on an alternating-call basis. To reach unlisted numbers, researchers measured a randomly chosen distance down from the top of each page of the Austin telephone book, then used the numbers listed across the four columns as a starting point. To include unlisted numbers in the sampling frame, surveyors added a "1" to these listings, as described by Keir, McCombs, and Shaw (1991). Such a method changes a telephone listing like 474-6589 into 474-6590. This technique captured unlisted phone numbers, but it also produced lots of calls to business numbers (including 154 FAX machines!) and

nonworking numbers. The completion rate was 44 percent (431 completions, 971 net total numbers called). Of the 56 percent not completed, half were refusals, half were calls to subjects who were not at home.

Survey Demographics. The obtained sample, 431 responses, matches fairly well with Austin demographics (as supplied by the Chamber of Commerce, based on census data). Demographic differences are summarized in Table 1, below.

Table 1. Survey Demographics vs. Census Data

	Survey	Austin Census
Education		
Some high school	3.6	16.6
High school grad/some college	48.2	48.7
College grad/advanced degree	48.2	34.6
Age		
18-24	15.8	20
25-34	28.4	29
35-44	25.4	22
45-54	15.2	11
55-64	5.6	8
65-above	9.6	10
Race		
White	77.8	67.9
Black	6.3	8.9
Hispanic	10.3	20.5
Asian	2.3	2.7

The overall survey sought answers to a broad spectrum of questions: national and state issues, respondents' media use patterns, income, and demographic information. Since respondents told surveyors what media they used, this study established with certainty that the respondents were indeed exposed to the *Austin American-Statesman* coverage—a refinement frequently missing in agenda-setting studies. Responses from those whose primary newspaper was the *Wall Street Journal*, *Dallas Morning News*, or some other paper, or no paper, were not considered for this study. The survey obtained 251 responses from those whose primary newspaper was the *American-Statesman*.

To get at Austin residents' opinions of what was precipitating the Barton Creek controversy, surveyors first asked subjects if they were familiar with the issue. Those who said they

Table 2. Media Framing vs. Public Opinion of Causality in the Barton Creek Environmental Controversy

Cause	Media Framing*	Public Opinion of Causality**
Developers	89.2	56.1
Polluters	57.3	16.3
Growth	53.7	9.3
Population Growth	2.4	7.6
Other	—	11.1***

*Percentage of stories from a 23-week sample (Oct. 1, 1993, to March 12, 1994) that included this cause in the story frame. Many stories include multiple mentions of causal factors, so the percentages do not total to 100. Number of stories=82.

**Percentage of responses to an open-ended survey question that mentioned this cause, among those respondents who named a cause. These numbers eliminate "don't know" answers, denial of any problem, and neutral summary of news coverage. Such answers were 31.2% of the original survey answers. The question was: "What do you think are the *underlying* causes of the environmental problems at Barton Creek?" Respondents were *Austin American-Statesman* readers who expressed some familiarity with the Barton Creek controversy in a preceding filter question.

***Two answers in this category were public attitude (7%) and government (4.1%). Numbers in this column have been rounded and do not total to 100%.

were very familiar or somewhat familiar were then asked: "What do you think are the underlying causes of the environmental problems at Barton Creek?" Responses were later analyzed and grouped by major clusters of mentioned causes, presented in Table 2, above, right column.

Results

Both hypotheses were confirmed. As H_1 predicted, *Austin American-Statesman* framing of environmental causality in the Barton Creek controversy almost completely ignores the causal role of population growth. Its coverage instead directs readers' attention to developers and polluters. Only two stories (2.4 percent of the sample) mentioned population growth, and they did so merely in passing. They did not overtly connect population growth to environmental degradation in Barton Creek, nor did they suggest that population stability might be a possible solution to the problem.

As H_2 predicted, public opinion of causality tracked *American-Statesman* framing rather than expert framing. When asked about underlying causes of the Barton Creek controversy, Austinites gave the causes most frequently mentioned in *American-Statesman* coverage: developers and polluters. Population was seldom mentioned in newspaper coverage (2.4 percent of the

stories sampled), and it was seldom mentioned by newspaper readers (7.6 percent of responses that named a cause). In fact, Table 2 shows a perfect rank-order correlation between newspaper framing and public opinion, a correlation based on percentages that reflect frequency of mention. This correlation suggests that frequency of media mention may indeed set what McCombs and Evatt (in press) call the "agenda of attributes." That is to say, the more a causal agent is included in media story frames about a given issue across time, the more the public perceives that agent to be the chief cause of the problem.

Discussion

The Austin, Texas, population is growing at a rate that one real estate authority described in the *American-Statesman* as "phenomenal" (Jones, 1993), and this population growth inevitably gives developers phenomenal economic incentive to convert nature into subdivisions. But Austinites don't see it that way. They are concerned about the effects of population growth: the Barton Creek controversy was the number one community issue in 1993, and media coverage of the issue remained strong in 1994. Yet only a small percentage of surveyed Austinites were able to connect the major issue of their community to the population growth that precipitated it. Instead they blamed the developers who build homes for Austin's thousands of new residents. Indeed, in October 1993 a full front-page mug shot of one particularly demonized developer was offered by the *Austin Chronicle*, a weekly arts and entertainment tabloid, as a clip-out Halloween mask.

The surveyed population does not lack education. As the Austin Chamber of Commerce *Community Profile* put it, "Austin is the most highly educated community in U.S. cities with a population of over 250K." Further, as Table 1 shows, the survey sample was even more educated than Austin's base population.

The Austin example suggests an answer to the conundrum posed earlier: Why were so many environmental experts wrong in predicting that Americans had achieved a new threshold of environmental awareness in the late 1980s? It seems plausible that environmentalists confused media coverage and public concern about the *effects* of environmental degradation with media coverage and public concern about the *causes* of environmental degradation. Certainly in the late 1980s environmental problems received considerable media attention—just as Barton Creek received considerable media attention in 1993. But the *Austin American-Statesman*'s avoidance of population is entirely typical of the nation's newspaper framing of environmental

problems (see Maher, 1994). It seems likely that this pattern of framing, extrapolated across thousands of communities, would serve to keep Americans from connecting population growth to the problems it causes. Because news framing seldom includes basic causes like population growth, public opinion of causality may be influenced news framing, which keeps population low in importance to Americans, while its effects receive both media coverage and public concern.

Of course, the data reported in this study cannot establish with certainty the direction of flow of influence between media framing and public understanding. But the correlation between media framing and public opinion, when juxtaposed against expert framing and public opinion, strongly suggests that the media are much more successful than scientists in telling the public how to think about causes and solutions in environmental issues.

Even if we assume the reverse flow of influence, that the media are merely framing the issues to reflect societal values, the results of this study suggest that Americans and their newspapers are not connecting population growth to the problems it causes.

One might object that high consumption, and not population growth, is the chief cause of environmental problems in the U.S., hence Americans need not be concerned with their growing numbers. This paper does not argue that population growth is the *sole* cause of land development and disruption of wildlife habitat. Americans are indeed consuming more land per capita than they did before the interstate highway system and other engineering feats facilitated urban sprawl.

But at any per-capita consumption level, growth in capitas inevitably multiplies environmental impact. And while the U.S. population is not growing at Kenya's rate, by 2050 there will be 346,000,000 Americans at current fertility and immigration rates (Bouvier, 1991). Further, the environmental experts and land-development authorities cited earlier agree that population growth is a basic determinant for converting wildlife habitat into human habitat.

Thus population growth is a considerable factor in causing many environmental issues that trouble Americans. Yet it remains off the agenda for most Americans.

Conclusion

Environmentalists who optimistically predicted new perceptual thresholds and an expanded sense of scale and causality may have projected their own knowledge of causality onto the American populace. Anyone with environmental training can connect population growth

to water shortages or deforestation or endangered species problems. But the vast majority of Americans have no such training. As this study suggests, Americans take their cues about causality from the news framing, not from the experts.

Further, environmentalists like Fosberg seem to believe that a single media message, like the *Time* magazine Planet of the Year cover story, can immediately set the agenda for sweeping environmental reform. Environmentalists failed to consider that for every media story that implicates population growth as the source of problems, there are dozens that do not. For every urgent appeal from a prestigious science group to brake population growth, there are thousands of stories across the nation that make no connections between local environmental problems and population. This is bound to affect Americans' collective concern about the salience of population, and the indifference of Austinites to the population-environment connection is likely very typical.

Limitations and further study

This study extends and complements two previous studies. The first, a 1993 series of focus groups conducted for the Pew Global Stewardship program, showed that most Americans could not make the connection between environmental degradation and population growth. The Pew study did not use a probability sample, however, thus it lacks generalizability. This study did use a probability sample, and shows that even a well-educated populace like that of Austin, Texas, does not connect population growth to the major community issue of the day. In the second antecedent study, Maher (1994) showed that about 90 percent of a national sample of news stories about urban sprawl, endangered species and water shortages ignored the causal role of population growth. This paper examines a single issue in a single community longitudinally, and shows that news coverage similarly ignores population growth. Further, it connects news framing with public opinion of environmental causality.

Like all communication research, this paper has inherent soft spots. It can be argued that an open-ended survey question like that used in this study does not plumb deep enough into the public psyche, that a survey merely gleans top-of-the-head answers. Such a criticism has been leveled at agenda-setting research in general, since many agenda-setting studies use the "MIP question," which asks respondents to name the most important problem of the day. But the Pew focus groups utilized deep and probing questions about environmental causality, and found the same result: Americans don't connect population with environmental issues.

This paper suggests a causal connection between news framing and public understanding of causality, but further research is needed to establish causality. An experiment with doctored news clippings could establish the flow of influence between media framing and public understanding. Another problem suggested by this research is what media scholar Doris Graber has called "the etiology of content": why do journalists choose some frames and ignore others? Why do journalists ignore population growth when they frame a local urban sprawl or endangered species problem? A series of interviews with a national sample of reporters could establish their reasoning for ignoring population growth as a causal factor.

In his book, *Ecology and the Politics of Scarcity*, William Ophuls noted, "The ecological crisis is in large part a perceptual crisis: ordinary human beings simply do not see that they are part of a delicate web of life that their own actions are destroying, yet any viable solution will require them to see this." Recent surveys indicate that Americans' perceptions about environmental causality have not improved since Ophuls made that observation almost 20 years ago. This paper suggests that news coverage may contribute to Americans' perceptual myopia, with regard to the population-environment connection.

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Predictors of Channel Exposure and of Topic-Specific Attention to Messages about Risk

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Predictors of Channel Exposure and of Topic-Specific Attention to Messages about Risk

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Abstract

Risk communicators need to make more sophisticated choices of channels in which to provide messages. In order to do so, it is imperative to understand the factors that lead to channel selection by individuals at risk. Researchers argue that judgments of channel cost and message relevance both should influence channel preference.

This was tested by surveying Wisconsin anglers (N=333) regarding their use of information channels particularly in the context of risks posed by eating sport-caught fish. This study tests channel cost, channel utility, as well as two dimensions of risk judgment and issue salience as predictors of channel exposure and attention to risk messages within those channels.

As hypothesized, channel utility and one dimension of issue salience (level of worry) predicted to attention. Other findings suggest that type of channel, type of risk, and the relationship between dimensions of issue salience play an important role in predicting channel use.

Predictors of Channel Exposure and of Topic-specific Attention to Messages about Risk

Risk communication scholars, among others, often examine information channel as an independent variable in an attempt to understand the effects, if any, that channel selection may have on receivers. This study looks at a prior stage in the communication process, examining possible predictors of channel use. Unlike the vast majority of risk communication studies, here channel use will be treated as a dependent variable.

The purpose of the former type of study (where channel use is an independent variable) typically is to determine the degree to which channel use is a predictor of behavior change, particularly risk-taking behavior. Information campaigners, risk communicators, and other scientists interested in modifying or predicting behavior are often interested in the effects of factors such as the amount of exposure to channels of information and the amount of attention paid to information within such channels.

Such research is sender-oriented and focuses on the communication process <u>after</u> an individual has encountered a message. For example, channel use has been studied not only as a predictor of risk-taking behavior (Gantz et al., 1990) and of beliefs about science and technology (Elliott & Rosenberg, 1987) but of political

behavior (Feldman & Kawakami, 1991) and of levels of knowledge (Culbertson & Stempel, 1986).

These studies operate from the perspective of the communicator. Their assumption is that channel use will have some sort of impact on the behavior of individuals. Risk scholars employing this approach are attempting to assess the extent to which particular channels of information will change or moderate risk-taking behavior. Little or no effort is spent on discovering the channels that individuals are predisposed to selecting.

The process of communication, however, is not unidirectional, from sender to receiver. Rather, individuals may choose from a variety of media channels to suit different situations. Uses and gratifications research (Katz et al., 1974) for example, conceives of individuals as actively using channels of communication to satisfy the needs of their current social situations. Factors that are associated with channel selection and use need to be explored in order to better explain and predict communication processes.

Some risk communication scholars (for example, Krimsky & Plough, 1988) suggest that, rather than embedding messages in predetermined channels, it would be more profitable to first determine what channels best suit the information needs of individuals. These researchers subscribe to the belief that individuals are

rational beings who will use channels that meet their needs. Factors that predict to those channel selections, thus, need to be determined to fully explore the communication process.

This paper examines variables that could potentially impact channel use, our dependent variable. The study first makes a distinction between exposure to a channel and attention to specific content within a channel as two distinct measures of channel use. Then, patterns in channel exposure and the amount of attention paid to particular types of stories by Wisconsin anglers are studied within the context of information about the health risks associated with eating sport-caught fish.

Channel use: Exposure vs. Attention

Communicators commonly select exposure to a channel as the primary measure of channel use (for example, Gerbner et al., 1984). However, other researchers have found that attention to specific types of information in a channel rather than mere channel exposure is a much stronger predictor of channel effects (for example, McLeod & McDonald, 1985). Chaffee & Schleuder (1986), for example, found that attention to media news in specific channels was a significant predictor of knowledge about public affairs and politics even after controlling for channel exposure.

Such work suggests that exposure over time to any single channel is not a sufficient measure of channel use if one is interested in information effects with respect to a particular issue or content area. Rather, attention to particular content within channels should be a stronger measure of channel use. This study will explore factors that are associated with both channel exposure and levels of attention to specific content within specific channels.

Predictors of Channel Use

Individuals select channels based on a combination of factors. Some of these factors may be receiver-oriented, others may be related to the issue or topic of interest, and still others may be related to perceived channel characteristics.

Receiver attributes: Many researchers have sought audience attributes that influence channel selection. Typical of such work is a study of senior citizens by Goodman (1992) which found that education, age, income, and living arrangements were associated with exposure to channels. Other audience attributes uncovered by researchers include social and psychological factors such as cosmopolitan lifestyles and need for activation (Donohew et al., 1987).

We will employ a variety of individual characteristics in this study but will use them primarily as control variables in our regression equations. Our focus will be on variables discussed in the next two categories.

Perceived issue/topic attributes: Message characteristics such as issue salience are likely to have an impact on channel use. Issue salience in the context of risk can be characterized as the extent to which an individual finds a risk personally relevant in the sense that it poses a hazard to him or herself. That is, the greater the individual's assessment of a risk, the more attention he or she should pay to risk-related messages. Here, it is important to note the distinction between individuals' personal (or perceived) judgment of risk and the calculated statistical probability of that risk taking place.

For the purposes of this study the term "personal risk judgment" denotes an individuals assessment of his or her level of risk. Whether or not this assessment is accurate (in keeping with scientific risk estimates) is not discussed in this paper as accuracy does not have a bearing on our research questions that is, we do not hypothesize that accurate risk judgments will impact channel use.

Further, the concept of risk judgment includes not only individuals' evaluations of their personal

likelihood of coming to harm but the additional dimension of worry generated by the hazard. Dunwoody and Neuwirth (1991) have characterized risk judgment in terms of these two conceptually distinct dimensions -- cognition and affect. The cognitive dimension is the individual's perception of his or her likelihood of facing adverse consequences of a risk action (for example, the likelihood of getting sick from eating contaminated fish). The affective dimension deals with the level of worry generated by the risk.

It is likely that these dimensions tap into the concept of issue salience; that is, the higher one rates one's own chances of getting sick and/or the more worried one is about getting sick personally, the more one should consider the issue of fish contamination (in this case) to be important. The impact of issue salience on channel use will be examined in this study via measures of cognitive and affective risk judgments.

Perceived channel attributes: Rubin (1993) argues that apart from social and psychological factors, attitudes about a medium or channel and its content, as well as media orientations, play a role in channel use. Individuals' attitudes about channels can be studied in a number of ways. Johnson & Meischke (1992), for example, asked a sample of women to evaluate channels from which they had received cancer-related information in terms of three channel dimensions: editorial tone

(credibility), communication potential (presentation and style), and utility. Similarly, Marin and Marin (1990) analyzed the perceived credibility of channels and of sources of AIDS information within a sample of Hispanics.

Sitkin et al. (1992) have offered a model that is based on how individuals in organizations select channels. They find associations between perceptions of what they call data-carrying capacity (the degree to which a channel is able to efficiently convey task-relevant data), symbol carrying capacity (the degree to which a channel is able to transfer symbolic meaning), and media use.

Chaffee (1986) has pointed to two concepts that he thinks are important predictors of channel exposure. It is these two concepts that will be central to our analysis. According to Chaffee, the "sources one consults for information ... are determined mainly by (a) their accessibility and (b) the likelihood that they will contain the information one might be seeking" (p. 64).

Chaffee characterizes channel accessibility in terms of both the frequency with which a source attempts to communicate with a receiver and the physical and psychological ease with which the receiver can use the channel. Since we are studying receivers here, not sources, accessibility for the purposes of selective

exposure will be measured in terms of the latter characteristics in this study. This means that perceived channel accessibility or channel access cost is determined by perceived cost: time, and energy -- in other words, the effort an individual feels that he or she must expend in order to use that particular channel.

The second factor that Chaffee articulates is perceived channel relevance or utility, which refers to the perceived likelihood that a channel will contain information that is useful. This study defines channel utility not only by the amount of information available through a channel but the perceived accuracy of that information.

Although Chaffee proposed these two predictors of channel use more than a decade ago, little research has attempted to explore their actual relationship to channel choices. In a recent convention paper, Neuwirth and Dunwoody (1994) tested the argument by asking a sample of young adults about their use of information channels to learn about the risk of AIDS. They found that cost of channel access was a significant predictor of channel exposure, while respondents' estimates of the utility of AIDS information in particular channels served as a predictor of topic-specific exposure. Thus, although both concepts did indeed predict to channel use, they each predicted to a different dimension of such use.

Hypotheses and Research Questions

This paper examines the extent to which channel accessibility (cost) and channel utility (relevance) will predict to channel exposure and to attention to a specific type of message within those channels. Neuwirth and Dunwoody's (1994) work suggests that measures of utility and relevance may predict to different dimensions of channel use, specifically that cost may be more closely related to exposure but that judgments of relevance, in contrast, may be more closely related to attention measures. We test these notions in the following two hypotheses:

Hypothesis 1: Higher levels of perceived channel cost will be associated with lower levels of channel exposure.

Hypothesis 2: Higher levels of perceived channel utility will be associated with higher levels of attention.

Issue salience, on the other hand, should be entirely a predictor of attention rather than exposure. We, thus, hypothesize:

Hypothesis 3: Higher levels of personal risk likelihood will be associated with higher levels of topic-specific attention.

Hypothesis 4: Higher levels of personal worry will be associated with higher levels of topic-specific attention.

Finally, since cognitive and affective dimensions of risk judgment have been shown to be conceptually distinct (Dunwoody, Dhume, Bro and Kanarek, 1995; Dunwoody & Neuwirth, 1991), we ask the following research question:

Which dimension of issue salience (personal risk likelihood or personal worry) is a better predictor of topic-specific attention?

Hypotheses were examined for four channels of communication -- newspapers, television, radio, and fishing magazines -- using data collected from a sample of Wisconsin anglers. Independent variables included not only the four central concepts of channel cost, channel utility, personal risk likelihood, and personal worry but also demographic features such as individuals' age, gender, level of education, income, and race.

The Risk of Eating Sport-Caught Fish in Wisconsin

Contamination of sport fish in the Great Lakes and other bodies of water in Wisconsin presents health threats that are sometimes difficult to measure. Nonetheless, scientists are convinced that the threats are real, and states in the Great Lakes basin (Illinois,

Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin) since the early 1970s have issued annual consumption advisories that recommend fish to avoid as well as ways to prepare fish for eating that minimize exposure to chemicals. Wisconsin tests sport fish for polychlorinated biphenyls (PCBs), DDT, toxaphene, chlordane, dieldrin, mercury and dioxin.

Among that cocktail of chemicals, PCBs and mercury have been singled out for the greatest attention by state agencies. According to the state's advisory (Health Guide, April 1994), PCBs have been linked to developmental and growth problems in infants born to women who regularly eat contaminated fish, and long-term consumption is also suspected of causing cancer. The chemical, long used by industry and now buried in the sediments of the Great Lakes, works its way up the food chain and accumulates in the fat of fish. Bigger fish bring with them potentially higher contaminant loads.

Mercury is more of a problem in inland lakes and waterways. Naturally present in many water bodies and introduced by industrial emissions to air and surface water in others, it is stored throughout the body of a fish, particularly in muscle tissue. Mercury is toxic and ingesting large amounts can harm the central nervous system and may affect body movement and senses of touch, taste and sight. Unlike PCBs, mercury can be excreted from the system. But fish excrete mercury at a very slow

rate, so the highest levels of the contaminant are still found in large, old fish.

Methods

The sample in this study is comprised of anglers in the state of Wisconsin. Through the systematic random sampling of fishing licenses from seven Wisconsin counties, 786 names and addresses of anglers were collected. These anglers were sent a mail questionnaire. Ultimately, 198 were returned by the post office as undeliverable. Of the remaining 588 anglers, an initial and two follow up mailings elicited a total of 333 responses, a response rate of 57%.

Dependent variables: The eight dependent variables in this study were both exposure and attention to each of the following channels: (a) newspapers; (b) television news; (c) radio news; (d) fishing magazines.

Channel exposure was measured by evaluating responses to the question "Over the past seven days, how many days did you read a newspaper (television/ radio)?" This was immediately followed by the attention question: "If you were to encounter a story about fish contamination in your newspaper, how much attention would you pay to it?" Responses to this latter question ranged from a lot of attention (scored 3) to no attention (0).

Exposure to fishing magazines was determined by counting the number of responses to the question "Do you or someone in your household subscribe to or regularly read any fishing publications (e.g. In Fisherman, Woods and Waters)? If yes, please list them." Topic-specific attention to fishing magazines was measured in the same way as it was for the other three channels; that is, respondents were asked to indicate the degree of their attention to potential articles regarding fish contamination.

The mean, median, and standard deviation for these dependent variables can be found in Table 1.

Independent variables: The primary independent variables for this study were channel cost, channel utility, cognitive risk judgment, and affective risk judgment. These were measured as follows.

1. Channel cost: Respondents were asked to rate the effort (in terms of cost, time, and energy) of using the four channels listed above; that is, they were asked whether a accessing a channel would require high effort (effort score=3), some effort(2), little effort (1) or no effort (0). Table 2 provides descriptive statistics for channel cost for these four channels and Table 6 provides measures for the same variable but for other channels.

2. Channel utility: Respondents were asked to evaluate the usefulness of fish contamination

information that they would find in each channel. Channels were rated as very useful (utility score = 2), somewhat useful (1) or as not useful (0). Usefulness was defined as a combination of amount of detailed information and accuracy of the channel. Descriptive statistics for channel utility are presented in Table 3.

3. Cognitive risk judgment: Respondents responded to the following question on a scale of 0 to 100: "How likely is it that you personally will become ill from eating fish caught in Wisconsin waters or the Great Lakes? (0 = absolutely no chance of getting sick; 100 = certain to get sick).

4. Affective risk judgment: Respondents were again asked to respond on a scale of 0 to 100: "How worried are you personally about becoming sick from eating fish caught in Wisconsin waters or the Great Lakes? (0 = not at all worried; 100 = the most worried you could ever be). Table 4 provides summary statistics for both cognitive and affective dimensions of risk.

5. Demographics: Demographic variables in this study were gender, year of birth (age), level of education, income, and race.

Results

The hypotheses were tested by conducting regression analyses. Significant regression variables and their

beta values are available in Table 5. The findings for each hypothesis are discussed here, individually.

Hypothesis 1: Higher levels of perceived channel cost will be associated with lower levels of channel exposure.

This hypothesis is not supported. Channel cost was not associated with exposure to any of the four channels of communication. It was, however, positively associated with topic-specific attention to newspapers and television. In other words, the more effort individuals felt they needed to access newspapers and television, the more likely they were to pay attention to stories regarding fish contamination within those media.

Hypothesis 2: Higher levels of perceived channel utility will be associated with higher levels of channel attention.

This hypothesis is supported. In addition, the data suggest an even larger pattern. Channel utility, unlike channel cost, was significantly associated with exposure as well as with attention for all four channels. The more useful individuals considered information in a channel, the more likely they were to use that channel in terms of both exposure and attention.

Hypothesis 3: Higher levels of personal risk likelihood will be associated with higher levels of topic-specific attention.

Contrary to our expectations, personal risk likelihood was significantly associated with only one of the dependent variables -- exposure to newspapers. The negative beta indicates that greater use of newspapers is associated with lower estimates of coming to harm from eating sport-caught fish. This hypothesis, thus, is not supported.

Hypothesis 4: Higher levels of personal worry will be associated with higher levels of topic-specific attention.

As hypothesized, personal worry was positively associated with attention for all four channels of communication. The more worried an individual was about becoming sick from eating sport-caught fish, the more likely he or she was to pay attention to stories or articles about fish contamination in any of the four channels.

Demographics: Demographic independent variables that were included in the analyses were gender, age, level of education, and income. With the exception of age, there is little in the way of patterns to analyze.

· Gender was significantly related only to newspaper exposure and attention with males using the newspaper more than females and paying more attention to newspaper stories about contaminated fish than females.

· Age, not surprisingly, was positively related to three of the four exposure variables. The older an

individual, the more likely he or she was to be exposed to newspapers and television; and the more likely he or she was to attend to stories about fish contamination in newspapers.

On the other hand, the younger the angler, the more likely he or she was to be exposed to fishing magazines.

· Level of education was significantly related to only one of the dependent variables -- exposure to newspapers. The higher the level of education, the more likely the angler was to be exposed to newspapers.

· Income was positively related to exposure to radio news and public affairs programming as well as to the number of fishing publications that were subscribed to.

· Race was negatively associated with exposure to radio news and public affairs suggesting that Caucasian anglers were more likely to use this channel of information.

Discussion

Three patterns emerge on examination of the results. First, our exploration of the extent to which channel cost and utility predicted to anglers' use of channels for information about contamination in sport-caught fish supported the value of one dimension -- utility -- but not the other. In this study, perceived

cost of a channel played no role whatsoever in anglers' tendency to use a channel for fish contamination information. Rather, the major predictor of channel exposure and attention was the perception of the relevance of information available in a particular channel.

A possible reason for the failure of channel cost to predict to channel use could be that the channels examined in this study are not cosnsidered to be costly. Cost measures were collected for a wide array of channels and these indicate that there is sufficient variance in measures of channel cost (see Table 6). However, as exposure and attention measures were available only for four channels (newspapers, television, radio and fishing magazines), data were not amenable to including the other channels of information. Evidently, these four channels are not perceived as costly and the lack of variance makes it difficult to see the extent to which channel cost would be a predictor of channel use. We suspect, however, that channel cost would predict to channel exposure if more "costly" sources of information such as physicians, government officials, and written materials from environmental agencies were included in the study.

Another pattern suggests that in the case of information regarding fish contamination, anglers tend not to discriminate between exposure and attention with

respect to channel utility. As hypothesized, channel utility predicted to topic-specific attention. However, channel utility also predicted to channel exposure. Although the latter finding was not predicted, it is not implausible. Information about contamination in fish while available through many different channels is not plentiful. In addition, risks incurred from eating sport-caught fish are low with little issue salience for anglers.

It is possible that the impact of channel utility on topic-specific attention as well as on channel exposure stems from a blurring of distinctions between the two. In the case of a low-level, low-salience risk with limited available information, anglers are not actively seeking fish contamination information. Rather, they may access it when they encounter it during regular channel use. Thus, there may be little difference between exposure and attention. Type of issue should, therefore, be a variable rather than a constant when predicting to channel use.

A third finding was that cognitive risk estimates fail to predict to channel use. We found support for our hypothesis that worry estimates predict to levels of topic-specific attention. However, our other measure of issue salience -- likelihood estimate -- did not have an impact on level of attention.

It may be that likelihood estimates predict to worry estimates, a theory that is supported in the findings of Griffin et al.(1994). In a recent convention paper, these researchers found that personal risk likelihood predicts quite strongly to worry about a risk. This indicates that cognitive judgments of risk may act indirectly, not directly, on channel use.

In summary, it is likely that when cost is not a factor, judgment of channel utility will be the most important predictor of channel use. Channel cost should not be dismissed as a predictor, however. The study looked at a wide array of channels and found much variance in perceived cost. A comparison of Tables 2 and 6 illustrates this point. Future research needs to take both cost and utility into account over a variety of information channels.

In addition, risk scholars should consider type of risk as a variable rather than as a constant. Low-level risks particularly those with clearly evident benefits should be compared with high-level risks that have no apparent benefits. Furthermore, the relationship between different dimensions of risk perception should be evaluated so as to achieve a better understanding of channel use.

Rather than focusing solely on the effects of channels chosen by information providers, it is imperative that risk communication scholars understand

the process by which individuals select channels to inform themselves. Risk communicators need to be aware of factors that lead to channel use in order to provide information to individuals at risk as, a better understanding of the predictors of channel use will foster communication that is consistent with the channel exposure and attention of those at risk.

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Table 1

Dependent Variables: Descriptive Statistics

Channel use:	Mean	Median	Standard Deviation
Newspaper Exposure	5.01	6.0	2.36
Newspaper Attention	2.26	2.0	0.79
Television Exposure	4.81	5.0	2.2
Television Attention	2.37	3.0	0.74
Radio Exposure	4.56	5.0	2.59
Radio Attention	2.18	2.0	0.84
Fishing mag Exposure	0.7	0.0	1.03
Fishing mag Attention	2.28	2.0	0.83

Newspaper, television, and radio attention were measured in terms of number of days. Fishing magazine exposure was measured in terms of number of fishing publications subscribed to.
Attention to all four channels was measured a lot (3); some (2); a little (1); no attention (0)

Table 2
Channel Costs

	Newspapers	Television	Radio	Fish mags
No effort	24.8%	42.9%	46.0%	19.1%
Little efrt	46.5%	39.0%	35.9%	36.9%
Some effort	22.3%	11.7%	12.0%	37.2%
High effort	6.4%	6.4%	6.1%	6.8%
Mean	1.1	0.82	0.78	1.31
Median	0.05	1.0	1.0	1.0
S. Dev.	1.0	0.88	0.88	0.86

No effort=0; Little effort=1; Some effort=2; High effort=3
Percentages denote the valid percent of the sample that indicated that effort score for that channel.

Table 3

Channel utility

	Newspapers	Television	Radio	Fish mags
Not useful	5.2%	9.0%	13.0%	8.8%
Smwht usefl	49.0%	50.8%	60.1%	61.8%
Very useful	45.8%	40.2%	26.9%	29.4%
Mean	1.41	1.31	1.14	1.2
Median	1.0	1.0	1.0	1.0
St. Dev.	0.59	0.62	0.62	0.58

Not useful=0; Somewhat useful=1; Very useful=2

Percentages denote the valid percent of the sample that indicated that utility score for that channel.

Table 4

Cognitive and affective risk judgments

	Cognitive risk judgment	Affective risk judgment
Mean	14.31	34.81
Median	5.0	25.0
Standard Deviation	19.94	32.77

Responses could range from 0 (no likelihood/not worried) to 100 (absolutely likely/as worried as I've ever been).

Table 5

Prediction of channel use (primary independent variables)

(Significant betas)

	Newspaper exposure	Newspaper attention	Television exposure	Television attention	Radio exposure	Radio attention	Fish mag exposure	Fish mag attention
Chanel cost		.132*		.124*				
Chanel util	.223****	.181**	.147*	.178**	.154*	.223**	.222***	.284***
Cogntv risk	-.183*							
Affctv risk		.22***		.226***		.225***		.269***
Gender(m=1)	.114*	.119*						
Year born	-.343****	-.17**	-.26****				.146*	
Education	.141*							
Income					.172**		.155*	
Race					-.159*			
R^2	.233	.132	.084	.105	.064	.113	.067	.173

Betas are significant at

* = <.05

** = <.01

*** = <.001

**** = <.0001

Table 6

Costs for channels other than newspaper, television, radio and fishing magazines

	Local govt. offcials	State govt. officials	University researchers	Physician	Govt. publications
No effort	16.8%	18.6%	22.2%	24.9%	17.2%
Little effrt	14.3%	10.2%	6.9%	15.3%	23.5%
Some effort	29.0%	22.0%	21.6%	32.1%	38.9%
High effort	39.9%	49.1%	49.4%	27.7%	20.4%
Mean	1.92	2.02	1.98	1.63	1.62
Median	2.0	2.0	2.0	2.0	2.0
St. Dev.	1.1	1.16	1.21	1.14	1.0

Who's listening? And to whom?

Worldviews of Biotechnology Executives and Scientists
toward Public Relations and Communication

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Abstract

Depth and personal interviews with leaders of three significant biotechnology enterprises sought insights from executives and scientists about their worldviews toward public relations and communication and asked to what extent worldviews reflected standards of excellent and effective practice. Participants viewed the function as an important part of management. When their worldviews demonstrated openness and a willingness to grant ready access to information, they experienced greater acceptance and potential support for their programs. To a limited degree they conducted research to learn whether their publics perceived them as wanting to serve the public good. The study suggested that working through differences by understanding worldviews is one way that organizations and their publics can cultivate effective long-term working relationships and public support.

Maybe, Tomatoes

if the vines mature
if the caterpillars don't get them

if we water, sucker, feed
if we pick and preserve

maybe, tomatoes
thin sliced on sandwiches
chunked into salads
peeled and whole
juiced and sauced
stewed
pickled
stuffed

—*Connie J. Green*

in *Some Say Tomato*

Charlottesville, VA: Northwood Press

Courtesy Mariflo Stephens

Introduction and Rationale

How prepared are proponents of modern biotechnology to discuss complex social issues this technology raises with strategic publics? Not as well as they could be, according to the industry magazine *Bio/Technology* (Hassler, 1994).

At a meeting on food safety issues in agricultural biotechnology, for example, a woman complained about speakers from the scientific community. When they addressed her group, she said, they always started with a disclaimer about not being prepared to discuss such issues. Yet as Jesse Ausubel of Rockefeller University in New York noted in the same article, "Public opposition to new technologies has not hindered—but in fact has helped stimulate—their development" (Hassler, 1994, p. 7).

Sociologists and scholars of risk communication often discuss these issues and meet their counterparts from the life sciences in an increasing number of conferences, many of which also are open to the public. Outside of academia, though, to what extent do biotechnology industry executives and scientists engage in dialogue with non-scientists and regulators about public concerns? And for what purposes?

After all, if the debate that public opposition provokes makes the producers of new goods and services adjust in consideration of consumer needs, as Hassler (1984) wrote, that result is a win-win situation. Producers are able to sell their products to consumers who have enough confidence in, and desire for, the products to purchase them. And the corporation has healthy relationships with stakeholders, enabling it to survive and thrive.

Calgene, Inc., for one, found that its willingness to be accessible and open with everyone from public interest groups to government regulators helped stimulate an awareness of its genetically modified tomato. Its subsidiary, Calgene Fresh, is the developer of the FlavrSavr™ tomato, the first whole food biotechnology product introduced in selected grocery stores in mid-1994 (Benoit, 1994). The company's

openness also stimulated an interest in tasting and purchasing that product upon its becoming available commercially.

Calgene's experience isn't necessarily typical.

Scientists traditionally have communicated *within* their own community in the quest to generate breakthrough knowledge (e.g., Lacy & Busch, 1991; Colwell, 1994). Still, industry observers (Burrill & Lee, 1993; Staff, 1993) have commented on the need for biotechnology companies to communicate more—and better—about what they do, and to participate in public policy discussions about their products and issues (Hassler, 1994). More than 200 of these companies in the United States are publicly traded (Stone, 1994), yet they can be hard to distinguish individually.

Moreover, a product can take seven to 12 years to move from research and development to the point of commercialization (Biotechnology Industry Organization, 1993). That timeframe can be frustrating as entrepreneurs try to comply with multiple tiers of government regulations, maintain their sources of venture capital, stay abreast of the whims of political support, and ride the ups and downs of public perception.

Within the context of such a dynamic environment, one that often brings challenges from activists, an opportunity exists for public relations practitioners to learn not only about the *public* perceptions of this technology. To increase the prospects of their function adding value for the organization, practitioners in biotechnology enterprises also need to understand how their own executives and scientists view the role and purpose of their public relations and communication programs. Public relations is used in this paper as the management science concerned with building organizational relationships and solving problems of the organizational environment, both internal and external, through managerial decision-making. It encompasses communication as a process or tool to share those decisions with others both inside and outside the organization (J. Grunig, 1992).

As a foundation underlying public relations practice, J. Grunig and White (1992) synthesized Kearney's (1984) concept of worldview as one's images and assumptions about the world. They described it as a "schema" that organizes what a person knows about the world and how he or she makes sense of new information. A person's worldview allows the individual to make assumptions about the relationship between oneself and others. An organization's worldview is concerned with the relationship between the organization and others with whom it interacts.

Familiarity with worldviews toward communication (J. Grunig & White, 1992) can help public relations practitioners within the industry become better equipped to help their organizations bridge cognitive gaps with nonscientist and policy-maker publics. In their role as boundary spanners, public relations practitioners can contribute to their organizations' effectiveness and long-term survival by focusing on two-way symmetrical communication (J. Grunig & L. Grunig, 1992). They can accomplish this by actively seeking out the needs, interests, and concerns—as reflected in their worldviews—of *both* their external stakeholders and their management and research teams. In so doing, public relations managers can plan communication programs that more effectively help their organizations and their publics adjust to each other, in ways that are appropriate to a dynamic environment.

This study therefore seeks to contribute to our knowledge of the worldview of leaders in biotechnology enterprises toward public relations, i.e., their beliefs and values about communication, and how they make sense of different viewpoints held by their stakeholders. To conceptualize elements of a worldview that are important to effective communication, I begin with an overview of recent research about the thinking within the biotechnology industry. This section also includes a brief description of the models of public relations and what constitutes excellent practice (J. Grunig, Ed., 1992), and a summary of significant research on public perceptions of biotechnology and risk communication. Next I describe this study's methodology

and findings. Discussion concludes with an assessment of those worldview elements as expressed by the interviewees that have contributed to effective communication in their own experience. The interview protocol is attached as an appendix.

Conceptualization

> Technology is a lens through which we see the world, and biotechnology (both traditional and new) has the power to change our understanding of ourselves, of the natural world, and of our place in it.
>
> —*Edwin Hettinger (1992)*

Despite considerable research about societal concerns involving safety and risk, moral and ethical reservations, and consumer perceptions, understanding, and acceptance of biotechnology, little research to date considers the worldview toward public relations and communication of those working inside the biotechnology industry. Examining the history of the "new" biotechnology, however, quickly reveals scientists' desire to conduct their research in a socially responsible manner.

When scientists first successfully transferred DNA from one cell to another, in 1973, the initial realization of new potential gave way to a realization of vast unknowns that people feared might result from manipulating living material. In 1975, the scientific community took it upon itself to meet in Asilomar, California, where more than 150 prominent researchers from around the world discussed their situation. They decided upon a moratorium until they would be able to determine that proceeding with their research would be safe both to themselves and to the public (Goodell, 1986; Rabino, 1994).

Plein (1991) found that during the 1980s the industry transformed its image from one of risk and uncertainty to one of positive potential and familiarity. Four techniques of issue definition enabled this shift: 1) unifying and organizing the industry's interests; 2) forming alliances between government regulators and the private sector; 3) associating the technology with a popular issue on the political

agenda, i.e., economic development, and disassociating it from issues that, at least at the time, were perceived as negative, i.e., the environment and ethical questions; and finally, 4) portraying those opposed to the technology as extremists. The result of the latter technique was to deny critics in some of the more mainstream groups a legitimate chance to gain credibility and contribute to the policy-making process.

Writing from a public administration perspective, Plein credited the strategy of industry unity as an effective communication tool in the policy process. His acknowledgment that the industry failed to meet the heart of its criticism directly merely nodded toward the possibility that economic matters could divide biotechnology's supporters in the future, but he did not assess in depth the long-run ramifications of discrediting the opposition.

Since Plein's article was published, the two major trade associations in the field merged into one collective entity in 1993, the Biotechnology Industry Organization (BIO). Where the predecessor organizations frequently attacked one another at the expense of being able to build public support, BIO in its first year concentrated on an aggressive identity-building effort to establish itself in both media and political circles as the voice of the industry in Washington (D. Eramian, personal interview, December 6, 1993; *Biotechnology Newswatch*, 1993).

The most recent study (Rabino, 1994) that bears on the topic of worldview toward communication compared how genetic engineering scientists in the United States (n=430) and their colleagues in Europe (n=400) viewed the impact of public attention, political advocacy, regulation and litigation on their work. Rabino conducted two waves of surveys, both with a particularly high rate of return—79 percent in Europe and 74 percent in the United States. This suggests high interest among the scientists because of both the pervasiveness of the technology and its indispensability to their research in spite of frequent controversies.

European researchers held the more negative views about public scrutiny, responding that it has hurt more than it has helped their efforts. Rabino attributed this finding to a stricter regulatory environment than in the United States, which relies more on voluntary compliance. In contrast, scientists in this country were more concerned about economic competitiveness. University researchers were somewhat more likely to perceive benefits from public attention than researchers in government laboratories or private industry, again due probably to a difference in the applicable regulations.

As reflected in open-ended comments solicited at the end of the questionnaire, some scientists in both Europe and the United States attributed the existence of regulations, strict or otherwise, to pressure from outside interest groups. Conflict resolution between activists and the industry in this country tends more to litigation while settlements in Europe occur more through face-to-face negotiation, public debate, or the political process. In either case, researchers themselves engaged in self-regulation and acknowledged that prudent government regulations, especially when accompanied by efforts to communicate with the public and allow for public input during the regulatory process, could contribute to public confidence and support for their work. According to Rabino (1994):

> The majority of researchers...feel that to counter the negative public image and attention, it is important for genetic engineering scientists to be open and informative with the public (which is viewed as uninformed or misinformed) about the methods and aims of their research....Scientists would have to become more involved in educating, communicating, policy-making and regulating. (p. 44)

Public Perceptions of Biotechnology in the Context of Risk Communication

Numerous researchers have addressed aspects of risk communication that determine the degree of public trust and confidence that may evolve when new technologies are introduced. For example, Slovic (1987) focused on the psychological strategies people use to make sense out of uncertainty. Quantitative estimates of risk

tell only part of the story; perceptions and attitudes give a broader indication of how great they may consider the risk. Scherer (1991) discussed assumptions that have been questioned in research about risk communication, including the belief that science alone could offer objective truth, that scientific experts were the sole sources of correct information, and that the public would accept risk information if only it would learn about risk issues. He argued that an alternative communication process would help avoid a crisis of public confidence; such an alternative process would involve greater understanding of science by the public and more openness by the scientific community to other ways of looking at risk.

One of the better known recent studies about agricultural biotechnology was Hoban and Kendall's (1992) national telephone survey of consumers. They found respondents generally supportive of science and technology, including biotechnology, although awareness and understanding of the latter were low. Acceptance of uses that involve changing the genetic make-up of animals was lower than for changes to plants; the process of gene transfers was of concern possibly as much a result of underlying values and beliefs as of a lack of understanding. Trust surfaced as a central issue: "Confidence in government regulations and trust in information sources were strongly related to acceptance of biotechnology products and general attitudes about biotechnology" (p. 5). Health professionals, university scientists, farmers, and environmental groups were perceived as the most trustworthy information providers.

The biotechnology industry hardly can be unaware of what the public thinks and what its concerns and desires are. During the past decade, seven polls conducted by both public and private sector researchers in the United States have tapped the opinions of almost 6,000 people including farmers, science policy leaders, biology teachers, and random samples of the public (Zechendorf, 1994). Zechendorf (1994) gauged that acceptance of biotechnology in the United States tended to be favorable

in spite of perceptions of risk. In polls analyzed for significant trends, he found that most United States citizens feared hazards, were not able to assess risk reasonably, perceived less risk for genetic engineering than nuclear technology, thought that biotechnology will improve life, based any opposition on specific applications, and overwhelmingly (91 percent) got their information about science and technology from television. Only a relatively few people in the United States were well-informed; the higher their education level, the more likely they were to accept biotechnology. Zechendorf noted, "The overall acceptance is astonishingly high, considering the rather bad media image of biotechnology" (p. 874).

Taking a different approach, Hornig's (1993) content analysis of newspaper coverage of biotechnology found many "booster" articles written from an economic or business point of view. Representatives of industry, scientists and universities were the most frequent sources, with relatively little material from activists and agricultural interests. University sources, in particular, were found to be responsible for positive coverage, more so even than industry voices. Readers' concerns about risk, public awareness issues, adequacy of research, and ethics rarely were reflected in the newspapers studied. Hornig faulted the media for failure to present a diversity of views that might stimulate debate and eventually lead to consensus. Although the researcher was the sole coder, her conclusion was significant:

> Responsiveness to the public's desire for information on the broad range of considerations relevant to science policy-making is more likely to build the atmosphere of trust and the sense of empowerment that must underlie such confidence. Cynicism about the activities of both public agencies and private interests involved in science and technology is unlikely to evaporate unless these information needs are met. (pp. 11-12)

Concerns of Activists and Regulators

Earlier, Margaret Mellon (1988), writing for the National Wildlife Federation, looked not only to government but also to the private sector to provide opportunities for public participation in decision-making. Federal agencies provide access to

information through laws governing both biotechnology and procedural laws applicable to all agencies, including the Freedom of Information Act and the National Environmental Policy Act. The degree of access varies from agency to agency. In addition to assuring better decisions, an informed public would be more helpful for industry, Mellon suggested. Though possibly more costly up front, agencies and firms that encourage full information and full participation may stem a rise in public frustration later, Mellon (1988) continued, especially "if it later becomes apparent that the technology was oversold or its risks understated" (p. 51).

At the opening of the Food Advisory Committee's hearings for the Food and Drug Administration (FDA) in 1994, James Maryanski, biotechnology strategic manager for the agency's Center for Food Safety and Applied Nutrition, noted two different ways of looking at the technology. "Science calls it recombinant DNA, the public calls it genetic engineering," he said. Based on experiments cited in the news media, he added that consumers develop the impression that "exotic" foods will soon be available. Regardless of how such foods are developed, consumers rely on the FDA to assure that food is safe and to ensure confidence in new techniques, he pointed out.

Not quite a year earlier, the Government Accounting Office (1993) had summarized some of the unresolved issues as whole food products neared commercialization. These included providing guidance to industry on a case-by-case basis and a need to improve interagency coordination, both factors that create regulatory uncertainty. Such uncertainty could not only slow commercialization of new products, it could also undermine consumer confidence in the agency's efforts to ensure these products are safe, the GAO said.

Nevertheless, the hearings provided a forum for contrasting perspectives of industry and activists. Robert Serenbetz, chief executive officer of DNA Plant Technology, emphasized the importance of keeping the public informed. In his

view, the more the technology is demystified and the more the public understands about biotechnology, the more they would appreciate its potential benefits. "I also believe this public review of FDA's process for assessing food safety clearly demonstrates to consumers that genetically engineered foods do receive rigorous FDA oversight," he said at the hearing.

On the other hand, in a statement by Margaret Mellon, now with the Union of Concerned Scientists, Jane Rissler expressed their concern about the agency's proposed policy allowing whole food products that were genetically modified into the market . Mellon suggested that early approval of the policy would place industry's agenda ahead of the public interest. She feared that such action would mislead the public into thinking all such products would go through as extensive an approval and review process as Calgene's tomato. She and other consumer activists were disturbed that the FDA had not answered several thousand concerns or negative comments received during the public comment period.

More recently Mellon lamented that in-depth information-sharing and education between regulatory agencies, industry, and the public have not developed enough. The current public debate is so one-sided, she said, "it isn't salad days for the environmental community... Industry is on its way but without products at the moment, that aren't yet realized. Without products it's hard to get people interested [in the issue]" (M. Mellon, personal communication, March 21, 1995).

The Case of bST

When several agricultural pharmaceutical companies developed bovine somatotropin (bST) to increase milk production in cows in the 1980s, controversy dogged the product from the outset. In one of only a small handful of studies of public relations practices by a biotechnology company, Hornig (1991) suggested that use of conflict resolution techniques such as negotiation might have generated a better outcome from both the company's perspective and that of society in general.

Through a newspaper content analysis, she found that press coverage had afforded numerous opportunities for the company to express its point of view. Consumer and activist reactions, at least at that time, received far less emphasis.

Instead of pursuing a course of education and two-way dialogue, however, the chemical industry during the late 1980s engaged in name-calling tactics against those who opposed the introduction of bST. Such statements may well have contributed to the ill will that developed later, Hornig suggested. In addition, the industry equated bST as simply the next step in the chain of progress associated with agricultural productivity and economic prosperity. The industry portrayed this product's introduction as inevitable and value-neutral, adding that bST was pure and a product that was developed at great expense.

Monsanto, for example, attempted to capitalize on an image of science as a rational, benign and progressive force. The problem was that this image was not likely to reflect public sentiment accurately in the wake of Three Mile Island and other disasters. Thus, Hornig gauged, bST's developers would have fared better during the period of her study by going beyond a focus solely on the benefits and addressing additional concerns about the product's safety and its socioeconomic impact among prospective purchasers. In her assessment, Monsanto ignored the point of view of dairy farmers as its primary audience and did nothing to work with the dairy community to explore solutions to the problem.

Hornig (1991) suggested that messages about the introduction of new technologies succeed when they are congruent with important beliefs of their audiences and responsive to the perceived needs of potential adopters. As she put it,

> An honest attempt to resolve the conflict of interests here, even a failed attempt, would have been far better public relations than trying to deny the legitimacy of the economic issue, or to deny any responsibility on the part of bST's developers for its social as well as health effects, or to blame others for the crisis....(p. 9).

It is also possible that Monsanto representatives *did* speak to those issues and concerns and that the media chose not to cover that perspective as newsworthy.

In the same year as Hornig's (1991) study of bST, Gerard Ingenthron (1991), director of public affairs for Monsanto Agricultural Company, recommended two basic strategies for corporate scientists to communicate about genetically engineered *crops*: (a) Addressing the public affairs implications early during a research program, and (b) engaging in comprehensive, quality communication activities with a range of diverse publics. While he regarded scientists as the most credible sources for technical information, he also recognized the need to translate their expertise in ways that others could understand: "We need to explain the basis of the technology...but one cannot make bioengineers of our journalists, much less the public. We need to speak on their terms, about their interests—what's in it for them, or for society" (p. 114).

Organizational Approaches Toward Public Relations

J. Grunig and L. Grunig (1992, pp. 287-289) elaborated on four models to represent an organization's public relations values, goals, and behaviors. In brief, the models are: *Press agentry*, a one-way set of activities built on seeking and obtaining publicity; *public information*, also a one-way dissemination of information approach, built around truthful and accurate reports about the practitioners' organizations, although typically no other information is volunteered; *two-way asymmetrical*, which involves seeking information from and offering information to publics, primarily to motivate or persuade them to think or behave as the organization wants them to behave; and *two-way symmetrical*, which uses research to develop mutual understanding between an organization's management and the publics it affects.

A simpler approach is to collapse these models as symmetrical or asymmetrical worldviews toward public relations. Only the two-way symmetrical model is, as its name implies, fully balanced, since it does not involve manipulative

persuasion. Because of its emphasis on building relationships for the long run, this model sets the standard for excellent and effective practice.

Another way of looking at asymmetrical practice is the relationship between the organizations and their publics. This type of practice is not unusual if the organization feels its publics have increased external control over its choices more than it finds comfortable. For those organizations that both conduct research and provide information in a blend of symmetrical and asymmetrical communication, their practice may be described as mixed motive (J. Grunig, 1992). Practitioners demonstrate loyalty to both their employers and to the publics with whom their employers interact. Thus, most public relations practitioners in scientific organizations or departments act as journalists in residence. They work in the public information model both to translate technical material into forms that are easier to understand and to represent positive aspects of their organizations, often motivated by the desire to attract funding for research and development. Sometimes activists oppose the technologies under consideration without understanding them. In this country a tradition of individualism may inhibit some organizations from engaging in the collective decision-making that the standard of excellent public relations suggests is more effective in the long run.

In reality, most organizations practice a mix of the models, with the predominant choice based on the organizational culture. Factors influencing that choice include whether the organizational worldview includes, for example, the two-way symmetrical model, and whether the organization's public relations director is trained or experienced in the chosen model.

To summarize, among the elements of a worldview that contribute to effective public relations and communication are:

- a spirit of openness and honesty;
- availability and willingness to grant access to information readily;

- interest and ability to express scientific findings and applications in "real world" terms easily understandable by nonscientists;
- trust-building efforts with both supporters and critics; and
- active listening and taking into account different interests and viewpoints in the public relations planning process.

The section on methodology describes this study's approach to identifying whether and to what extent these characteristics are present in the worldviews of biotechnology executives and scientists.

Communication About Science and Technology Issues with Different Publics

To understand the nature of communication in which scientists engage, Donohue, Tichenor, and Olien (1973) examined concepts of "knowledge-of" and "knowledge-about science." *"Knowledge-of"* science supports and reinforces the internal views of the science system. For example, the organizations in their study preferred to control information flow to publics by releasing material to the press only after publication in a refereed journal. *"Knowledge-about"* science is external to the system and incorporates criticism as well as the release of comprehensive information and encouragement to journalists to obtain material directly from sources in the organization.

Pollack (1986) linked these variables with the influence of the dominant coalition's values on the models of public relations practiced at scientific organizations. The dominant coalition is the top decision-making leadership of an organization, its power elite. For both "knowledge-of" and "knowledge-about" science, the perception of scientific knowledge by top management determined the nature and timing of information released to the mass media. Of the approximately 200 scientific organizations that responded to Pollack's survey, most practiced

predominantly the public information model. The two-way asymmetrical model also was strong in corporations.

In addition to the approaches of administrators, how do scientists themselves look at communication? In the past they were able to rely on establishing a track record of accomplishment with their peers to maintain research support and did not need or want to pursue public visibility (Nelkin, 1987). But since mid-century, when the Soviets launched Sputnik, scientists increasingly have popularized science "out of ideological and cultural as well as economic concerns" (pp. 136-137). The National Academy of Sciences has shifted from explaining and interpreting technical reports to viewing the press as a means of shaping public attitudes that will support funding of science.

Scientists in industrial public relations speak on behalf of corporations to enhance public confidence in the company's products, respond to crises that affect the company's reputation, enhance corporate credibility, and shape the news, especially where the news concerns controversy or risk (Nelkin, 1987). Too often, however, they dwell on language and image as instruments of persuasion in an asymmetrical approach to communication. Neighborhood activists, union representatives, and other critics rarely are heard at programs co-sponsored by universities and corporations for journalists, programs that often seem just to be compatible with industry's goals.

Not surprisingly, as covered by the trade and popular press, the biotechnology industries generally reflect asymmetrical models of communication (J. Grunig, 1989; J. Grunig & L. Grunig, 1992). There is also evidence of symmetrical communication. For example:

• *Press agentry*: In an effort to win the favorable attention of stock analysts, pharmaceutical biotechnology companies distribute "lots of attention-grabbing press releases that trumpet their latest research studies or new manufacturing sites"

(Power, 1993). Frequently these announcements tout positive news only, with no mention of problems.

• *Public information*: BIO, the trade association, undertook activities such as trade show exhibits and a special publication for local elected officials complete with a resource manual and information about the industry's potential to create new jobs (Staff, 1994b).

• *Two-way asymmetrical*: Peter Steinerman (1994), vice president and director of the biotechnology group at Ruder-Finn Inc., New York, spelled out several steps for biotechnology firms to utilize marketing public relations techniques. These included research to identify the relative importance of messages for critical audiences and the impact of potentially damaging news.

• *Two-way symmetrical*: Sandoz Crop Protection Corporation developed an external corporate relations strategy to earn customer respect over the long term. The company expressed a willingness to change its business perspective "to address environmental and safety concerns of customers, regulators, and the public while still producing effective products" (Thayer, 1990, p. 15).

Methodology

For this project, I wanted to gain insight into the thinking of leaders involved in nationally known biotechnology enterprises, in both the public and private sectors and the industry at large. Qualitative research is particularly appropriate for a study of worldview in public relations because it is well suited to developing a deeper understanding of meaning, motivations, and interests (Mariampolski, 1984). Further, qualitative methods are most vigorous "when they are used to discover how the respondent sees the world" (McCracken, 1988, p. 21). A semi-structured interview protocol, included as an appendix, permitted respondents the flexibility to emphasize what they considered important while allowing the researcher to keep the interview on track.

Drawing from previous experience as public relations director at the Virginia Department of Agriculture and other contacts through my membership in the Public Relations Society of America, I arranged telephone or face-to-face depth interviews with a small purposive sample. Primary respondents were:

* Stephen Benoit, most recently vice president of marketing, Calgene Fresh, with background in finance and strategic planning, and responsible for both sales and corporate communication;

* Dr. Rita Colwell, a distinguished marine biotechnologist, educator, director of the University of Maryland Biotechnology Institute, and president of the American Association for the Advancement of Science; and

* Dr. Mary Moynihan, communications coordinator for UMBI, with a background in writing and editing for regional business and research publications.

In addition, I conducted shorter personal interviews with two other public relations counselors involved with major companies introducing biotechnology products. Jim Altemus, public relations manager for Monsanto Agricultural Company's plant biotechnology office, commented on that division's current efforts, and Merrill Rose, general manager of Porter/Novelli's Chicago office and head of this public relations agency's food and nutrition practice, provided additional information on behalf of Calgene Fresh.

I also observed three days of hearings of the Food Advisory Committee to the FDA in April, 1994, described earlier, as the agency considered safety issues surrounding whole foods produced by new biotechnology methods. Because the FlavrSavr™ tomato was the first product of plant biotechnology to be approved for commercial production, Calgene was the object of precedent-setting attention, within both the industry and the media. The purpose of the FDA hearings went considerably beyond the one company's experience, however; the discussion and

decisions continue to be applicable as federal policy is determined and evolves for many more whole food products nearing the point of production for market.

To round out insights culled from the interviews, I also reviewed a number of company publications, articles about communication by company executives, and, finally, corporate and financial reports and news articles from both the trade and daily media, gleaned from searches of the Lexis-Nexis electronic database and Internet resources. Both the reports in the news media and literature produced by the companies should be considered not only in light of what they say but also in light of what they do *not* say.

Findings and Analysis

This section reports and analyzes the issues and interests about which respondents spoke and their approaches to communication about these issues.

As expressed in the literature on public perceptions of biotechnology, major areas of public interest or concern most often are safety considerations, presence and type of benefits, and ethical questions. Both the benefits and the risks may revolve around health, economic and environmental issues; culinary or taste improvements constitute a benefit. Ethical concerns also may include those based on religious beliefs and distributive justice, both domestically and internationally.

Among the respondents in this study, their comments reflected all three areas and particularly the first two, safety and benefits. The extent to which they typically sought out concerns among their respective stakeholders and incorporated them into their communication efforts varied, from informal environmental scanning to sophisticated market research. That is not surprising, as each organization's situation is distinctive.

For example, since its founding in 1984, UMBI has pursued a rapid capital expansion program to establish itself as a leader in publicly supported biotechnology research. At the same time that it represents an emerging growth industry for the

state of Maryland, it also has needed to perform leanly in light of tight state budget requirements. Much of its communication effort thus has been geared to generating support among legislators for its potential to contribute to the state of Maryland's economic development.

In the private companies, both Calgene and Monsanto are pioneers with marketplace "firsts." Monsanto found itself in a reactive mode with bST, with lessons learned from that experience which appear to be altering the company's approach to more recent communication efforts. Calgene has undertaken a clearly proactive approach for introducing the FlavrSavr™ tomato.

Openness and Willingness to Share Information, Coupled with Intellectual Curiosity

Toward the end of the 1980s, long before the FlavrSavr™ tomato would be ready to introduce to the marketplace, Calgene sought guidance from the FDA because it recognized the consumer public would be more likely to accept the product if it were subject to regulatory review (Fox, 1994). In 1991 the company sought a voluntary consultation with the reviewing agency, followed in 1993 by the chief executive officer's petition for review under the existing, stringent food additive provisions of the Food, Drug, and Cosmetics Act (Hoyle, 1994). Even FlavrSavr™ critics acknowledged that consideration under those provisions is tougher yet than under the evolving provisions for whole food products.

The extra review steps cost the company time, money, and jobs, leading to a restructuring and scaleback of the Calgene Fresh subsidiary during the last half of fiscal 1994 (Rose, personal communication, 1994; Benoit, personal interview, 1994; Staff, 1994a). Nevertheless, despite plowing under a number of its fields since October, 1993, while awaiting the FDA's decision, Calgene expected to—and did indeed—bring the tomato to market before the end of 1994.

Though furloughed from his post as vice president of marketing, Stephen Benoit was still motivated by a desire to do something challenging.

"That's also what makes Calgene tick," he said, "a positive contribution using technology to make people's lives a little better. Science for science's sake is not particularly helpful; science with a conscience is what it needs to be all about, a commonly shared value."

Indeed it seemed natural for people working in the biotechnology industries to feel compelled by both the intellectual challenges and the desire to improve the quality of human life (Benoit, 1993). Even though he is not a scientist himself, Benoit echoed some of the passion with which UMBI's multi-faceted director, Dr. Rita Colwell, spoke. Driven by curiosity about why and how things work, Colwell said she loves to build and to create. For her, the motivation was also a matter of having a vision about where things can be. "The status quo isn't enough, especially in a society whose technology is going through enormous pyrotechnics. It's like a huge fireworks display what's happened in science and technology in the last 30 years."

Similarly, UMBI's communications coordinator, Mary Moynihan, was attracted to the institute in part because one of its research centers focused specifically on public issues in the social, legal, ethical and regulatory arenas.

Sensitivity to these issues was certainly apparent on an individual level, perhaps more so than could be seen at the macro-organizational level in this type of limited study. To wit, Monsanto's Jim Altemus, who was not directly involved with the introduction of bST, observed his colleagues' handling of the issue. His own approach in managing the company's information needs for plant biotechnology reflected an understanding of both where the company had been and where it wants to go.

"With Monsanto's genetically engineered potato, we're taking a look at society, people's relation with food," Altemus said. He continued:

> It's an intimate relationship, and it is our responsibility to provide something that talks about those concerns. We prepared a discussion report as an

example of our willingness to talk, not just the scientific point of view but with others who have other points of view. It directly relates to the company's attitudes, what did we learn from the past. Are we repeating it or are we responding to needs and wants of the people in an open-ended, honorable way? It's an example of Monsanto's style, very modest, [to show] how does our product fit with ecosystems, with diversity. It's very middle of the road and nondefensive, how can consumers get information?

Consumers—or anyone else, for that matter—who wanted information from Calgene should have found it readily available, according to Benoit. "We were incredibly accessible for them," he said, explaining further:

> What we successfully did was communicate openly about what we were doing, what the technology was, how we were using it, what we expected the outcome to be. We never had an issue of safety, we were willing to share the research data with anyone who cared to look at it. We had a general philosophy to communicate, a willingness to give people the information they want so they can make choices they want to make. That was the hallmark of the effort we undertook.

The company made its safety studies public either on request from its own offices or through federal agencies reviewing the data. Corporate fact sheets also said Calgene Fresh would voluntarily label the FlavrSavr™ tomato as a product of food biotechnology. "We believe that tomato purchasers need a reason to believe we can deliver a superior product and that acknowledging the role of technology will provide that confidence," read one news release.

But what those working within the industry are learning to communicate is not necessarily the detailed scientific findings, even though that information may be made available. Respondents grasped the need to explain their work and to explain it in terms that would be meaningful to their publics. As Benoit explained, consumers are more concerned with whether a food product is harmful and what its benefit(s) may be so they can make their own choices.

"One of the great sins is assuming the public is stupid," he said. "We explained the technology so people could understand what we were doing and

why...better taste is what we will ultimately be judged on. We went from food biotechnology to [still calling] it a tomato."

Where scientists and technologists in years past did not even consider talking with reporters as a general rule, they largely have come to understand the importance of doing so now, even if many have not yet developed the skills. From the inward professional focus of a researcher, as Rita Colwell told it, speaking with the press would have ruined a scientist's reputation 20 years ago.

"I think the attitude was that what we did was important for its own good. We didn't have to explain it to anybody, we just deserved the (funding) because we were serving the country," Colwell said.

With the change in the world political climate, she continued, the fall of the Berlin Wall, the collapse of the Soviet Union, and the change in the nation's security and defense needs, attention has focused more recently on social stability and how we have used—or misused—the earth's resources. Those shifts in attention have brought a concurrent change in funding priorities to the point that public research institutions have a greater obligation now to let the public know about both the scientific and the economic benefits. As a state facility, UMBI is monitored by state legislators, a key strategic public "who will make sure that we gyroscopically keep us on what they think is the track that the public wants us to be on," Colwell said. Elaborating on this responsibility, she said:

> We have a greater burden on us than, let's say, Johns Hopkins or Stanford in their respective states... It means that we have a responsibility therefore to tell the public what we're doing, to educate them, that we are in fact through basic research and creativity-driven directions in research, serving them because what we're doing is trying to find ways to understand what the life processes are or how they work or can be effective...and to also transfer this technology to the public good. It doesn't mean just dumping it on the street but to figure out ways it is transferred to create jobs, to keep the economic strength of the state maintained.

Public Relations Practices as Indicators of Worldview

Beyond the effort to perform out of a concern for social responsibility—improving human life and adding to knowledge—the biotechnology enterprises in this study engaged in a mix of the public relations models described earlier. Respondents placed a high value on the function as part of strategic management, while placing primary emphasis on media relations and viewing public relations as part of communication rather than the other way around. As Colwell expressed it:

> [Public relations is] managing interactions with the public. Communication is a far more serious business, and that means preparing in a variety of media, spoken, written, visual image, the message, the education you need to get done... What you really have to address is the fundamental information that has to be transmitted and it has to constantly be transmitted, it has to transmitted in a variety of media—a brochure for a certain kind of clientele, or it would be in the form of a PBS report, or a book that goes to another portion of the clientele or in the form of a newspaper article.

Because so much of the communication effort was directed outside the industry, respondents shared an interest in educating nonscientist publics. Educational programs served a variety of goals: To inform publics about both their organizational activities and the basic principles of science about which they otherwise would be unfamiliar, and thus not able to make choices for lack of adequate information (asymmetrical), and also to address issues about which publics have expressed concern or interest (symmetrical).

Whether based on research or on a particular philosophical approach to communication, participants in this study recognized that publics unfamiliar with the subject would be more likely to grasp its significance if it was described in terms they already understood. Using language that is easy to understand is thus a necessary communication skill for those who explain their work to nonscientific publics.

UMBI's Mary Moynihan, for one, thought it might even be an advantage *not* to have a scientific background to be effective in this regard. As she reflected:

> If I'm going to explain this to the public, and I'm very committed to that, I don't want to understand it too much myself. You or I think in terms of what does this mean to me? How is it going to change my life, how is it going to change the world? Researchers don't think that way. They're focused on a specific idea although they know somewhere down the line it has applications. We have to find a way to understand their research and also how it's going to help us.

Benoit also went through a learning curve to represent the work of Calgene's researchers to other audiences. He framed it in terms of what non-scientist executives could offer the research staff:

> If you were willing to listen, scientists were more than willing to share everything they had and take the time until you got it right, you were not expected to understand at their level in terms of being conversant, but [they showed] a real willingness to have the business folks understand the essence of the technology. They recognized that if they wanted a career any different from working at a university, they needed people who could translate their work into products, and that these people rarely have the same background as bench people.

Depending on the staff and financial resources available to the organizations in this study, their research efforts ranged from seat-of-the-pants to much more formal methods. For instance, UMBI's communications staff was too small and too rushed at the time of the study to be able to conduct either formative or evaluative research, but the institute did operate an internal clipping service to monitor both its visibility and other issues of interest in the external environment. Moynihan, who also doubled as UMBI's legislative analyst, said she recommended a more systematic scanning effort and hoped to complete a well-developed communication plan in the near future.

Monsanto's Jim Altemus said he relied heavily on research, testing news releases, for example, before sending them out. One of his concerns was to choose vocabulary that readers not only would understand but also to which they would respond favorably, one of the characteristics of asymmetrical communication. At the same time, he wanted the company to be seen as honest and open, "to increase the feeling that Monsanto can be trusted with that technology." Hence, the invitation,

printed directly on one of its reports, for readers to contact Monsanto "to obtain additional information, share an insight or simply open a dialog," a symmetrical approach.

Research for Calgene Fresh has investigated consumer awareness of and attitudes toward genetically modified foods in general and the FlavrSavr™ tomato in particular. Undertaken primarily for marketing communication purposes, the quantitative survey also asked about consumer awareness of groups that opposed such products, finding only three percent able to name specific groups. Nearly half of all respondents and two-thirds of those who were already aware of these products expressed at least some interest in trying genetically modified foods (Porter/Novelli, 1993).

"We did pretty novel research about why people reacted the way they do when they hear the phrase 'genetic engineering.' That led to how you should communicate. You've got to be open, communicate the truth, frame it in a context people can use to evaluate a given technology," Benoit said. Taste on a year-round basis was the main consumer interest.

Media Relations a Key Focus

Publicity and visibility figured prominently in the strategies of both Calgene and UMBI. As a result of the FlavrSavr™ tomato being the first such product approved for market, Calgene experienced mostly unsolicited media attention. Without even being in grocery stores yet, the company's research found eight percent of the public "aware of a product that doesn't exist and that they can't look at," Benoit added. That level of awareness was eight times higher than for other tomato brands. In addition to being the first, he repeatedly emphasized openness and willingness to communicate about Calgene's actions, the technology and how it was being used, and the expected outcome. "Communication philosophy should be to tell the truth every chance you get. It's a lot easier," he said.

While Calgene received unsolicited media attention, UMBI also placed great emphasis on coverage, but from a different perspective. Recognition was more forthcoming at the international level, perhaps because of respect among scientists within the scientific community. That stature has taken longer to achieve in-state and nationally. As Colwell put it, "I've been irritated by the fact that we haven't been recognized until recently as a place where some very fine work is being done, where some excellent education is obtained. I always wanted to push to make our reputation better, to let the world know there is a lot of exciting (research) here."

Colwell's perspective probably stemmed from her insatiable drive both to know and to excel. In founding the institute, she said:

> I just felt we didn't have time to be slow and deliberative and touch all the bases and make sure everybody's happy and move forward in the traditional way. I felt we really had to leap out and start a separate institute and serve all the campuses (of the University of Maryland System), not just College Park.

Her vision transmitted to others who are backing the institute. As Moynihan related, "It's a great leap of faith that the state is making. There's a certain gestation period that goes along with setting up this kind of institution and it's beginning to show definite results."

Much of UMBI's communication effort was directed to media coverage in an effort to create awareness of the research it sponsors. This kind of activity fits the public information model quite well and also reveals some aspects of symmetrical communication. Business and trade press coverage increased substantially, as well as television appearances. One of the reasons Colwell was eager to build recognition through the media was an anticipation that Maryland residents who were aware of UMBI and its work would ask state legislators to support it. Media coverage also tied in with communicating openly, as she explained:

> Now I think we understand that we *have* to tell the public because the money isn't coming to us because we deserve it, it comes to us because we serve, not because we deserve. Communication is a very important aspect, and I just

> think if you can't tell people what you're doing, you ought not to be doing it... If you have an interest in doing it as I do, you make an effort to talk on PBS or to make a TV program as I will be doing on Thursday next week, or just open up to the school kids who call in on closed circuit and ask questions.

From her vantage point as a writer, Moynihan noted that many good stories go untold, and amid UMBI's fast-paced environment, she expressed a desire to cultivate media relations more extensively, by calling reporters with story ideas, editorial boards, op-ed pieces, and similar tactics. Facilitating reporters' efforts to get information, she said she steered them to the appropriate staff and research experts and allowed them freedom to make their own contacts although most came to her for assistance first. At the time of this study, she was developing an experts' directory on computer, intended to make that part of the job--both hers and the press—even easier. Tours for legislators and museum visits featuring interactive skits for inner city students were other popular activities.

Other techniques also fit the public information model, including museum exhibits and the opening of UMBI's new Aquaculture Research Center at Fells Point. Internal communication was strengthened through a newsletter which introduced staff at the institute's geographically dispersed centers both to each other and to external supporters.

Less Systematic Approach to Critics and Activists in Trust-Building Efforts with Publics

Research elsewhere has documented that the presence of activists in an organization's external environment can be a significant influence on the organization's communication (L. Grunig, 1992). Those whose worldview is broad enough to listen to different interests and viewpoints will be more likely to practice two-way symmetrical public relations.

In this study the respondents indicated some movement in that direction, although none specifically solicited input from activist groups as part of their strategic planning processes. The organizations and the activist groups interacted as their

paths crossed—during participation on conference panels, or as the organizations responded to criticisms they considered to be misstatements of fact or misconceptions that needed to be cleared up.

Calgene's Stephen Benoit said that even those who opposed the introduction of the FlavrSavr™ tomato acknowledged that the company had done everything it could to communicate about the product and make itself accessible. From his perspective:

> There were not many criticisms about the way we do business. The activist groups didn't come to us, but we met with them...on many panels together. I like a lot of them as a matter of fact, we just have different points of view. One of the humbling experiences early on, you think you're on the forefront, but not everybody knows who you are, and it's a small universe of people who actually care. That keeps you from overreacting and doing more than you need to in the media.

An attentive ear and a desire to adjust organization performance to address critics' concerns can guide an appropriate response. UMBI's Rita Colwell analyzed the feedback process this way:

> I listen to the critics to find out what it is that they're worried about. If they're worried about a lot of things that are simply impressions that we're not explaining, we need to do a better job, to let them understand what we're doing and why we're doing it....Criticism generally derives from ignorance. I use that word not pejoratively but simply as an observation: What you don't know, you fear.

Summary, Limitations, and Implications

At the beginning of this paper, I cited an observation that public concern can have a positive effect in stimulating development of new technologies. Where organizations gear their communication to be responsible and responsive, meaningful dialogue occurs and the organizations and their publics adjust to each other's needs and interests. This study took a qualitative approach to gain insight into the worldviews of biotechnology executives and scientists toward communication and public relations. Understanding their values as well as the values of stakeholders

can help public relations practitioners perform more effectively as boundary spanners, helping that adjustment process take place.

Depth and personal interviews with leaders of three significant biotechnology enterprises revealed a mix of public relations models in practice. The small number of interviewees means their observations can not be taken as representative of all in the industry. Moreover, such a small number of participants per organization does not give a complete picture of the organization's behavior, although the documentation cited helps to fill in some of the gaps between individual perception and collective action. Also, the accuracy of the self-reports in this study may be questioned in light of possible response bias according to both what the interviewer may think the researcher wants to hear and the use of real names for attribution. However, Dean and Whyte (in Dexter, 1970), emphasized, *"The interview situation must be seen as just ONE of many situations in which an informant may reveal subjective data in different ways" (p. 122).*

In that light, then, and mirrored against the literature discussed in the concept analysis, the participants' thoughts do provide an indication of how at least some in the industry make sense of the communication function. That knowledge should be helpful to practitioners in other biotechnology organizations. Future research should supplement this type of insight with quantitative assessments of the models practiced, such as the questionnaire utilized by the IABC Excellence Study (J. Grunig, Ed., 1992).

Respondents viewed the function as an important part of management although the term public relations may be seen as part of communication rather than the other way around. When their worldviews demonstrated openness and a willingness to grant ready access to information in response to the interests and needs of their publics, they experienced greater acceptance and potential support for their programs. They perceived their motivations deriving from a desire to serve the public good. To a limited degree they conducted research to learn whether their publics

perceive them similarly. Much of their programming was educational in nature, predominantly although not exclusively in the asymmetrical mode.

Of the worldview characteristics identified as significant for effective public relations and communication, the major area not found in this study was a systematic effort to develop more trusting relationships. I do not interpret this gap to mean the characteristic is not an important part of the worldview or that there is anything wrong with the worldview of the interviewees. Rather, I would like to grant the benefit of the doubt. Efforts at trust building well may exist at the respondents' organizations and simply may need a different line of questioning to afford an opportunity for discussion. It also may be that such efforts exist and are focused on supporters but not on critics. Alternatively, these enterprises may be so caught up in this rapidly changing industry that an effort seen as time-consuming over the long term gets put off while the organizations address more immediately pressing, short-term concerns. This is a topic that future research should consider and for which other methods of observation, such as long interviews or participant observation, would be better suited.

In sum, biotechnology researchers and executives recognize much of the value that effective public relations and communication can accomplish for their organizations. The organizations in this study likely need to broaden their perspective to a long-term view as well. The value of the present study is in suggesting an understanding of worldviews toward this function as an avenue through which both the organizations and their publics can work through their differences together. Learning about each other's values and beliefs is a first step toward achieving long-term support. What's needed, as Rita Colwell put it, is "vision tethered by reality."

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APPENDIX
INTERVIEW GUIDE

1. Background—individual

Position title and experience
Educational background
Interests, goals and motivations; how you got involved in science or leadership or current position
Role models, both generally and for effective communication
Your philosophy of: 1) Communication and public relations; 2) new or innovative technology; 3) reasonable risk (how you see the purpose of these concepts)
Significant changes, if any, in your philosophy in these three areas ("defining moments")

2. Organization's worldview of communication and public relations

Examples of what you consider effective—and ineffective—organization management, and specifically, public relations and communication actions that are or have been effective in accomplishing the organization's mission (probe: to get beyond tools and techniques, specific examples or *events* or issues involving other organizations, and how they have handled communication surrounding those examples)
How these *organization* events/experiences may have shaped *your* thinking about effective public relations and communication management
How *your* thinking may have shaped the *organization's* decisions regarding public relations and communication
Discrepancies, if any, between what you think should be and what you perceive to be the way the organization practices public relations and communication

3. Stakeholders

Who the key stakeholders and publics are, including those from community relations, grassroots, and activist standpoints, and whether these stakeholders are supporters or critics or a mix
How your organization interacts with these stakeholders
Your perception of the organization's external environment; where you see the focus
Your organization's interests, needs, concerns, and what you think the interests, needs, concerns are of your stakeholders
Ways, if any, in which you have incorporated stakeholders interests/needs/ concerns into your planning and decision-making processes

4. Organization structure

Strategic alliances, partnering, and similar "virtual" relationships, if applicable
Degree of authority managers/employees have to make communication and public relations decisions independently

5. Decision-making processes

Flow of internal communication in your organization when you are considering communication with external stakeholders
Who provides input and who makes decisions
What happens if the decision made is different from what you would have chosen, i.e., how staff, including yourself, co-orient with each other in considering different viewpoints

6. Anything else respondent would like to share, and close

The Life Course of an Environmental Issue: Claims, Frames, and Global Warming.

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ABSTRACT

A content analysis of a decade of coverage of global warming in five national newspapers is presented. The empirical analysis is drawn from a constructionist perspective on the content of news discourse emphasizing claims-making and framing. The issue is also discussed in terms of Downs' issue-attention cycle. The issue's life in the news is modeled as exhibiting three phases that are related to the sources quoted and the frames presented in highest level syntactic structures.

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INTRODUCTION: NEW KINDS OF PROBLEMS.

Of the great variety of environmental issues that have achieved social prominence in recent times one stands out as perhaps a prime example of a new class of environmental problems. Global warming represents a type of environmental problem that is generally identified with the idea of *global change*. In fact, change is at the very root of the issue of global warming. But perhaps a more important characteristic that issues such as global warming, ozone depletion, loss of biodiversity, and others share is their intangibility for the common person. We now must acknowledge at least the potential existence of environmental problems that are practically invisible yet at the same time constitute threat on a global scale.

Solutions to such problems will defy the efforts of the physical and biological sciences alone because the social dimension of global change is inescapable. An old adage holds that the first step in solving a problem is recognizing that a problem exists — and in this adage lies the essence of the social aspect of issues like global warming. How society comes to recognize and define something as a problem is no trivial question. This research is concerned with a narrowly defined aspect of that question (news media representation) with regard to one environmental problem (global warming).

An important aspect of global warming as a news topic is that it has clearly and dramatically demonstrated a kind of cyclic life course that may be common to the treatment of this variety of long-term issue in the news. Previous research on the volume of news attention given to global warming has shown how the issue rose from virtual obscurity, became a competitively pursued story, and eventually fell from prominence — nearly disappearing altogether.[1] Recent work examining public understanding of the issue has shown that the public is generally misinformed about global warming.[2] Together, these observations beg for a closer examination of the content of the news coverage of the issue.

This investigation, in an effort to understand the life course of this environmental issue, will add to the growing literature that has examined global warming. Using a constructivist application of the ideas of claims-making and framing, an empirical evaluation of the content of major newspapers across the span of a decade will show how significant changes in the nature of the content of the news relate to the definition of global warming as a problem.

Before providing a description of global warming's career in the news, the theoretical foundation for this investigation will be outlined.

SOCIAL PROBLEMS: CONSTRUCTED, CLAIMED, AND FRAMED.

Constructivism. Dunlap and others have shown in considerable detail how public concern for the environment arose in the late 1960s and has persisted since.[3] What role did the news media play in this phenomenon? Mauss notes that "the growth of public concern about the environment, as reflected in attitude and opinion surveys, follows rather closely the increased attention and coverage given these issues by the media." [4] Over the past 20 years a wide range of studies have examined the nature of the mass media's coverage of the environment and the variety of social impacts of that coverage.[5]

Mauss notes that many studies, considered along with opinion polls conducted over the years, show that concern about and attention to the environment was steadily on the rise even as actual pollution problems were declining in many areas. He concludes that "this finding can be explained, at least in part, by the attention created by mass media coverage and emphasis on pollution." [6] Munton and Bradley echo this sentiment, observing that "article after article, book after book, and commentator after commentator have informed the public about environmental pollution and told them that they should be worried." [7]

The relationship between the media and the environment is a complex one that can be fruitfully seen in the light of social problems theory. In recent years the social problems literature has generally embraced a constructivist viewpoint. Constructivists argue that

human perception of the world comes about through a process of "meaning-making," which is accomplished through the exchange of a variety of symbols: thus social reality is a constructed thing that is not defined in an absolute sense by the existence of any true reality.[8]

Fortunately, the constructivist viewpoint exists across a range of abstraction. In a more moderate form, this tradition emphasizes that evidence of social reality is present in the process of collective definition that is embedded in various forms of social exchange, most especially communication. This viewpoint offers some moderation in the constructivist argument, an argument that when taken to its opposite extreme can present a world that is virtually unknowable.[9]

Claims-making. The 1977 work by Spector and Kitsuse that brought a new focus to the constuctivist social problems literature was built upon the tradition of Mills, Gouldner, and most especially Blumer.[10] Recent entries within this tradition that address the environment include the work of Hilgartner and Bosk as well as that of Gamson and Modigliani.[11] Spector and Kitsuse focus on the process of the constructed definition of a social problem, stating that this process is grounded in "claims-making" activities: "the activities of individuals or groups making assertions of grievances and claims with respect to some putative conditions. The emergence of a social problem is contingent upon the organization of activities asserting the need for eradicating, ameliorating, or otherwise changing some condition." [12]

The idea of claims-making is the conceptual component of their model that makes it, like Blumer's, a model of reality constructed through a process of symbolic exchange. They point out that "claims-making is always a form of interaction: a demand made by one party to another that something be done." [13] These claims-making activities may take a variety of forms: writing government representatives, petitioning, protest, resolutions made by professional or other organizations, filing lawsuits, garnering media attention or simply filling out complaint forms. "All of those who involve themselves in these activities

participate in the process of defining social problems." [14] Participants may take any form: individuals, groups, crusaders, officials, news persons, professionals, or government agencies.

Spector and Kitsuse point out that much of the social activity surrounding the recognition of a problem goes on within and between social agencies such as the government, protest groups or professional organizations. While certainly not media-centric, their model can still be seen to confer power to the media. This is most critical to the legitimization stage in their model. Once a claim is recognized as legitimate and worthy of action it will also become recognized as having the characteristics of news.

Probably the most fruitful manner of applying Spector and Kitsuse's model to the question of the media's role in the definition of social problems is to use it as a basis for recognizing the media as a social clearinghouse for claims. The media serve as a conduit for communication between social agencies and as a way for those agencies to bring pressure to bear as they champion their claim. Claims that become news are those that have entered one very important arena in the struggle for legitimacy.

Framing. The metaphor of the "frame" has been spread far and wide, crossing disciplines to the degree that no summary definition is possible. In a call for communications researchers to strive toward a clarification of framing, Entman observes:

> Despite its omnipresence across the social sciences and humanities, nowhere is there a general statement of framing theory that shows exactly how frames become embedded within and make themselves manifest in a text, or how framing influences thinking.[15]

In terms of looking at media content, the commonly cited roots of framing extend to Goffman's 1974 dramaturgical perspective that frames are "schemata of interpretation" that people use to "locate, perceive, identify, and label," and subsequently to Tuchman's 1978

derivation that assigns frames the role of an organizing device that allows the journalist to more efficiently net, sort, and transmit information.[16]

More recent formulations include the 1980 work of Gitlin, who writes that media frames "are principles of selection, emphasis, and presentation composed of little tacit theories about what exists, what happens, and what matters."[17] Gamson and Modigliani consider frames as being embedded within "media packages" that can be seen to "give meaning to an issue. A package has an internal structure. At its core is a central organizing idea, or *frame*, for making sense of relevant events, suggesting what is at issue." [18] They identify five signifiers of frames: metaphors, exemplars, catchphrases, depiction, and visual images. And according to Dunwoody, when framing is applied to the content of messages it is "a schema or heuristic, a knowledge structure that is activated by some stimulus and is then employed by a journalist throughout story construction."[19]

Two recent perspectives on framing offer significant guidance toward a clearer conceptual definition and a useful operationalization. Entman offers that:

> Framing essentially involves *selection* and *salience*. To frame is to *select some aspects of a perceived reality and make them more salient in a communicating text, in such a way as to promote a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation* for the item described.
>
> Frames, then, *define problems* — determine what a causal agent is doing with what costs and benefits, usually measured in terms of common cultural values; *diagnose causes* — identify the forces creating the problem; *make moral judgments* — evaluate causal agents and their effects; and *suggest remedies* — offer and justify treatments for the problem and predict their likely effects. [original emphasis] [20]

As Entman brings some clarity to the concept, Pan and Kosicki provide a basis on which to observe frames by outlining four categories of framing devices that may be

located in news discourse.[21] Syntactical Structures are general organizing schemes that most obviously manifest themselves as the inverted pyramid. Script Structures have "distinct structure defined by the rules that may be called story grammars. A generic version consists of the five Ws and one H in news writing." Thematic Structures more commonly occur in issue-related stories as opposed to event stories. These are causal statements that can be seen as hypothesis tests having the form of a statement and then its logical support based on traditional modes of journalistic evidence (e.g., quotes, attribution). Rhetorical Devices refer back to Gamson's framing devices: metaphors, exemplars, catchphrases, depiction, and visual images.

There is some common ground between the work of Entman and the work of Pan and Kosicki. These ideas will be returned to in the operational definitions used in this study. But first, an overview of global warming's life in the news will be offered as background.

GLOBAL WARMING: CHARACTERIZING THE LIFE OF THE ISSUE.

At the heart of global warming is the proposition that human activities are altering the composition of the planet's atmosphere to a degree sufficient to affect the natural processes that play fundamental roles in shaping global climate. Many, perhaps even most, scientists agree that the release of gasses such as carbon dioxide, CFCs, and methane will have the consequence of raising the average temperature on Earth. A considerable amount of contention exists over issues such as when this might happen, how quickly it might come about, and the degree and nature of the consequences.

How can global warming's history in the news be summed? Figure 1 shows the amount of news coverage given to global warming in five major newspapers over the past decade (details of Figure 1 are addressed below). Perhaps it could be concluded that the issue of global warming has simply enjoyed its day in the sun. Puns aside, a serious problem presents itself if one considers that during the span of this decade there was little substantive change in the science that should warrant diminishing concern. It is easy to

understand the spike of attention associated with Dr. James Hansen's Congressional testimony (during the drought summer of 1988) that global warming had manifested itself. But the overall build-up and eventual decline of news coverage presents a more complex problem. The existence of a cycle of attention is clear. But in a broader sense it is important to ask what social forces might drive such a cycle and how these forces might exert themselves through the news.

Transient attention to specific issues may be typical of American public opinion, policy, and media coverage. Downs offers his "issue-attention cycle" as an explanation for such coming and goings of news coverage and public concern. In this theory he suggests that there are typically five stages to the life of a given issue.[22]

> **1. Pre-problem**. "This prevails when some highly undesirable social condition exists but has not yet captured much public attention, even though some experts or interest groups may already be alarmed by it."
>
> **2. Alarmed discovery, euphoric enthusiasm**. "As a result of some dramatic series of events, the public suddenly becomes both aware of and alarmed about the evils of a particular problem." This is combined with a reaction of overconfidence, "euphoric enthusiasm," in society's ability to discover a solution.
>
> **3. Realizing the cost**. "A gradually spreading realization that the cost of solving the problem is very high indeed." The public and policymakers also realize that the problem is being caused by a condition which is providing benefits to society.
>
> **4. Gradual decline of interest**. Three reactions occur. Some people become discouraged. Some suppress attention out of fear. Others simply get bored. Often, all three reactions operate to varying degrees. Meanwhile, another issue is on the rise and attention shifts.
>
> **5. Post-problem**. "A prolonged limbo — a twilight realm of lesser attention or spasmodic recurrence of interest."[23]

Looking at the issue of global warming in terms of Downs' issue-attention cycle is a useful way to present a brief history of the issue, and will present a useful tool for approaching the problems and results of this investigation. The time prior to 1988, when global warming was primarily the concern of scientists and top policy-makers, can easily be characterized as the pre-problem stage. During this time there was considerable scientific activity, extending back to the 1750s in fact. The policy attention that the early science produced caused some mild controversy that served to earn the issue prominent display in the news on a couple of occasions. But public awareness of the issue remained low in the absence of any sustained media attention.

An important aspect of the pre-problem stage involves the preparation of the issue for its alarmed discovery. For global warming, much of this preparation was in the form of the generally rising level of environmental concern in society[24] and the linkage of global warming to the related atmospheric problem of ozone depletion.[25] This linkage gave global warming added legitimacy and plausibility.

This preparation is also political. Between 1985 and 1988 a number of influential Congresspersons adopted climate change as an important concern. The scientists who were becoming increasingly concerned about global warming therefore had excellent access to an important public arena as conditions became favorable for the alarmed discovery of warming.

It takes little imagination to see the alarmed discovery heralded by Hansen's mid-drought Congressional testimony, set against the backdrop of the Yellowstone fires. It is interesting to speculate on how the issue might have behaved if there had not been a circumstantial heat wave that summer and if Yellowstone had not become so engulfed.

But Downs' second stage has an inherent dualism as it is also characterized by a euphoric optimism over solutions. This contrast was abundantly clear in the headlines of late 1988: Calculating the consequences of a warmer planet earth; Major greenhouse impact

is unavoidable, experts say; Scientists dream up bold remedies for ailing atmosphere; Fighting the greenhouse effect. But perhaps nothing captured this dualism better than the contrast between Hansen's testimony and President Bush's pledge to counter the greenhouse effect with "the White House effect."[26]

The third stage, a realization of the true cost, gradually replaced this optimism and alarm. This change came about primarily through actions in the political sphere. The science bashing carried out by then Chief of Staff John Sununu served to promote the idea that solving the problem of global warming would bear an enormous price tag, even though many experts disagreed. It was a fear of the economics of preventing climate change that motivated Bush to non-action and prompted Sununu to order that Hansen's written testimony be watered down.

But it was more than just politics. By 1992 the true complexity of the problem was becoming evident as nations of the world began contemplating a treaty to slow the release of greenhouse gases. Downs points out that it is during this part of the cycle that society becomes aware that the problem at hand is related to things that are held dear, things that provide benefit.

A May 25, 1992, *New York Times* business page article tells how "the price of driving a car has never been lower" because of the plummeting cost of oil.[27] It goes on to say that, world-wide, automobiles are reproducing faster than people and this poses dire consequences for global warming. Then of course, there's the complex interactions of population and economics. Another *Times* article, on the same day's front page, reveals how China's "contribution to global warming may be rising more quickly than that of any other country."[28] This is due to the fact that one fifth of earth's population is entering a period of economic growth fueled by coal. Once again, the consequences are related to global warming.

On a more fundamental level what is becoming increasingly evident is global warming's utter complexity, both scientific and social. Writing from the Earth Summit in

Rio, *The New York Times'* William K. Stevens contrasts a 1972 conference on the environment with the 1992 Earth Summit:

> In those palmy save-the-whales years, full of hope and idealism, the delegates to the United Nations Environment Conference in Sweden asserted confidently that "the capability of man to improve the environment increases with each passing day."
>
> Here, the optimism of 1972 has been replaced by a hard realism. The delegates in Rio have discovered how hard it is for nations to unite on fundamental environmental problems facing them.[29]

The article goes on to emphasize the difficulties associated with simultaneously negotiating the reduction of both deforestation in developing nations and industrial emissions in developed ones. Two aspects of the same problem, in more ways than one. The article's headline summarizes that the "Earth Summit finds the years of optimism are a fading memory."

It's unlikely that the stages of Downs cycle operate independently or in any strict linear sense. There should be considerable overlap between the grim realizations of phase three and the declining attention of phase four. There should also be other demands being made on the public's attention. The public arenas and ecologies of news perspectives tells us that there are only so many issues that can be supported at a given time and that those issues must compete with each other in a sort of zero-sum game.[30] As the difficult nature of global warming became news — and the volume of media attention began to decline — the nation was also sliding into increasingly difficult economic conditions, was captivated by Operation Desert Storm, and began anticipating the most unusual presidential election in recent memory. As Downs suggests, there were new issues to attend to.

And what of the fifth stage in the cycle? Did the issue of global warming enter "a prolonged limbo — a twilight realm of lesser attention?" News coverage of global warming

had a brief comeback in mid-1992 thanks to the Earth Summit. However, the amount of media attention to global warming during the first six months of 1993 is similar in volume to that of the first half of 1988.[31] Clinton's announcement of his "Climate Change Action Plan" in late 1993 received cursory coverage and no follow-up. Coverage in 1994 was scant. And while outside of the bounds of this analysis, another recurrence of attention occurred in early 1995 as Antarctic pack ice went to sea while the Earth Summit treaty was being reviewed in Berlin.

But Downs holds that an issue in the fifth stage of the cycle is not a simple return to its earlier state. In the wake of its rise and fall, global warming has entered the popular lexicon — even being featured in television and film drama — and has created significant international agreements. Downs points out that such factors "almost always persist and often have some impact even after public attention has shifted elsewhere."[32] So may be the case with global warming.

While examining the volume of media attention and the nature of the news story can inform many questions about the life course of this issue, much of the knowledge to be gained about global warming's history as a socially defined problem lies embedded in the content of the news.

STATEMENT OF THE PROBLEM AND OPERATIONAL CONCEPTS.

Because of their presumed influence, the media become, to quote Gurevitch and Levy (1985), "a site on which various social groups, institutions, and ideologies struggle over the definition and construction of social reality." The media, in this view, provide a series of arenas in which symbolic contests are carried out among competing sponsors of meaning.

Participants in symbolic contests read their success or failure by how well their preferred meanings and interpretations are doing in various media arenas. Prominence

> in these arenas is taken as an outcome measure in its own right, independent of evidence on the degree to which the messages are being read by the public. Essentially, sponsors of different frames monitor media discourse to see how well it tells the story they want told, and they measure their success or failure accordingly.[33]

The ultimate rationale for this study is well captured by the above passage from Gamson, Croteau, Hoynes, and Sasson. In this light it is taken that media content will capture important aspects of an evolving struggle to define a problem.

Two ideas require operationalization: claims-makers and frames. Both are closely related and are being cast under the constructionist rubric. The idea of the claims-maker is being operationally defined as a function of the attributed source. While journalists bring a great deal more to a story than a collection of sources — things like background and emphasis — it is in the source that the broader authority of the story resides. Attribution is the first lesson in journalism.

But sources are used for a wide variety of reasons, including their past history with both individual journalists and the media in general, prominence in their field, availability, and their ability to provide useful material such as interesting quotes. Nonetheless, any party wishing to place a claim in the media arena has a keen interest in becoming a source or to be represented by a source. And as was pointed out above, prominence in the news may be taken by the claims-maker as success in its own right. Perhaps the best indicator of that variety of success is the quote. While journalists quote for as many different reasons as they choose sources, from the viewpoint of the claims-maker nothing signifies successful access to the media arena quite as well as a direct quote. This study will define the claims-maker as the quoted source. The following section addressing measurement details how claims-maker categories are developed and identified.

Framing is being operationalized in concert with claims-making. In fact, for this study it will be held that the frame is the claim being made by the media and that this claim

is manifest in the macro level meeting of Pan and Kosicki's syntactical and thematic structures. In other words, the frame is the claim presented by the media in the headline and the lead paragraph (lead is addressed below). Frames of this form are held to have the four functions specified by Entman: to define problems, diagnose causes, make moral judgments, and to suggest remedies.

Locating the frame at the top of the inverted pyramid draws from Entman's emphasis of salience in his definition of framing. Within that emphasis, salience "means making a piece of information more noticeable, meaningful, or memorable to audiences. An increase in salience enhances the probability that receivers will perceive the information, discern meaning, and thus process it, and store it in memory." [34]

Restricting the operationalization of the frame to only the headline and lead places this analysis firmly on the macro level. Tradition holds that the headline and lead should be written to inform the reader as to what is most important about the story. While styles vary and there are exceptions to the inverted pyramid, journalists and their editors are aware of the fact they are competing for the reader's attention and that the top of the story is generally the point of the readers' first contact with the information content of the story.

The specification of claims-makers and frames continues below in the section on measurement. At this point the research questions being addressed may be presented:

RQ1: Can Downs' issue-attention cycle serve as a model in which the amount of coverage of this issue may be seen in terms of phases?

RQ2: How are frames and claims-makers distributed in media coverage of global warming? Do these distributions change through time?

RQ3: Are there associations among the frames and claims-makers?

METHODS.

Sample. The newspaper story is the unit of analysis, based on a set of newspapers chosen to represent national level media. Selecting a set of newspapers to represent the national media is always a somewhat debatable matter. This study follows the lead of others[35] in selecting *The New York Times, The Washington Post, The Los Angeles Times, The Christian Science Monitor,* and *The Wall Street Journal.*

Further support for this selection comes from a qualitative review which seeks to define the world's 20 most important newspapers. Merrill states:

> In the vast global wasteland of crass and mass journalistic mediocrity is a small coterie of serious and thoughtful internationally oriented newspapers that offers a select group of readers an in-depth, rational alternative. . . . They are well-informed, articulate papers that thoughtful people the world over take seriously.[36]

Merrill cites the five papers above plus *The Miami Herald* as the best in the United States (in no assigned order). Two other factors support this selection. Each of the five papers selected is generating its own coverage of the issue at hand through the employment of its own science writers. Therefore, each story selected from these newspapers is original and unique. Many of these stories go on to live a second life in other papers across the nation via the Associated Press and other wire services. Finally, this set of five newspapers is represented in a single consistent reference index: the *National Newspaper Index.* [37]

Only news stories are used in this study. News stories are defined as content containing references to global warming or the greenhouse effect, excluding editorials, opinion columns, letters to the editor and advertisements. The selection of stories was done using a computerized version of the National Newspaper Index.

Across the period of the study approximately 500 items on global warming appeared in these newspapers. Only about half that number was determined to be necessary to empower statistical analysis. However, subsequent analytic needs involving comparison of distinct phases of coverage necessitated over-sampling of the early and late phases of coverage (determination of the Phases is discussed shortly). Therefore, a random half of the stories that fell in Phase 2 were selected and all of the stories that fell in Phases 1 and 3 were selected. The final sample yielded a total of 252 stories entered into the analysis.

Measurement: Claims-makers. As discussed above, claims-makers are being operationalized as quoted sources. Examination of the full content of the *Washington Post* coverage revealed the following categories of individuals quoted: university scientists, government scientists (NASA, NOAA, etc.), other scientists (including foreign), Congresspersons, Presidential administrations, foreign officials, environmental interest groups, business and industry interest groups. All but 6, or 98% of all quoted sources, fell into these categories. For analysis, categories were collapsed to scientists, politicians, and interest groups.

The number of quotes for each category were summed by story for an interval level measure. Distributions were found to be highly skewed, so a nominal level measure was also computed as the presence or absence of each source category in a story.

Measurement: Frame. Frame is being conceptualized as the claim presented in the highest syntactical structures, the headline and the lead. A qualitative reading of all headlines and lead paragraphs in the *Washington Post* revealed four prominent categories that agreed well with Entman's four purposes of frames:

1. Define Problems: impacts of global warming. These stories deal with what will happen as a consequence of this phenomenon. Impacts may be negative (coastal flooding), positive (improved regional agriculture), or debated.

2. Diagnose Causes: evidence as to the realty of global warming as a problem. These are typically presentations of scientific findings that support the idea that there is a problem

(evidence of rising sea level), refute the idea that there is a problem (evidence that changes are within limits of natural variance), or present the argument that the nature of the problem is unknown.

3. Make moral judgments: action statements. These stories present general statements calling for action or reporting action taken (U.S. should sign a treaty, did sign a treaty), arguing against action or reporting action blocked (emission standards not needed, scientific testimony altered), or present the argument that a course of action is not clear.

4. Suggest remedies: provide specific information about how solutions should be implemented. These stories report specific solutions that have been proposed or implemented (tougher emission standards), solutions that have been rejected or deemed inadequate (voluntary programs), or present a debate about a specific solution or solutions. Note that the specificity of the solution — a statement of exactly how the solution should be carried out — is an important distinction between an action statement and a solution statement.

All but 17, or 93% of all stories fell into one of these four categories. Most of the stories could be classified by reading only the headline. When headlines were ambiguous (often because they were too short) the first paragraph was read. Most stories were classified by this point. In a few cases it was necessary to read into the story by an additional paragraph or two (typically when the story begins with an anecdote). The goal of the classification is to identify the most immediately identifiable characteristic of the story with respect to the four categories.[38]

DISCUSSION OF THE RESULTS.

Figure 1 presents the distribution of the sample through time and Figure 2 presents the distribution of stories through the 5 newspapers (without over-sampling). Inspection of this distribution supported the idea that the attention paid to this issue might be divided into distinct phases for analysis.

Using the ideas of Downs, three distinct phases were identified. The overall distribution fits Downs' 5 stage model fairly well. Downs proposes that attention to an issue will remain low until a dramatic discovery brings a sudden increase in salience. While the issue-attention cycle does not offer specific predictions about changing salience during the middle three stages it does suggest general aspects of the content of these stages and also suggests that salience during these stages should be at its highest before feathering into a decline. Finally, Downs directly predicts that the final phase will involve a lowering of the salience of the issue, but not a lowering to the levels seen in the first stage.

An examination of the time distribution of stories clearly suggests 2 important points in the series: mid-1988 when Hansen testifies before Congress and mid-1992 when the Earth Summit concludes. A fifth order polynomial was found to fit the data so that the important points in the issue fell near the curve's inflections. The curve clearly suggests Downs' overall propositions as they would be applied to the volume of media attention. Dividing the series into these three segments and fitting linear functions to each segment shows that the means and the slopes vary between the phases (analysis of variance significant at $p < .001$).

Stories were thus coded as being in Phase 1, 2, or 3. Because of the content of the news, the three phases are being labeled as pre-controversy, controversy, and post-controversy.

Regarding the relationship between frames and claims-makers, it is first necessary to report the obvious: political and special interests are strongly associated with the judgment frame while scientists are strongly associated with the causes frame. This is true across the full span of the decade, as shown in Figure 3.

More interesting results are found by examining changes across phases in prevalence of each claims-maker and each frame. Figure 4 shows that there was a significant decline in scientists as a percentage of all claims-makers quoted across the decade.[39] Quotes of political and special interest claims-makers both increased slightly, but not significantly.

Previous research on global warming by Miller and others has shown that scientific sources were being crowded out by political sources during the late 1980s.[40] This analysis of a full decade supports their observation and shows that it is part of a longer-term trend.

It is an open question as to why scientists declined as quoted sources so dramatically. Of course it must be recognized that story space is a finite resource. Although not statistically significant, special interests made the second largest gain across the decade. Mazur and others have noted that as the issue of global warming matured the cold war as simultaneously coming to an end. This allowed a number of scientifically-oriented special interest groups (for example the Union of Concerned Scientists) to shift their attention from nuclear weapons issues to environmental issues such as global warming.

An equally interesting question looks at how the prevalence of frames shifted as the issue evolved. Figure 5 shows that the framing of the issue moved away from defining problems and diagnosing causes and toward making judgments and suggesting remedies. These results can again be seen as a situation in which a set of perspectives must compete for finite space in a limited number of stories. The relationship that exists between the results in Figure 3 and the results in Figure 4 can be seen in terms of the impacts reported in Figure 5. As politicians and interest groups were increasingly successful in making their claims (Figure 4) they brought along their associated frames (Figure 3) in a process that influenced the make-up of the content of the news (Figure 5).

These results beg the interesting question of the relative role of claims-making and framing in the changing attention that the media give to the issue. How do claims-makers and frames compare in their ability to predict the amount of coverage given to the issue? To address this question a secondary dataset was extracted as a time series. The unit of analysis was set as 2 month periods (n = 60) and interval level variables were created as: number of stories per unit, number of quotes for each claims-maker category per unit, and number of stories for each frame in each unit. Each unit was assigned to one of the three phases.

First, what relationships exist within the variables representing claims-makers and frames? It must be noted that these variables are highly correlated with one another because each is a product of the number of stories in a given 2 month period (average correlation .38 with upper range of .89). Measures of association involving claims-makers, frames, and the number of stories must be used with caution because they contain a strong spurious element. However, it is reasonable to see if the set of claims-maker and frame variables form interpretable factors that could describe their relationship and that might be useful in further analysis.

Table 1 presents a factor analysis of the frame and claims-maker variables that provides a satisfactory solution. The associations found in the crosstabulations are upheld here as it is shown that political and special interest claims-makers group together with their associated frames to form one factor while scientists and their associated frames group to form another. An alternative result would have found frames grouping together and claims-makers grouping together. This strongly suggests that the two concepts of frames and claims-makers are part of a larger single concept relating to the content of news discourse.

How well do these factors perform in predicting the most salient characteristic of the issue — the dramatically changing amount of news coverage? While, as noted above, the absolute strength of an association with the number of stories per unit of time involves a spurious element, it is reasonable to pit the two factors against one another in a relative evaluation. Table 2 present the results of an analysis in which the number of stories per unit is regressed on dependent variables made up of factor scores (the political-interest factor is simply being called political for the remaining analysis). The political factor proved to be only a slightly stronger predictor of the number of stories, in fact there is not a significant difference in the two equations.

Discriminant analysis was used to more thoroughly evaluate the relationship between the two derived factors and to use them to judge the validity of the three proposed phases.

Table 3 reports the results of three discriminant analyses in which each factor was first evaluated by itself before the two were combined in a single analysis.

Taken individually, it is seen that the scientific factor does a somewhat better job than the political factor in correctly classifying cases into the three phases, presenting classification rates of 50% and 45% respectively. Both rates are moderately successful as compared to the 33% rate that would be expected by chance. An examination of the relative success rates for each phase (on the diagonal in each matrix) shows that the political factor did an excellent job in correctly classifying Phase 1 but did a poor job of distinguishing between Phases 2 and 3. On the other hand, the scientific factor did an equally good job of distinguishing between Phases 1 and 2 but a poor job classifying Phase 3. This can be explained by the changing prevalence of claims-makers and frames in each of the phases.

If both factors are entered into the analysis together they combine to do a quite respectable job of correctly classifying the matrix, hitting the mark 63.3% of the time, a marked improvement over the 33% chance rate. This clearly indicates that the two factors overlap considerably in their relationship within the three phase model. Further, it is again seen that the classification rates on the diagonal decline across the phases with Phase 1 being perfectly classified while Phase 3 is less well classified.

CONCLUSION.

This project does not hold as an express purpose the operationalization of Downs' issue-attention cycle. But the model can be used as a more general basis for a division of the decade's media coverage of global warming into three distinct phases. Inferring from Downs' model to what might be expected to be seen regarding the amount of media attention to an issue does allow the first research question to be affirmatively resolved.

It must be emphasized that Downs' issue-attention cycle is a social process model and is not specifically designed to evaluate news media attention to an issue. Nonetheless, elements of the issue-attention cycle do seem to fit a qualitative reading of the news

coverage of global warming. This, combined with the good fit between the observed quantity of news attention and the expectations of the Downs model, suggests that it might be reasonable to interpret the three phases used in this study as a partial expression of the issue-attention cycle.

The results of the second research question show that scientists become less dominant sources as the issue matures. At the same time the emphasis of the news coverage shifts away from a presentation of the issue in terms of its causes and problematic nature and toward a presentation more grounded in political debate and the proposal of solutions. These observations seem to dovetail most closely with the first three stages in the issue-attention cycle. The progression from the pre-problem stage, to alarmed discovery, and then to a realization of the costs strongly suggests that there should be a politicization of the issue, an increase in its level of controversy, and a shift toward judgments and solutions. That progression was observed in this study.

Overall, these results suggest that the most appropriate way to relate Downs' model to the changes observed in media coverage of global warming is to argue that what has been observed across this decade is just the first three stages of the cycle. This would predict that the years following 1994 should present a continued decline of media attention to the issue punctuated only by a "spasmodic recurrence of interest," as Downs' puts it. A casual observation of the issue during 1995 suggests that this is in fac what is happening. A follow-up study may in future years provide evidence of this.

The results of the third research question apply less to the issue-attention cycle and more to the theoretical basis of this investigation as it relates to news media coverage of environmental controversies. To answer the third research question: yes, strong associations do exist between the claims-makers and frames observed in this study. What might these associations tell us about journalistic coverage of environmental controversy?

The results show that there is greater independence between phases and frames than there is between phases and claims-makers. Thus, changes that occurred in the life course

of the issue perhaps involved shifts linked to who was getting their message into the media rather than how the media was choosing to present the information. It may be reasonable, at least in this case, to argue that a good deal of the journalistic discretion that goes into shaping media coverage of an environmental controversy occurs by way of deciding which sources to use and how much overall attention to give the issue. These decisions seem to hold more sway over the life of an issue compared to the decisions that allow a point of view — a frame — to dominate a story. In essence, this supports a model of transmission rather than processing: reporting over interpretation.

The more alarming aspect of the results of this study is unfortunately also the least surprising: that scientists left the debate as it heated up. In fact, scientists found themselves sharing a shrinking portion of a growing media pie during an important part of the public debate over global warming. Whether they were squeezed out by other sources or chose to become distanced from an increasingly political debate is an open question.

Figure 1. Items in 5 Newspapers, by Quarters 1985-1995
Based on 50% sample, divided into three phases with linear fits compared.

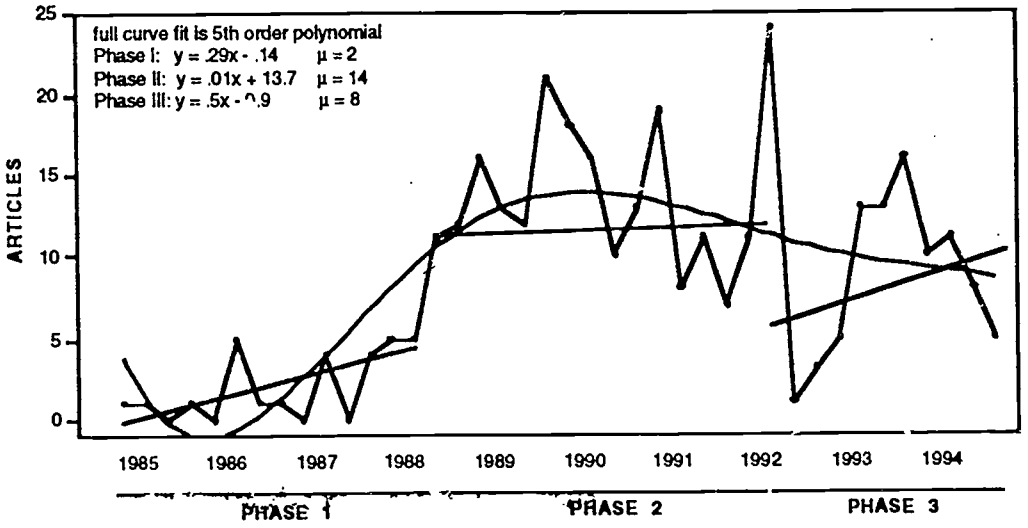

Figure 2. Distribution of newspaper articles by phase (n = 252).

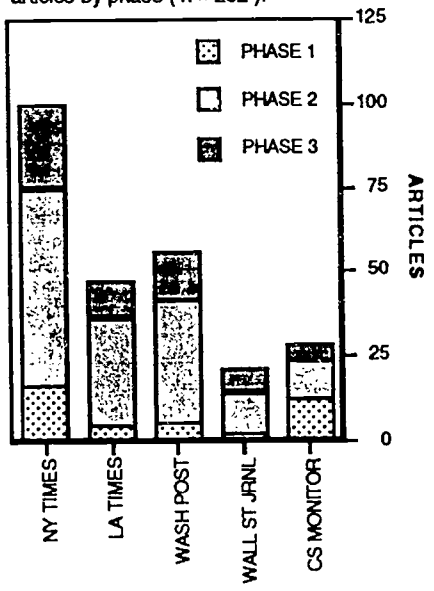

Figure 3. Sources by frames: presence or absence of each source for each frame during full time span. N = 252 in each of the three crosstabs. Chi-squares: scientists = 96, politicians = 66, interests = 27, all p < .001.

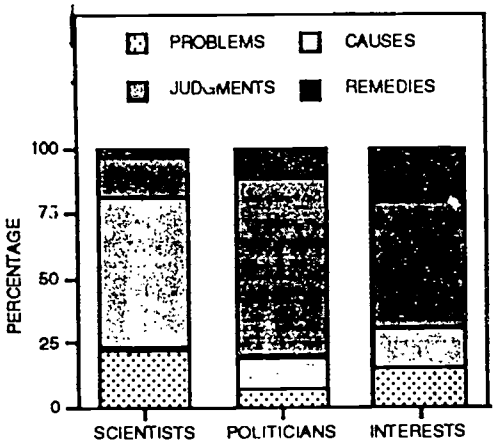

Figure 4. Phases by sources: presence or absence of each source in each phase. N = 252 in each of the three crosstabs. Chi-squares: scientists = 17 p < .001, politicians = 3 n.s., interests = 4 n.s.

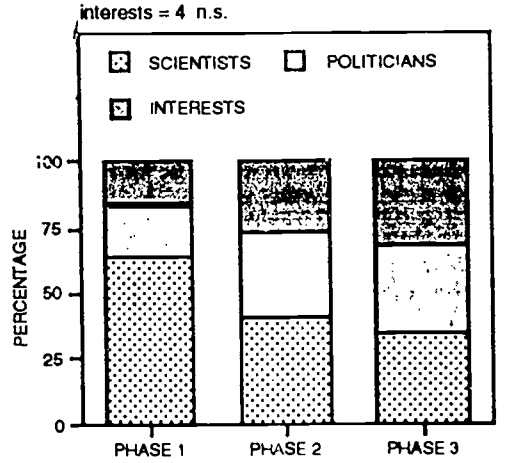

Figure 5. Frames by phase: percentage each frame type in each phase. Chi-square for full table = 22, p < .001, n = 235.

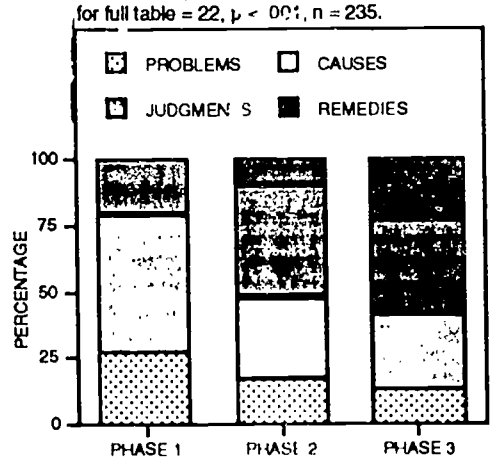

Table 1.
Factor Analysis: Claim and Frame Variables

Variable	Mean	SD	Factor 1 Political Debate	Factor 2 Scientific Proclamation
Claimsmaker: Special Interest Sources	2.4	3.5	.85 *	.12
Frame: Remedies for Problem	0.5	1.1	.84 *	-.33
Claimsmaker: Political Sources	3.2	4.8	.76 *	.48
Frame: Moral Judgments about Problem	1.5	2.2	.70 *	.55
Claimsmaker: Scientist Sources	5.5	5.4	.22	.87 *
Frame: Causes of Problem	1.3	1.3	.19	.86 *
Frame: Problem Definition	0.7	0.9	-.09	.53 *
Percentage of total variance explained			48.5	23.3

Principle components analysis with varimax rotation. Two factors explain 71.8 percent of total variance, n = 60.

Table 2.
Regression Analysis: Comparison of Factor Scores.

Dependent variable = number of stories in 2 month period, n = 60.

Independent Variable	R^2	Std. Beta	t value	*p*
Fact Score: Political	.50	.71	7.6	<.001
Fact Score: Scientific	.45	.67	6.9	<.001

difference between equations not significant

Table 3.
Discriminant Analysis: Comparison of Political and Scientific Factors.
For the case of a 3 group analysis, n = 60.

Ind. Variable: Factor Score Political		Predicted Phase		
Actual Phase	N	Phase 1	Phase 2	Phase 3
Phase 1: Pre-controversy	20	100.0% (20)	0.0% (0)	0.0% (0)
Phase 2: Controversy	25	44.0% (11)	12.0% (3)	44.0% (11)
Phase 3: Post-controversy	15	46.7% (7)	26.7% (4)	26.7% (4)

Prior Probability = 33% Correct Classification = 45.0%
Canonical Correlation = .39 Wilks' Lambda = .85 $p < .01$

Ind. Variable: Factor Score Scientific		Predicted Phase		
Actual Phase	N	Phase 1	Phase 2	Phase 3
Phase 1: Pre-controversy	20	55.0% (11)	5.0% (1)	40.0% (8)
Phase 2: Controversy	25	20.0% (5)	60.0% (15)	20.0% (5)
Phase 3: Post-controversy	15	46.7% (7)	26.7% (4)	26.7% (4)

Prior Probability = 33% Correct Classification = 50.0%
Canonical Correlation = .46 Wilks' Lambda = .79 $p < .01$

Ind. Variables: Scientific and Political		Predicted Phase		
Actual Phase	N	Phase 1	Phase 2	Phase 3
Phase 1: Pre-controversy	20	95.0% (19)	5.0% (1)	0.0% (0)
Phase 2: Controversy	25	36.0% (9)	48.0% (12)	16.0% (4)
Phase 3: Post-controversy	15	33.3% (5)	20.0% (3)	46.7% (7)

Prior Probability = 33% Correct Classification = 63.3%
Scientific: Canonical Correlation = .27 Wilks' Lambda = .66 $p < .001$
Political: Canonical Correlation = .54 Wilks' Lambda = .79 $p < .01$

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[38] Coding for the other variables involved manifest content and required very little (if any) judgment, so reliability was not evaluated. Coding for the frame variable does involve judgment so an inter-coder reliability test was executed. A value for Scott's pi of .85 was achieved and deemed acceptable.

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Risk Perception in Community Context.

Evaluating the psychometric paradigm and its relationship
to risk amplification and reported communication channel usefulness.

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ABSTRACT

This project incorporates three sequential steps. First, the psychometric model of risk perception is evaluated for its validity under field conditions. Second, individuals are classified as amplifiers or attenuators within the social amplification of risk model. Finally, the characteristics of attenuators and amplifiers are explored, with special focus on their use of communication channels. Survey data from an on-going case study is employed in the analysis. The case study involves a mid-western community in which a controversy exists over the possibility of the existence of a cancer cluster caused by the operation of a small reactor.

Results show that the psychometric model of risk perception has validity under the field conditions utilized in this study. Use of the psychometric model to classify individuals as risk amplifiers or risk attenuators produces a useful dichotomy that reveals differences between the two polar groups in terms of demographics, satisfaction with institutional response to the risk, concern over individual and social levels of risk, and the evaluation of various communication channels as having been useful in coming to a judgment about the risk.

A final model comparing the two groups suggests that, in this case, two dominant forces are in play against one another: an evaluation of personal risk versus satisfaction with the institution managing the risk. Subordinate to these forces are the demographically based variables of education and years of residence in the community. This model also illustrates that aggregate-level observations may not be fully characteristic of underlying processes of polarization.

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1. INTRODUCTION

Risk has recently grown as a topic of interest within the field of communication, with two related problems generally of greatest interest. The first involves the nature and consequences of news media representation of risk, typically with respect to technological or environmental controversies. The second area involves the difficulties encountered by scientists and other experts charged with informing the lay public about their risk from various natural or man-made hazards. The second area has most involved communication researchers in the area of risk perception: understanding how the individual perceives and makes judgments about risks faced in life.

This investigation has the overarching goal of advancing understanding of how individuals come to a judgment about risk. This goal includes a focus on the role of communication channels within the process of risk judgment.

This project incorporates three sequential steps. First, the psychometric model of risk perception is evaluated for its validity under field conditions. Second, individuals are classified as amplifiers or attenuators within the social amplification of risk model. Finally, the characteristics of attenuators and amplifiers are explored, with special focus on their use of communication channels. These areas of the literature will be addressed following a description of the case study being utilized in this project.

2. CONTEXT: THE CASE STUDY

Since the Manhattan Project, the U.S. Department of Energy has operated its Ames Laboratory at Iowa State University in Ames, Iowa. The wartime assignment of the Ames Lab was to purify enriched uranium for use in the atomic bomb program. Since then the Ames Lab has continued to be involved in ceramics and metals development, methods of non-destructive

analysis, and the development of environmental remediation technologies. Ames Lab is also very active in the area of technology transfer.

Over the years, various activities and accidents at the Ames Lab have created a handful of waste sites in the Ames area. The Ames Lab and the citizens of Ames have recently been in conflict over three such situations. The first involves the construction of a youth sports complex on a site contaminated in 1953 by low-level radioactive thorium. Despite being cleaned-up in 1988, community resistance stalled the city's plans to build there.[1] The second issue involves the clean-up of a waste burial site in Ames where some 7,000 pounds of low level radioactive and other mildly hazardous materials have been interred for about 40 years. The DOE has recently concluded the remediation of that site.[2]

The third issue involves a small research reactor that the Ames Lab and Iowa State University jointly operated from 1965 until decommissioning in 1981. Some residents of the Ross Road neighborhood (one-half mile directly south from the former reactor site) believe that they are now part of a cancer cluster caused by the reactor. One section of the neighborhood had 13 cases. Two epidemiological studies have been done. The first was inconclusive and the second found that cancer rates in the area were not significantly above normal.

To address concerns in the community, the Ames Lab has hosted four public forums, a community workshop, and has created an information repository on reserve at the ISU library. These issues have also received a fair amount of attention from the local newspaper.[3]

This investigation has as its primary focus the third issue: the perceived cancer cluster. This issue is being emphasized for two main reasons. First, it is of an enduring nature. It predates the other issues and will out-last them as well. Second, it is an intractable problem: there is no evidence of a cancer cluster — and even if there was such evidence it could not be causally associated with the former reactor. While the cancer cluster issue cannot be termed a "hot button" topic, it is a issue that is widely known of in the community. The key aspect is that due to the general recognition of the issue most individuals have had to come to some conclusion about it.

In more general terms, the situation faced by Ames residents is not uncommon. Many communities face relatively small and localized hazard issues. Cases like Love Canal or Times Beach capture high media attention, but are atypical of the experience Americans more commonly have with environmental hazards. Understanding how individuals perceive their situation relative to this variety of hazard and how they use information channels to form opinions is a task of some importance.

3. LITERATURE

To frame the primary questions of this investigation, three areas of literature will be briefly examined: the psychometric model of risk perception, the social amplification of risk model, and communication channel utility.

The Psychometric Model. A considerable amount of research has been done in the area of risk perception. Dunwoody and Neuwirth prefer the term "risk judgment" to emphasize the active information processing inherent in the construct.[4] In any case, the psychometric model of risk perception has grown from research that asks individuals to compare a range of hazards based on a set of attributes, such as how well the hazard is understood or how many people might be affected by the hazard. The research has consistently shown that people evaluate hazards not only on the hazard's objective harm (e.g., deaths per year) but also on a range of more subjective criteria.[5]

The series of projects initiated by Fischoff and coworkers, and carried on by Slovic and associates, have shown that two important dimensions can be seen to describe the perception of risk.[6] [7] One dimension of risk is termed dread. This is related to the scale of the risk and the degree to which it impacts innocent individuals. The second dimension, termed knowledge, involves how well a risk is understood and how observable its consequences are.

The model has since been widely replicated and cited. The risk space model has been validated in various countries and researchers have also expanded risk into additional

dimensions using a wide variety of attributes such as the number of people affected or the voluntariness of the risk.[8] [9] Non-human mortality and transgenerational effects have also been examined as risk perception factors.[10] But the basic premise of the two dimensional psychometric risk perception model has remained essentially unchanged.[11]

Some salient criticisms of the model have been addressed, including consistency among individuals in risk perception and the nature of risk perception within a single technological domain.[12] The model held up in these investigations, and also faired well in a reanalysis of the original data carried out by Gregory and Mendelsohn, who also found that perceived benefit plays a role in risk perception.[13]

While these studies do suggest a remarkable validity to the psychometric model, an important weakness remains in this direction of research: risks are examined in the abstract. People can certainly be called upon to evaluate a set of risks, or attributes of a single risk, even though they do not personally face that risk as an important aspect of daily life. But is it safe to assume that people perceive or judge risk in the same way when it involves a "live risk," a hazard or a risk controversy that is part of daily life?

This question is not ignored in the literature. Risk perception studies have looked at specific risks in context. Such research has typically been in the form of case studies.[14] While these studies and others have great merit, they have not employed the psychometric risk perception model. It would be useful to know if the psychometric model can be used to understand the perception of such local hazards. That is the first issue to be addressed in this study.

Social Amplification of Risk. In response to the acute need to find some way to bring the diverse array of perspectives on risk, risk perception, and risk communication together into an integrative framework, Kasperson and coworkers formulated the social amplification of risk.[15]

Social amplification of risk holds that the communication and behavioral responses of individuals, groups, and institutions operating under a risk event or controversy act as

"amplification stations." It is the interaction among the risk interpretations and responses of these stations that determine the nature of the life course, or "rippling," of the risk event or controversy.

Within the concept of the amplification station exists a linkage between the macro level social functions of institutions or groups and the micro level processes that operate within and between individuals. Kasperson conceptualizes the micro level functioning as "individual stations of amplification" and the macro level analog as the "social stations of amplification."

Social amplification is primarily a framework in which to utilize a variety of discrete theories and methods. Renn describes how social amplification might integrate the strengths and weaknesses of the social, psychological, and cultural approaches to risk.[16] The distinctive problems of each approach — social relevance for psychometrics, complexity for sociology, and empirical validity for cultural theory — may tend to cancel out and allow for an emergent perspective.

The full application of the social amplification framework is a complex and long-term research goal. The present investigation has a more specific focus: to develop an understanding of how individuals can be classified as being either amplifiers or attenuators within the concept of the individual station of amplification. The existence of this dichotomy is a key micro-level prediction of the social amplification of risk model.

Since no objectively-based definition of risk exists in this case study it must be held that amplifiers and attenuators exist relative to each other by way of their perception of risk from the threat — as opposed to existing relative to some "true" condition. In other words, there is no "correct" position in this controversy. Within this framework, the evaluation of individuals' perception of risk might be based on the psychometric model and this evaluation may in turn be used to group individuals as either amplifiers or attenuators.

While largely a semantic matter, placing amplifiers and attenuators under the umbrella of amplification (in its engineering guise as to either increase or decrease) can create unnecessary confusion. Rather, the idea will be recast as what it essentially is: polarization.

Channel Utility. The final aspect of this study seeks to examine the information channels people use in forming an opinion about a perceived risk. The focus of cor. .m will be the relative roles of mass communication, interpersonal communication, and other forms of information-seeking behavior.

Chaffee presents an argument that the dichotomy of mass versus interpersonal communication has been endowed with excessive polarity.[17] His analysis of the literature builds the case that individuals use a given channel based on how accessible the channel is and how likely the individual believes it is that the desired information will be found in a particular channel. In this light, it should be emphasized that this research does not seek to determine mass or interpersonal supremacy, but rather to assess the various ways in which individuals use both channels in coping with a specific risk situation and how these channels relate to other forms of information-seeking.

A handful of studies inform this question. Mazur and Hall examine how members of a New York county evaluate the risk of radon as either a specific concern in the home or as a more diffuse national hazard.[18] They find that neither interpersonal contact with family members nor mass media messages correlate with a specific concern about radon in the home. However, both were strongly correlated with a more general concern about radon as a national hazard, with family influence considerably stronger than mass media influence.

McCallum and coworkers compared mass media and interpersonal channels as preferred ways of gathering information about toxic chemicals in the local environment. They surveyed subjects in six communities around the nation that were facing toxic chemical issues and found that mass media channels were strongly preferred as sources of such information. Interpersonal sources were used only 12% of the time.

Following Tyler and Cook's observation that mass media impact social-level judgments more than individual-level judgments,[19] Coleman found that mass media are stronger than interpersonal channels in influencing society-level risk judgments.[20] Mass media also had some influence on personal risk judgments, an effect which interpersonal channels did not have.

Contrasting the variety of findings in these studies goes to Chaffee's argument: interpersonal and mass communication channels have varying roles in shaping people's perceptions and no broad generalization can hold. The role of other information-seeking behavior is less clear from these studies. Chaffee points out that people have varying abilities to use other information resources, such as libraries or expert opinion. Dunwoody and Neuwirth also point out that people probably make different use of various channels during the life span of their relationship with a given risk. This study will attempt to address these issues, looking at the relative usefulness of mass communication, interpersonal communication, and other forms of information-seeking in the process of risk judgment.

4. RESEARCH QUESTIONS

This study is both confirmatory and exploratory in nature. It seeks to confirm that the psychometric model describes how individuals in this case study evaluate the given risk. It also seeks to confirm that the individuals engaged in this risk controversy can be productively seen as being polarized into amplifiers and attenuators. Finally, it seeks to explore the characteristics of polarization and look for important differences between the two camps. Toward these ends, this study employs a set of three research questions:

RQ1: Do individuals evaluate the given risk in terms of dread and knowledge as the psychometric model predicts?

RQ2: Based on the psychometric model, can individuals be consistently grouped as amplifiers and attenuators as polarization predicts?

RQ3: What differences are there between attenuators and amplifiers in terms of the demographic, risk, and channel use variables measured?

5. METHODS

A mail survey instrument was developed to achieve the goals of this investigation. The instrument consists of three general segments. First, the set of original psychometric model questions were modified slightly to fit the specific issue at hand. While researchers have expanded and modified this set of questions, the model is most strongly associated with nine aspects of dread and five aspects of knowledge. These questions are shown in Table 1. The second part of the instrument consists of a set of questions seeking to ascertain what sources of information people have found to be useful in making judgments about this risk issue. Questions are also asked concerning satisfaction with attention paid to this issue by local media, Ames Lab officials, government representatives and others. Finally, a few general demographic variables are included.

The sampling unit is the non-rental household. Subjects are drawn from the northwest quadrant of Ames — the area defined by previous epidemiological studies and by stories in the *Ames Daily Tribune* .[21] The area is also defined by social and geographic boundaries: the city limits to the north and west, and a large park to the south and east. The current Polk's City Directory for Ames was consulted as a sampling frame. A random sample of 50% identified 223 households to participate in the survey. Either principal adult member of the household could complete the questionnaire.

Mail survey procedures described by Dillman[22] were adhered to and the survey arrived in Ames on about September 23, 1994. The survey return period was closed on November 1, 1994. At that time, 130 questionnaires were received for a return rate of 58 percent.

6. DISCUSSION OF THE RESULTS

The first task is to evaluate the psychometric model and determine if it can be used as an effective means of proceeding with the analysis. The 14 questions shown in Table I were entered into a factor analysis. The rotated factor matrix was virtually uninterpretable. The results presented one strong factor with a mix of knowledge and dread variables and several weak factors with one or two variables each. No clear pattern was discernible.

The further evaluate the model, the communalities of the variables were examined to see if there were any very weakly associated variables that might be appropriately excluded from the analysis (overall, the KMO statistic was adequate at .75). All variables but one had strong communality: the dread variable FATAL describing the likelihood that any illness from the risk would be fatal. This single weak variable was ejected and the factor analysis was again executed. Table II presents the results. With the exclusion of the one weak variable the rotated matrix provides a satisfying solution that conforms well to the prediction of the model.

One knowledge factor emerges made up of individual and scientific knowledge about the risk, how familiar the risk is to the individual, and how observable the consequences of the risk are to the individual. Dread appears to be made up of 2 components. Factor 2 might be called "pure dread" as it consists of elements that relate more clearly to fear: catastrophe, transgenerational effects, an increase in the risk, and being unable to calmly contemplate the risk. Factor 3 appears most closely related to the idea of personal efficacy. This factor involves the individual's ability to control exposure to the risk, ability to exercise choice in accepting the risk, and personal ability to reduce the risk. These all speak to the degree of individual agency with respect to the risk. A fourth uninterpretable factor emerged that has an equal measure of both knowledge and dread.

Overall, the solution to the factor analysis supports the application of the psychometric model in this field situation, satisfying the first research question. This is a fairly important result in itself since the psychometric model has been most frequently applied to the evaluation

of individual perception of a range of risks considered in the abstract. This analysis suggests, at least for the specific risk examined in this case, that individuals may indeed evaluate risks they face through processes that can be understood in terms of knowledge and dread.

The four factor solution approaches but does not completely satisfy the proposition of a two-dimensional model of risk perception. Questions remain: how do the four factors relate to one another, are the two dread factors associated, and how should the fourth uninterpreted factor be treated? To resolve these questions, factor scores were treated in a second-order factor analysis. The resulting two factor solution grouped the dread factors together and grouped the knowledge factor with the fourth uninterpreted factor. With this result taken as evidence of association, variables for the dimensions of dread and knowledge are created by averaging the associated factor scores. Both variables are approximately normal with mean of 0 and are uncorrelated.

The second research question asks if the psychometric model might be applied to the task of separating individuals into amplifiers and attenuators. The literature on the recent concept of social amplification does not suggest what characteristics might indicate the two groups. To define the groups, the variables dread and knowledge are plotted against each other and the scatter is divided at the mean created by the line with slope -1 running through the origin of the plane.

A discriminant analysis was run to confirm that this method of group determination is in fact consistent with the nature of the original variables being used. The classification analysis used the full set of 13 variables to predict the polarization groups. The classification matrix shows strong agreement that the 13 variables can identify two groups divided along mean responses to dread and knowledge. The analysis correctly classifies 100% of the cases, identifying 54 amplifiers and 40 attenuators (some cases are lost due to incomplete responses). No significant differences were found between this group of 94 and the 36 other survey respondents.

Research question three asks what differences might exist between the two polarization groups. Table III provides the significant results, which can be organized in blocks: demographics, risk perception and behavior, satisfaction with institutional response to the issue, and the reported usefulness of various information channels.

Two of the demographic variables show a significant difference between attenuators and amplifiers. Both gender and education are significantly related to polarization. While amplifiers are slightly more likely to be female, attenuators are very much more likely to be male (overall, respondents are 47 percent female). Attenuators also have typically completed more education, with over half having completed a graduate degree (recall that Ames is a college town). As these results suggest, further crosstabulation confirms that gender and education are significantly related with males having more education. The respondent's age is independent of group status.

Two other demographic variables approach significance and are worth discussion. It was suspected that the presence of cancer in the respondent's family might tend to be related to amplification. The data show this association, but only at a weak level of significance ($p = .11$). Length of residence in the area is also of interest since the reactor was removed in 1981. The data again provide weak evidence for this association ($p = .098$). Amplifiers tend to be newer to the area, with a mean length of residence of 15 years as opposed to 20 years for attenuators. It may very well be a coincidence that the reactor was removed 14 years ago. Nonetheless, amplification may be intertwined with a fear of the unknown, as some of these individuals have never actually seen the former facility. It is also likely that generational differences may exist between the two groups with respect to environmental values and trust in government, for example

Risk perception and behavior variables provide a number of significant differences between the two groups. Taken together, these items might be roughly conceptualized as worry. Most of these differences would be expected by virtue of the method of differentiating the groups. As such, they also provide additional support for the validity of the two groups. Amplifiers think about and talk about the cancer cluster issue more frequently than attenuators

and also feel that both they and others are at greater risk. These differences are quite pronounced. On the other hand, there were no significant differences found when asking how long an individual had been aware of the issue or when asking what actions an individual might have taken because of concern over the issue. Further, attenuators are no different from amplifiers when it comes to knowing other individuals in the area who have cancer.

The set of four satisfaction variables were all predictably different. Attenuators are uniformly more satisfied with attention paid to the issue by Ames Lab, by elected officials, and by the news media. They are also more satisfied with the results of the existing epidemiology.

The channel usefulness variables provide rather dramatic results in terms of non-significance. Of the 10 sources of information evaluated as having been useful in making a judgment about personal risk, only neighbors reveal a significant difference between the two groups. Usefulness of family members differs between the groups, but only weakly ($p = .076$). Amplifiers rated both neighbors and family members as being more useful sources of information. The 8 information sources that showed no difference between the groups were the newspaper, television, friends, physician, elected officials, Ames Lab officials, public meetings, and the library's information repository.

Ranking of the usefulness of information channels is different for the two groups. An examination of the means of the 10 source usefulness variables shows that both groups rated the newspaper as the most useful source of information. After that, the rankings diverge. Amplifiers' top five are newspaper, neighbors, television, friends, and family. Attenuators' top 5 are newspaper, television, friends, neighbors and Ames Lab officials. Spearman's rho between the two rankings of 10 items is only .11 (not significant). This lack of association in the two groups provides evidence that the two groups are utilizing information sources differently.

For the next step in the analysis, all of the variables found to be significant (at $p < .1$) in detecting group differences were entered into a discriminant analysis. Table IV presents the results. The discriminant function produced by the 13 variables performed well, significantly

accounting for about 40 percent of variance. Correlations between the individual discriminating variables and the discriminant function can be interpreted as an indication of the relative strength of the variable's contribution to discriminating the groups. Further, grouping variables by the sign of the correlation can be useful (note that all variables are analyzed simultaneously and contribute to case assignment to both groups).

Variables are sorted by sign and listed by size of the correlation. It can be seen that evaluation of personal risk, risk to others, frequency of thinking and talking about the issue, and the usefulness of neighbors and family are grouped together. Conversely the grouping of positive correlations include education, gender, years of residence, and what might be taken as a set of variables indicating satisfaction with the institutional response to the issue.

The sign of the correlation can sometimes be interpreted as indicating which group it is more closely associated with. In this case, amplifiers were assigned the lower value so the set of negative correlations are associated with amplification. Such interpretation must be approached cautiously. Here, it appears that a lack of the qualities indicated by the negatively correlated variables indicate amplification and a lack of the qualities indicated by the positively correlated values indicate attenuation.

The more important results of this analysis are the manner in which the variables group and their ability to predict group membership. Overall, the variables found to significantly differentiate between the groups were in good agreement with the creation of the groups based on the psychometric model, with a classification rate from the discriminant analysis of 85%.

Finally, it is important to recognize that attenuators and amplifiers do not represent two homogeneous groups. There is a distribution of risk perception within each group. To recognize this while still pressing to examine for differences between the two groups, a continuous measure of risk perception was created by averaging the dread and knowledge factors. This scale is then used as the dependent variable in hierarchical regressions utilizing the 13 variables which show significant differences between the groups. Variables are analyzed in blocks

representing demographics, interpersonal sources, satisfaction with institutions, and worry. Results are presented in Table V.

For the analysis of the full sample, each block increments R^2 significantly (demographics only at $p = .06$). The full model achieves an adjusted R^2 of .52 with 5 variables displaying significant partial coefficients: education, usefulness of neighbors, satisfaction with Ames Lab, and evaluation of both personal risk and other's risk.

The more interesting results come from a comparison of the two polar groups. For the attenuators, only the block representing satisfaction with institutions significantly changed R^2. The primary variable in this column is satisfaction with Ames Lab. It appears possible that an interaction between gender and education prevents the demographic block from achieving significance. Inclusion of an interaction term did not alter either the change in R^2 or the adjusted R^2 for any of the blocks.

For amplifiers, the only significant block was the one involving the worry variables, although the years of residence variable in the demographic block is itself significant. For the worry block, evaluation of personal risk is the one strong element.

Stepwise regressions both focus and confirm the significant predictors of risk perception in the three groups, providing the following models (alpha = .05, showing standardized betas):

Full Sample:

Risk = -2.5 + .48 (Personal Risk) + .27 (Other's Risk) - .16 (Education). Adj $R^2 = .54$ $p < .001$

Attenuators:

Risk = - 0.5 - .57 (Satisfaction Ames Lab) + .36 (Education). Adj. $R^2 = .33$ $p < .001$

Amplifiers:

Risk = -0.1 + .62 (Personal Risk) + .25 (Years Residence). Adj. $R^2 = .43$ $p < .001$

7. CONCLUSION

The analysis presented in this paper is a preliminary investigation in what will eventually be a larger case study. The primary mission of this preliminary investigation is three-fold: to gather initial general information about the population and the controversy, to test the usefulness of the psychometric model, and to evaluate the viability of the polarization supposition made by the social amplification model. The results of the analysis to this point suggest that each of these goals have been met.

The secondary mission of this preliminary investigation conforms to the overarching goal of the larger case study: to understand the role of communication in risk controversies and to add to the understanding of effective risk communication. Framing these goals in terms of risk polarization is not far from stating the problem as one of audience analysis. Much of the work done to date in risk communication has treated receivers as a somewhat homogeneous mass — evaluating, for example, the effectiveness of various forms of message construction without regard to important differences that might exist in the target audience. It is likely that risk communication could benefit greatly by shifting some attention from message construction to audience analysis.

With respect to the idea of audience analysis, an important lesson is demonstrated by the hierarchical regression models and their stepwise counterparts: looking at a community's aggregate response to a risk controversy may be misleading. Different components in the community, at least in this case, have significantly different orientations toward the risk. These differing orientations may be most clearly seen if conceptualized and measured as polar opposites.

Utilizing such a light to examine the Ames case, it appears that two dominant forces are in play against one another: an evaluation of personal risk versus satisfaction with the institution managing the risk. Conceptually, these forces may approximate the notions of trust and outrage that have recently come to the risk perception literature.[23] Subordinate to these forces are the

demographically based variables of education and years of residence in the community. Interpreting the stepwise regression equations for these two subordinate forces further demonstrates how aggregate characteristics may not be representative. While attenuators tend to have more education, within their group greater education is associated with a greater perception of risk. And while amplifiers tend to have been residents of the area for fewer years, within their group those who have lived in the area longer perceive a greater level of risk.

The instrument used in this investigation provides only a rough look at the communication behaviors of this population. The main purpose of this set of questions is to point the way for the construction of a new instrument to be applied in the near future. There are, however, two interesting results with respect to communication from the analysis so far.

First, there is apparently a dynamic involving mediated communication. Some background on the news coverage is in order. Very little attention was paid to this issue by the television stations covering central Iowa. Two of the three stations are located in Des Moines, some 40 miles away. These stations pay only cursory attention to Ames. The third network affiliate is located in Ames but has what is widely considered to be the weakest news operation. Attention from the nearest metro daily newspaper, *The Des Moines Register,* has been non-existent. The only significant coverage has been in the local newspaper, *The Ames Daily Tribune.*

It is not overly surprising that respondents would rank the local newspaper as the most useful source of information on the issue. What is interesting, however, is that while attenuators and amplifiers alike rated the newspaper as the most useful source of information they differed significantly in their satisfaction with the attention paid to the issue by the news media overall. This result may suggest that the two groups are processing news information differently.

More refined measures of media use are needed to support this proposition, but if respondents are basing their satisfaction in part on how the local newspaper has covered the issue (as opposed to how the other media outlets have not covered the issue) then amplifiers have rated the newspaper as most useful but were less satisfied while attenuators have rated the newspaper as most useful but have been more satisfied. This suggests the possibility that the

same information from the same source had different consequences for different audience segments. This conclusion is a stretch for these data but not an insupportable proposition.

The other interesting result from the communication variables is that the two groups did not differ in their evaluation of the usefulness of any of the information channels except for neighbors and to a lesser degree family members. Since amplification is associated with finding neighbors and family members more useful as sources of information, it is a fair conclusion to state that concern over risk in this case is driven by interpersonal communication to a greater degree than by mediated communication. This finding is in agreement with much of the research previously cited.

Finally, it is important to return to the notion of polarization, drawn from the social amplification model, that underlies this analysis. Further investigation of the phenomenon of polarization might proceed along two lines, utilizing principles of social identification and models of information processing.

Social psychology has long recognized a process of group polarization.[24] In the most general terms, this is the process through which a group can come to hold and express attitudes that are more extreme than those held individually by its members. There are two dominant theories, social comparison and persuasive arguments. In social comparison, individuals compare their own views to the perceived average view held by the group and then tend to shift their attitudes to the more extreme side of the perceived group consensus. The final outcome of a group decision therefore tends to be polarized. In the persuasive arguments theory, individuals construct mental lists of arguments for and against a choice. When individuals discuss these lists in a group that tends to hold a polarized position, the arguments that are more universally held by group members tend to be those that are more extreme in the polarized direction. These more extreme arguments then tend to dominate both individual and group attitudes.

It is likely that some process of this nature has been in play in the Ames case. The Ames Lab, and its strong association with the University, creates an in-group/out-group situation that may have served to provide a polarization identity for some individuals. Further, the public

forums and coverage by the newspaper have likely provided a set of polarized arguments around which the groups could have formed and strengthened.

Individual polarization has also been related to cognitive consistency. Chaiken and Yates found support for the hypothesis that "thought-induced attitude polarization requires the presence of a well-developed knowledge structure."[25] They found in an experiment that individuals with a high degree of consistency tended to polarize on an issue more readily than their low-consistency counterparts. This point of view dovetails into an information processing perspective offered by Eagly and Chaiken, in which individuals are hypothesized to process information in either a systematic or heuristic manner.[26] Griffin and Dunwoody utilize this perspective to build a model of information processing specifically for risk information.[27]

Griffin and Dunwoody consider the heuristic-systematic processing model and hypothesize on characteristics that might lead individuals to process risk information in one way or the other. They propose a framework of variables that they organize in categories of demographics, characteristics of the hazard, individual worry, how individuals feel that their information needs are being satisfied, and how confident individuals feel that they are able to gather needed information. If there is a relationship among heuristic-systematic processing, cognitive consistency, and polarization — then it is also likely that the model that Griffin and Dunwoody propose could be profitably related to polarization.

For the case of the risk controversy in Ames, it might be hypothesized that amplification is associated with (for example) systematic information processing of news information intertwined with interpersonal influence. Conversely, attenuation might be associated with more rapid "gut level" heuristic information processing of news information that is intertwined with pre-existing attitude structures related to trust in the institutions involved. Further research may approach these questions.

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Table I.
Questions used for risk perception model with codewords.
Dread or knowledge questions indicated with (D) and (K).

For the following questions please give your own personal opinion about possible risks to yourself from the former reactor. Circle the number you think best locates your position on the 1 to 7 point scale. (low values are for judgments of low risk)

Catastrophe (D)	Do you think this kind of risk - that caused by small nuclear reactors - has the potential to cause catastrophic death and destruction?
Generations (D)	Do you feel that any risk that may be posed from the former reactor extends to future generations?
Dread (D)	Is this the kind of risk you can learn to live with and calmly deliberate about, or one that you constantly dread and worry about?
Changing Risk (D)	Do you feel that your risk from the former reactor in Ames is increasing, decreasing, or staying the same?
Personal Control (D)	How much control do you think you personally have over avoiding possible risks to yourself from the former reactor?
Personally Reduce Risk (D)	How easy or difficult would it be for you to reduce any risk you might face from the reactor?
Fairness of Risk (D)	Do you think the people who may have been exposed to some risk from the reactor are the same people who may have benefited from its operation?
Fatality of Risk (D)	If you were to become ill from this risk, how likely is it that the illness would be fatal?
Personal Choice (D)	Do you think you have much choice over accepting any possible risks from the former reactor?
Harm Delay (K)	Is it more likely that any possible harm to you from the reactor would have occurred immediately after exposure, or that it would be delayed over time?
Science Knows (K)	How knowledgeable do you think scientists are about any possible risks from the former reactor?
You Know (K)	How knowledgeable do you think you are about any possible risks from the former reactor?
Familiarity of Risk (K)	Is this a new, novel kind of risk for you, or one that's old and familiar to you?
Observability of Exposure(K)	If you were exposed to a risk from the reactor, how aware do you think you would be of your risk from that exposure?

Table II.
Factor Analysis of Psychometric Variables

Variable	Mean	SD	Factor 1 Knowledge	Factor 2 Pure Dread	Factor 3 Personal Efficacy	Factor 4 Indeterminate
You Know (K)	4.6	2.0	.80			
Science Knows (K)	3.4	2.0	.77			
Observability of Exposure (K)	4.8	2.1	.56			
Familiarity of Risk (K)	4.6	2.3	.51			
Catastrophe (D)	2.7	1.8		.80		
Generations (D)	4.4	1.9		.69		
Changing Risk (D)	2.9	1.4		.61		
Dread (D)	2.6	1.8		.59		
Personal Control (D)	5.2	2.1			.79	
Personal Choice(D)	5.1	2.0			.78	
Personally Reduce Risk (D)	4.7	2.1			.62	
Harm Delay (K)	5.9	1.6				.75
Fairness of Risk (D)	4.2	2.1				.73
Percentage total variance			32.9	12.1	9.9	8.3
Eigenvalues			4.3	1.6	1.3	1.1

Factors were determined with an eigenvalue cutoff of 1.0, principle components analysis with varimax rotation. Loadings under .5 are blanked. Four factors explain 63.2 percent of total variance. KMO statistic = .75.

Table III.
Comparison of Amplifiers and Attenuators.

Item	Attenuators mean	Amplifiers mean	p
Frequency talking about issue (1 never to 6 daily)	1.9	2.3	.004
Frequency thinking about issue (1 never to 6 daily)	2.1	2.9	.002
Risk to others (1 no risk to 7 high)	2.1	4.2	< .001
Risk to self (1 no risk to 7 high)	2.1	4.3	< .001
Usefulness of neighbors in making judgment (0 low to 7 high)	1.1	2.5	.003
Usefulness of family members in making judgment (0 low to 7 high)	0.6	1.3	.076
Satisfaction with epidemiology (1 not to 7 very)	4.5	3.1	.001
Satisfaction with attention from Ames Lab (1 not to 7 very)	4.6	3.1	.001
Satisfaction with attention from elected officials (1 not to 7 very)	3.9	2.4	<.001
Satisfaction with attention from news media (1 not to 7 very)	4.5	3.5	.018
Years as resident of northwest Ames	19.5	14.8	.098

Item	Attenuators col %	Amplifiers col %	χ^2	p
Respondent's gender			4.5	.03
female	34.2	56.6		
male	65.8	43.4		
Highest level of education completed			18.5	<.001
high school	16.2	22.6		
bachelor's	13.5	50.9		
graduate	70.3	26.4		
Have any members of immediate family had cancer?			2.6	.11
no	87.5	74.1		
yes	12.5	25.9		

Table IV.
Evaluation of significant differences between groups.
Saturated discriminant model using variables showing differences between groups

Function 1: Canonical Correlation = .64 Wilks' Lambda = .59 $\chi^2 = 37.8$ $p < .001$

Pooled within-groups correlations between discriminating variables and discriminant function:

.62	Personal risk	-.45	Education
.61	Other's risk	-.42	Satisfaction with representatives
.37	Frequency thinking	-.39	Satisfaction with news coverage
.35	Frequency talking	-.36	Satisfaction with Ames Lab
.31	Usefulness of neighbors	-.33	Satisfaction with epidemiology
.22	Usefulness of family	-.22	Gender
		-.18	Years as resident of NW Ames

ACTUAL GROUP	NO. OF CASES	PREDICTED GROUPS 1	2
GROUP 1 AMPLIFY	44	37 84.1%	7 15.9%
GROUP 2 ATTENUATE	34	5 14.7%	29 85.3%

PERCENT OF CASES CORRECTLY CLASSIFIED: 84.6%

Table V.
Hierarchical Regressions: Risk on Significant Group Differences

	FULL SAMPLE			ATTENUATORS			AMPLIFIERS		
BLOCKS	beta	R^2 cha	adj. R^2	beta	R^2 cha	adj. R^2	beta	R^2 cha	adj. R^2
1. DEMOGRAPHIC		.09	.06		.16	.08		.11	.04
Gender	-.15			-.30*			.05		
Education	-.20*			.36**			.20		
Years Residence	-.09			.17			.29*		
2. INTERPERSONAL		.16***	.21***		.00	.02		.05	.05
Neighbors	.27**			-.01			.22		
Family Members	.10			-.01			.10		
3. INSTITUTIONS		.12**	.30***		.33**	.30**		.02	.03
Ames Lab	-.22*			-.37**			-.04		
Elected Officials	-.18			.22			.01		
Epidemiology	-.06			.03			.01		
News	.07			-.07			-.02		
4. WORRY		.21***	.52***		.08	.30*		.40***	.38**
Thinking About Risk	-.02			-.07			.14		
Talking About Risk	.01			-.01			.06		
Personal Risk	.42***			.04			.49***		
Other's Risk	.28*			.28			.01		

* $p < .10$ ** $p < .05$ *** $p < .01$

Betas are partial coefficients from regression on each block independently. Dependnet variable is risk, as an averaged score of the variables knowledge and dread. High values on risk equal perception of great risk.