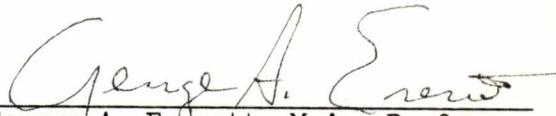
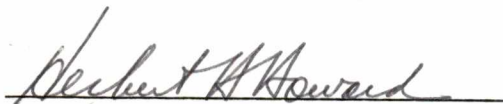


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I am submitting herewith a thesis written by Jeffrey W. McKenna titled "Why Scientists 'Go Public': Insights from the Situational Theory of Communication." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Communications.


George A. Everett, Major Professor

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WHY SCIENTISTS "GO PUBLIC":
INSIGHTS FROM THE SITUATIONAL THEORY
OF COMMUNICATION

A Thesis
Presented for the
Master of Science
Degree
The University of Tennessee, Knoxville

Jeffrey W. McKenna

December 1985

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ABSTRACT

To help explain the behavior of scientists as mass media sources, a mail questionnaire was sent in May 1985 to a national sample of 535 scientists actively conducting health-related research. Three hundred fifty-six scientists returned completed questionnaires for an overall response rate of 66.5%.

In a new application of Grunig's situational theory of communication, respondents indicated their levels of problem recognition, constraint recognition, and involvement concerning three aspects of their research: immediate practical or theoretical applications, impact on the delivery of health care, and social and ethical implications. Active and passive communication behavior for each of these research "situations" was then measured in terms of initiation and granting of contact with journalists and institutional public information officers (PIO's).

Seventy percent of the respondents reported some contact during their careers with a journalist, and 55% reported contact with a PIO. Passive communication was found to be a much more typical behavior for survey scientists than active communication. Both active and passive communication declined markedly from the immediate applications situation to the health care impact and the ethical implications situations. In support of the situational theory, both active and passive communication increased with an increase in problem recognition and decreased with an increase in constraint recognition; active communication increased markedly with an increase in level of involvement. Results of logistic regression analyses showed that the three situational variables

had consistently stronger associations with reported behavior across situations than did demographic and attitudinal variables. A number of demographic and personal attribute variables, however, were significantly related to cross-situational communication activity.

As the latest in a limited series of empirical studies of scientists as mass media sources, the survey suggests an improving climate of cooperation among the key actors in the science communication process, with specific areas for further improvement. Science writers are advised to seek out more diligently information and viewpoints from less-visible scientist-sources; PIO's are challenged to demonstrate more convincingly to scientists their true value as channels for public communication; both journalists and PIO's are admonished to sharpen their scientific competence; and scientists are urged to resist overselling their research to reporters and to become more "media literate" themselves.

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INTRODUCTION

Emile Gley, an enterprising French biologist, discovered the internal secretion process of the pancreas around 1900. Though doubtlessly aware of the enormous implications of this finding, Gley was in no apparent hurry to cause a stir. He sealed the account of his experiments in an envelope and deposited it with the French Society of Biology in 1905 with instructions that the packet be opened only at his request. When Canadian physicians Frederick Banting and Charles Best announced their discovery of insulin in 1921, Gley, then a professor of physiology in Paris, finally told the society to open his envelope and publish its contents (Comroe & Dripps, 1977, pp. 66-67).

Gley's behavior, perhaps delaying as long as two decades the production of insulin--what historian Michael Bliss called "the elixir of life for millions of human beings" (Broad, 1982, p. 1120)--can be attributed only to eccentricity. Scientists rarely delay publication of their completed work. However, there are those who would argue that today's scientist is as strangely uncommunicative with the general public as Gley in this instance was with his research contemporaries. Consider, for example, Goodell's (1977) caricature of an "average" scientist handling a "rare and reluctantly granted" press conference:

A pale, balding, bespectacled professor in a white laboratory coat steps to the microphone, blinks uncomfortably at the bright camera lights, unfolds a prepared statement from his pocket, and reads it verbatim in a quavery voice. . . . Occasionally he scribbles obscure equations on the blackboard. Mercifully, the session is short, and the scientist is allowed to slip peacefully back to his beloved laboratory. (p. 4)

The professor, Goodell adds, "lives in isolated splendor, consumed by his work, and dies in obscurity, understood only by his colleagues" (p. 5).

If there is at least a glimmer of truth in this description, and various authors maintain there is, a critical question is raised: Why do scientists choose or not choose to communicate to the public through the mass media?

The study reported here is an attempt to answer that question for a national sample of scientists actively conducting health-related research. A mail survey was used to determine scientists' attitudes and practices regarding public communication. Questionnaire items were constructed to measure how actively scientists communicated about each of three aspects of their research: its immediate practical or theoretical applications; its impact on the delivery of health care; and its social and ethical implications. Public communication activities were gauged by measuring scientists' interactions both with journalists and with public information officers in their institutions.

In distinguishing among these different research "situations," the study applies a theoretical framework known as the situational theory of communication in a new way to help explain the information-giving behavior of science news sources. Results of the survey suggest a generally positive trend in scientist-reporter relations, with a number of opportunities for improving those relations.

CHAPTER I

STATEMENT OF THE PROBLEM

Purpose of the Study

Numerous studies show that Americans know very little about scientific and technical matters (Miller, 1983; Rubin & Sachs, 1973; Schramm & Wade, 1967). The implications are serious, both scientists and nonscientists have argued, if the proposition is accepted that only an informed public can make valid judgments on scientific issues and ensure that science remains healthy and responsibly independent. Because the mass media are how most people learn and form opinions about science (Miller, 1983; Pfund & Hofstadter, 1981), one way for scientists to help build greater public understanding of science is to become more involved in the science news process itself. Unfortunately, there is scanty information about why scientists choose or not choose to "go public" with their views and findings.

The purpose of this study, a national mail survey of scientists conducting health-related research, is to identify within an overall theoretical framework those key factors affecting the involvement of scientists in public communication activities, particularly interactions with mass media reporters. The preponderance of "conventional wisdom" reflected in the literature suggests that such involvement, actual or desired, is minimal and not easily facilitated. Scientists and journalists historically have been portrayed as naturally antagonistic, products of mutually proud, suspicious, and uncharitable professions. Recent evidence, however, indicates that scientists not only share with

journalists remarkably similar attitudes about science news, but also would welcome greater contact with journalists (see "Scientists' Contact With the Media" in Chapter II).

Need for the Study

Scientists' reasons for communicating or not communicating to the public appear to be complex, and scientists seem to vary markedly in their knowledge, attitudes, and behavior concerning the mass media. Yet, by and large, communication studies of scientists have been atheoretical and narrowly defined; researchers have not attempted to develop an integrated theory with broad explanatory power.

In the writer's opinion, an accurate reading of the public communication behavior of scientists has been impeded by a prevailing assumption among science philosophers and communication researchers alike that "general attitudes" of scientists toward the mass media are primary determinants of when and how they will interact with media practitioners. As a review of the literature later will show, this assumption appears faulty. If mass media consumers are highly selective in the types of information they choose to attend to, why should mass media sources not be selective in the types of information they choose to talk about?

This study is distinctive in that it attempts to provide a situational explanation for scientists' communication behavior. Why scientists communicate to the public, the study hypothesizes, is better explained by their perceptions of specific communication situations than by their general or cross-situational attitudes about communicating to the public. This study approach is a new application of the situational

theory of communication developed by the University of Maryland's James Grunig over the past dozen years. To date, this theory has been used to predict and define different media audiences or publics for different kinds of information (especially regarding environmental situations or issues), and whether these publics will actively seek information or passively process it. In this study the principal variables of the theory have been tested to explain the active and passive information-giving behavior of media sources (scientists).

Basically, the situational theory (Grunig, 1983b) proposes that two independent variables predict when people communicate: problem recognition (Do they perceive a situation as problematic so that they stop to think about it?) and constraint recognition (Do they perceive themselves to be free in a situation to construct their own behavior?). A third independent variable explains both when and how (actively or passively) people will communicate: level of involvement (Do they perceive a connection to the situation?).

In its conceptualization of communication situations, the project departs somewhat from previous studies using the situational theory. It defines communication situations for scientists not as different subject-specific topics (e.g., in vitro fertilization or low-level radiation studies), but rather as the different levels of effects or consequences of a scientist's research (e.g., immediate applications versus social implications). Of the numerous science communication problems identified in the literature, the reluctance of scientists to place their research into the "big picture" of science and society stands out as one of the most critical (see "Science as a Social System" in Chapter II).

The utility of the study is based on the proposition that increased scientist-journalist interaction is desirable, even necessary, for improving science writing in the mass media--writing that satisfies science's demands for accuracy, completeness, and restraint and journalism's demands for interest, clarity, and drama. By further identifying those factors that facilitate or impede scientists' communication, the study offers a baseline against which individuals and organizations involved in both the making and reporting of science news can begin working to improve the process. In addition, the study attempts to fill a gap in the communication research literature by advancing a theoretical explanation of why scientists communicate as they do--or fail to communicate as well as they should.

Assumptions and Limitations

As defined in this study, a scientist is someone conducting or directing a scientific research project--not simply someone with an academic degree in one of the scientific disciplines. Because of the enormous range of workers in the physical, life, and social sciences, however, the decision was made to limit the study to a particular category: scientists conducting health-related research. For study purposes they are further defined operationally as individuals who in fiscal year 1983 received some research grant funding from the federal government through the National Institutes of Health (NIH).* NIH-funded

*Investigators employed by private industries like drug companies are thereby not represented. According to the National Science Foundation (1981), industry publishes only 3% of the nation's research articles in clinical medicine, biomedicine, and mathematics.

scientists were selected as study subjects for a number of reasons, as summarized below.

First, of all areas of science, biomedicine has the most obvious, immediate potential to affect people's lives (Fudenberg & Melnick, 1978). "Also, with its blend of science and social service, medicine is unique among scientific professions in the degree to which it finds itself directed by the popular voice" (Oates, 1973, p. 681). Consequently, the communication behavior of health researchers should be of broad concern to the public at large, as well as to journalists and communication researchers.

Second, the field of health and medicine consistently has been the most widely reported topic in science (Krieghbaum, 1967; Oates, 1973). Rich (1981) selected two medical stories--the outbreak of Legionnaires' disease and the birth of the first test-tube baby--as the most significant science news between 1976 and 1979. Unprecedented advances in basic and applied biomedicine (immunology research, recombinant DNA technology), plus the public's increasing preoccupation with fitness and health, suggest that medicine will continue as a hot topic in the press (Bacon, 1975; Nunn, 1979; Walsh, 1982; Yankelovich, Skelly & White, 1979).

Third, NIH is the largest sponsor of health research and development in the United States, funding nearly 40% of all research and nearly two-thirds of that conducted at colleges and universities.*

*In FY 1982, NIH accounted for more than \$3.4 billion of the total \$9.2 billion expended nationally for health R&D. Of the nearly \$3.3 billion received by higher education, NIH contributed more than \$2 billion (National Institutes of Health, 1983b).

Because of the keenly competitive peer review process at NIH, awarded grantees represent a large but distinct group of the nation's leading health scientists. Moreover, as recipients of tax-generated monies, they not only are publicly accountable for their research, but also have an abiding interest in maintaining public support for their work.

Fourth, the author has had extensive interactions with NIH-supported scientists, gaining a general working knowledge of several research areas and valuable insight into the overall enterprise of biomedical science--the peer review process, the setting of research priorities, and the communication of research results among scientists. In addition, a comprehensive year-to-year listing of all NIH-supported scientists is available and served as a ready sampling frame for the mail survey.

Limiting the study to a sample of scientists supported by NIH necessarily limits the generalizability of study findings (external validity) to that population. Moreover, ascertaining the actual "why" (internal validity) of scientist-to-public communication behavior is limited by the constructs of the chosen data-gathering method, the mail survey. (Chapter III, Methods and Procedures, presents a further discussion of the study population and survey approach, including the trade-offs for each.)

Neither of these limitations, however, is judged serious enough to compromise the value and utility of the study. Indeed, a focused survey of a focused population is likely to yield much richer, more useful information relevant to the topic than is a more general survey to a more general population of scientists.

Study Components and Definitions

As outlined briefly above, the study expands on previous studies of scientists as public information sources by applying a situational perspective to scientists' communication behavior. A mail questionnaire was used to measure the three situational variables (problem recognition, constraint recognition, and level of involvement) as they relate to three different aspects (situations) of the scientists' research. These different situations are:

1. The immediate practical or theoretical applications of their research;
2. The impact of their research on the delivery of health care (i.e., the practice of medicine); and
3. The social and ethical implications of their research.

In addition to these independent, situational variables, the questionnaire measured a set of dependent, behavioral variables to determine scientists' passive and active communication behavior, as defined operationally below. These variables were constructed to recognize the role of both mass media reporters and institutional public information officers (PIO's) in the communication of science news to the public.

1. Passive communication behavior was measured in three ways:
by asking scientists (1) if they have ever granted an interview with a mass media reporter concerning each of the above three situations, (2) how willing they would be to discuss each situation with a reporter, and (3) if they have ever helped a PIO

with an article about each situation. In all of these instances, the scientist indicated his or her actual and intended behavior in response to an information-sharing request--thus defined as passive (reactive) communication.

2. Active communication behavior also was measured in three ways: by asking scientists if they have ever (1) sought an interview with a mass media reporter concerning each of the above three situations, (2) suggested an article idea to a PIO about each situation, and (3) actually written an article (possibly as a news release or health column, for example) about each situation for mass media dissemination. In all of these instances, the scientist indicated his or her actual behavior in initiating an information-sharing activity--thus defined as active communication.

Analyses were then performed to determine to what degree the situational variables related to the scientists' active and passive communication behavior for all three situations (Hypotheses 1 and 2 below) and whether the situational variables predicted communication behavior better than various cross-situational demographic and attitudinal variables (Hypothesis 3). Responses to other questions (attitudinal, behavioral, and demographic) provided further explanatory information about these situational and behavioral variables (Research Questions 1-3 below).

Study Hypotheses and Research Questions

Three hypotheses tested relate to the explanatory power of the theoretical basis of the study, the situational theory of communication.

H1: The probability that scientists will communicate passively about their research will correlate predictably with the three situational variables; specifically:

H1a: Passive communication behavior will increase with an increase in problem recognition;

H1b: Passive communication behavior will decrease with an increase in constraint recognition; and

H1c: Passive communication behavior will not be affected by level of involvement.

H2: The probability that scientists will communicate actively about their research also will correlate predictably with the three situational variables; specifically:

H2a: Active communication behavior will increase with an increase in problem recognition;

H2b: Active communication behavior will decrease with an increase in constraint recognition; and

H2c: Active communication behavior will increase with an increase in level of involvement.

H3: The situational variables will be stronger predictors of active and passive communication behavior than will cross-situational attitudinal and demographic variables.

In addition to these hypotheses, three research questions helped characterize the respondent population and its collective attitudes and behaviors related to key science-journalism issues raised in the literature review.

Q1: How active are the survey scientists in communicating with the public, and how do they evaluate their experiences with the press and the press' performance in covering their research areas?

Q2: How do survey scientists view various issues related to the public communication of their own and others' research results?

Q3: What is the demographic and personal attribute profile of the survey population?

The rationale for these research hypotheses and questions is provided in the following review of the literature (Chapter II). How these hypotheses and questions were tested is explained in Chapter III and in Chapter IV (Results).

CHAPTER II

LITERATURE REVIEW

The recent literature in science and journalism, though at times conflicting and inconclusive, provides some illuminating insights into the perceptions and behavior of scientists as mass media sources. In numerous personal and anecdotal accounts of scientists "meeting the press," plus in the few relevant empirical studies conducted to date, scientists appear increasingly willing to accept their public communication responsibility. As science becomes more dependent on public support and as public regulation reaches deeper into the conduct of science, scientists are apprehensive of a "scientifically illiterate" public. In general, studies have found that people who understand science view science more confidently, support it more vigorously, and direct it more responsibly (Martin, 1981; Miller, 1983; Miller et al., 1980).

The scientists and journalists writing about the subject seem to advocate that communication efforts be aimed not so much at increasing the public's knowledge "of" science, what traditionally has been "fairly descriptive, one-project-at-a-time" coverage (Donohue, Tichenor, & Olien, 1973, p. 657), but at improving the public's knowledge "about" science--the functioning of the science system and its impact on society.

In some respects, popular misconceptions of science may be more insidious than outright ignorance of science. By perceiving science as an events-oriented rather than a process-oriented enterprise, expecting these events to be "breakthroughs, fresh insights, cures, new products and, therefore, solutions to human problems" (Trachtman, 1981, p. 14),

and believing scientific opinion to be monolithic, the public may develop heightened expectations of science which science, by its very nature, cannot satisfy.

In medicine, the distorted image of science is particularly dangerous, as the false hopes it conjures inevitably lead to disappointments, especially among chronically ill patients, "because their hopes for therapeutic benefit or cure are so intense" (Rourke, Hock, Pursell, Jones, & Spock, 1981). Cohn (1965) and Trachtman, for example, each ventured that probably 90% of new drugs described in news accounts have eventually been failures because they were ineffective, too toxic, or both.

Engendering a true sense of science, though, is a tall order indeed. Trachtman captured the dilemma:

To try to communicate to the general public something of the real feel of scientific research--tentative, sometimes seeming to take two steps backwards for every one forward, ultimately imprecise in technique and measurement, full of experimental error and, therefore, not at all like the idealized reports of utterly rational and totally inerrant experiments published in the scientific journals--is enormously difficult and extremely unsatisfying to the casual reader. [Moreover,] most newspapers and magazines can't and won't print accounts of science that describe it more accurately, since such reports might very closely resemble a news report that "nobody robbed the First National Bank today." (p. 14)

What, then, is the solution? Essentially, Goodfield (1981) stated, "What has to be reconciled is the vulnerability of the preliminary data of science, and its tentativeness, with the journalist's need for speed and hard news" (p. 36). Pharmacologist Louis Lasagna, addressing a symposium of biomedical communicators, expanded: "What is needed is some sort of larger social ambience such that the public can handle

premature (or tentative) stories with equanimity, without at the same time engendering total cynicism in regard to news stories" (Goodfield, p. 36).

Such an ambience would appear hindered by the current state of scientist-reporter relations. Bennett (1982) posited, "For a responsible science journalism to develop, a critical tradition must emerge--one that corresponds to the hallowed traditions of literary and political criticism" (p. 30). This process would examine in lay terms the main trends of scientific activity and explore the ethical, political, aesthetic, social, and economic roles of scientists and their pursuits. Gwynne (1979) wrote that the result would be a "properly skeptical" public, one that could treat scientists "more like economists, for example, who readily concede that they cannot precisely predict the rates of inflation or unemployment."

A key postulate of this study is that such a critical tradition is achievable only with a significant increase in the amount and quality of communication between scientists and workers in the mass media. The following literature review, then, will examine the nature and extent of scientists' involvement in mass media coverage of science and those factors that either impede or facilitate increased involvement.

The Science Communication Process

How scientists function as mass media sources is illustrated through an analysis of the science communication process. According to Tannenbaum (1963), one of the distinctive features of this process, as opposed to the process of communication in nonscience areas, is that it

is marked by "a fairly clearly defined chain of communication events" (p. 580)--the scientist as the initial source in the process, the science writer, the media editor, and finally, readers and nonreaders of science news.

In fact, La Follette (1983) contended, science reporting is unique from reporting on any other American social institution because the agenda for public discussion is set more by the source (the scientist) than by journalists themselves. By and large, the audience receives what scientists deem appropriate for presentation:

The very complexity and technical difficulty of the raw information of science facilitate this control at the source. Even media professionals who work exclusively on scientific subjects and have advanced degrees in science will not be able to make sense, on their own, of the pertinent literature in more than a few fields. (p. 42)

Grunig (1980) expanded on the simple source-channel-receiver concept in a model (Figure 1) that adds public relations science writers to the communication chain and indicates that information flows in both directions throughout the chain. It shows that scientists can also communicate through interpersonal linkers such as change agents, extension workers, and community leaders. Moreover, it indicates that the

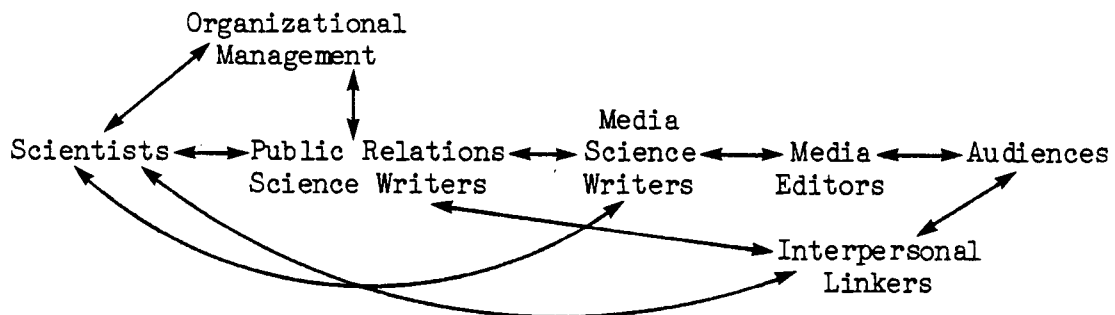


Figure 1. A Model of Science Communication Behaviors and Interactions
(Source: Grunig, 1980, p. 171)

interaction between public relations science writers and scientists takes place within the context of organizational management. The situation is further complicated because intermediate positions in the chain can be switched, and any of these intermediaries can be missing or circumvented.

A number of authors have criticized media science writers, themselves an "inner club" (Dunwoody, 1980), for depending on "something of an inner club of reputable scientists as sources of ideas for stories, background information, and final arbitration of what is and is not good science" (Goodell, 1980, p. 42).

While this narrow communication channel between prominent scientific sources and journalists serves as a quality-control "filter" for science news (Mazur, 1981), it serves also to restrict people's knowledge "about" science--its process, context, and limitations--by making the scientific process and scientific knowledge seem more authoritative than they are (Goodfield, 1981).

Factors Influencing the Public Participation of Scientists

The nature of the scientific process itself and the norms for communication within science pose a variety of barriers to scientists' relationships with mass media reporters. Conversely, concern over continued public support of science and increasing involvement of scientists in social causes may act to foster greater scientist-journalist interaction. Key findings from the literature are presented below.

Science as a Social System

Goodell (1977) pointed up the conflict between the scientist's dual roles of research worker and public communicator:

On the one hand, it is fairly well accepted today that scientists must do some public relations work, some popularizing, in order to loosen the public purse strings. . . . On the other hand, because of the emphasis in science on the nobility and necessity of doing basic research, activities such as popularizing are viewed as a little lowly, distracting at best, demeaning at worst. (p. 90)

Goodfield stated that a number of factors make public communication simply "not worth the risk"--the increasingly introverted nature of science as it has evolved; a competitive career structure that extols orthodoxy; and a community allegiance without an adequate sense of professional and personal responsibility for the impact of its work on society.

Dunwoody (in Bodde, 1982) commented that when interviewed by the press, scientists behave differently from politicians and other professional groups because of the fact that science is a strong, self-governing social system with rewards lying largely within that system. Thus, "the highest goal for a scientist is the Nobel Prize, not necessarily a lot of money or high public visibility" (p. 173).

A number of other authors have noted that the reward system in science may inhibit scientists' interaction with the mass media. Because scientists are rewarded by other scientists, not by the public, generating public information can actually have a negative effect on a scientist's prestige (Hagstrom, 1965). Goodell (1977) concluded, "The more immediate needs for personal success usually outweigh the long-range needs for public goodwill and social good" (p. 91).

According to Dismukes (1979), young scientists are especially affected by professional pressure against public activity.

As it stands now, a junior faculty member is evaluated almost exclusively on his research publications, and academic departments tend

to be narrowly specialized. A young assistant professor who spends any significant part of his time working on science-and-society issues is likely to find himself penalized in most universities in the competition for tenure. (p. 21)

Meadows (1974) maintained that "the factor more than any other that makes the communication of science to non-scientists difficult is the cumulative nature of science with its attendant growth of specialization." The efficient internal system scientists have developed to overcome communication problems "fails outside the circle of initiates" (p. 229). According to Goodfield, the careful scientific strictures designed to ensure the validity and reproducibility of research results can produce "a strongly negative, frequently unreasonable reaction against 'going public' at all" (p. 31).

Branscomb (1981) takes an equally harsh view of the historically difficult "filter-down" process of science literacy:

Even today, colleagues may ostracize those scientists who dare to "publicize" science for the masses; indeed, some have cynically interpreted the definition of "science as pursuit of knowledge for its own sake" as "the public be damned." (p. 6)

The reluctance of scientists to take an active role in public communication may be largely the result of their educational upbringing, Farago (1976) submitted. The scientists looked to by the media, with notable exceptions, are eminent and therefore middle-aged. Their training was based on the educational ideas current 30 years ago, which in turn were put into practice about 50 years ago--when "true science was regarded as a close approximation to a monastic existence." Involvement in public communication, he wrote, "was regarded not so much as wrong but as simply not done" (pp. 8-9).

Moreover, Goodell (1977) averred:

As a rule, scientists are also not well suited psychologically for the job of communicating with the public. Studies support the idea that many scientists are aloof, isolated from society, absorbed in their work, and uncomfortable in interpersonal and political situations. (p. 90)

The rare individual who qualifies as a "visible scientist" in Goodell's parlance shares three key personality characteristics: He or she is controversial--"a safe stand on a safe issue simply does not make news" (p. 23)--articulate, and colorful.

Public Accountability and Public Funding

More than coincidentally, various writers have observed, the increased discussion over public responsibility for science parallels a fundamental shift in the nature of scientific support during the lifetime of today's established investigators: Science is being paid for largely by public money. In 1981, for example, 57% of all support for U.S. medical research and development came from the federal government, with state and local governments providing another 6% (National Institutes of Health, 1983a). Researchers are affected personally by political decisions on research priorities and public expenditures: "How much and for what? Money for CT scans, fitness programs, research? For basic or applied research? For research on cancer, heart, brain?" (Hollobon, 1980, p. 593).

For federal research grants, competition is especially intense. In 1972 NIH was able to fund 3,625 of 6,141 research applications judged meritorious by peer review, an award rate of 59%. By 1982, NIH was able to fund 5,027 of 14,477 approved applications, an award rate of only 35%.

As Cowen (1979) commented, without flattery, "As concern over funding and public image has grown, so has pressure on some learned societies to indulge in a little 'professional PR'" (p. 11).

Melnick and Melnick (1978) found in discussions with research biologists that their attention to public policy matters was focused almost exclusively on issues that might affect support of their research. There was little concern about the relationship of their research to other areas of medicine, let alone to the needs of society as a whole. They simply do not appreciate, the authors wrote, that all issues in health care have relevance to basic research and that increased delivery of health care will translate into increased support of basic research.

The Peer Review Process

Whereas concern about public funding can be a motivational factor for scientists in communicating with the public, the process of peer review may be a constraint. In fact, Garvey (1979) noted, disclosure of scientific findings via the mass media as the principal channels of communication could actually curtail progress in science by enfeebling the foundation of scientific knowledge by unreliable and "unscientific" information. This consideration explains why some scientific journals will not publish a manuscript reporting a scientific work if information describing that work has been announced previously by the author in the mass media. Garvey maintained that such attitudes, though intended to maintain the integrity of science, "may serve to illustrate [to nonscientists] a rigid, inhuman, isolated character of science" (p. 29)--or, as Goodell (1977) wrote, mislead the public by presenting a "voila" view of science stripped of its natural trial-and-error interest.

The most famous--and, for this study, the most relevant--prepublication restriction is a policy of the prestigious New England Journal of Medicine dubbed the "Ingelfinger rule" after retired Journal editor Franz Ingelfinger. Under Ingelfinger, the Journal began in 1969 refusing to publish papers that had received substantial coverage elsewhere, in either the general or medical press. As Time magazine reported, the rule

now forbids researchers submitting articles to give interviews on their findings to reporters before the articles are published in the Journal. This restriction applies even when the results have first been presented at medical meetings open to the general press. ("The Ingelfinger Rule," 1980)

Two decades ago, the announcement by two physics publications of a policy rejecting articles based on research that had already been reported in the news media was met with a pointed editorial reaction in Science (Abelson, 1963) and a flurry of reader reactions (Tannenbaum, 1963). Similar reaction, from both scientific and journalistic circles, has followed issuance of the Ingelfinger rule.

Because of the continuing heated debate, and sometimes confusion, over the policy, current Journal editor Arnold Relman (1981) devoted a lengthy editorial in defense and further explanation of the rule (now sometimes called the Relman rule). The two purposes of the policy, he explained, are to protect the Journal's newsworthiness and to ensure that medical research is subjected to peer review before it is touted as "science" to the public and health practitioners. Contrary to what many people assume, he said, mass media coverage of open scientific meetings is rarely problematic, because the press rarely includes much detail. Instead, the Journal is "concerned about press coverage that goes substantially beyond the information presented at the meeting" (p. 824),

thereby revealing "the essential substance of a manuscript submitted to us" (p. 825), an issue usually involving medical news publications.

Bernard Wagner (1982), editor of Human Pathology, wrote that his journal follows the Ingelfinger rule, but does not regard the appearance of research in the news media as prior publication.

I believe, at present, that the release to the lay press or the presentation on television or radio of a sound piece of research should not preclude its subsequent publication in a peer review journal. There is one significant exception: If the research concerns new developments, facts, or advances, the news stories must be tightly linked to the data. Without this provision, one may conclude that the scientist is interested in informing the public before the medical profession and before the evidence is clear for interpretation to the public. (p. 968)

Many critics of the Ingelfinger rule point not at its explicit terms, but at its implied or perceived controls. As Culliton (1972) noted, the distinction between substantial prior coverage of research in the medical press and briefer coverage in the lay press

blurs in the minds of both reporters and scientists who tend to react to the Ingelfinger rule as if it applied to any form of news coverage whatever. Many investigators behave as though the ground rules for publication in the New England Journal of Medicine applied to other journals as well. (p. 1403)

Cohn (1965) acknowledged the good reasons for prior publication rules in science but added, "I merely say that we newsmen have learned that what starts as 'ethics' can soon become gag rule" (p. 752). Indeed, Edward Huth (1979), editor of the Annals of Internal Medicine, commented that scientists frequently refuse to grant interviews or otherwise assist journalists "because they fear that early news reports of their work might cause editors of scientific journals to reject their papers on grounds of prior publication" (p. 919).

Writing in the Journal of the American Medical Association, Grouse (1981) stated that the Ingelfinger rule "has had a chilling effect" on the relationship between clinical science news sources and medical reporters (p. 375). In the same issue of JAMA, McBride (1981) reported that JAMA's medical news reporters attending scientific meetings were encountering "buttoned-lip syndrome" from, most often, young clinical investigators who are loathe to give information to journalists "because they fear they may jeopardize acceptance of their reports for publication" in NEJM -- "sometimes just in case, that is, even before they have submitted a paper for consideration" (p. 374).

Grunig (in Bodde, 1982) said a compromise might be to allow public discussion once a paper has been accepted for publication, but before it actually is in print. "There would be no more reason why the scientists could not talk about it with the public, because it then will have passed the peer review test" (p. 175). Seemingly agreeing with this approach was Morgan (1984) of the Canadian Medical Association Journal.

CMAJ's policy on releasing information from studies that have passed peer review and are awaiting publication has been to prefer the public interest as represented by the media to the Journal's desire for priority in announcing a new finding. . . . What the investigator says to the press about a study before its peer review is a matter of conscience--and good sense--but we could not justify rejecting a study solely because its authors had made unwise statements to the press or had simply been misquoted.

Indications are that scientists increasingly are responding to their sense of public responsibility, even when it violates the canons of scientific review. Colorado epidemiologist Carl Johnson, for example, was nonplussed when an antinuclear group prematurely released his report, then being refereed for publication in Science, to the public. It reported higher-than-average cancer rates among people living downwind

of a nuclear power plant. Said Johnson: "To sit around for six months to a year revising the paper for Science would have been a disservice. I don't think I can sit on this sort of evidence" (Gwynne, 1979).

One example of a pressing health issue receiving special peer-review treatment by professional journals is the epidemic of acquired immune deficiency syndrome (AIDS), a disease affecting primarily homosexual men. Because of the public health threat of AIDS, but also because of its volatile political implications, the editors of NEJM, the Annals of Internal Medicine, JAMA, and Science announced that they would "expedite the publication of articles related to AIDS" (Bender & Quinn, 1984). In a commentary in The New York Times, prompted by the widespread confusion surrounding AIDS, Jay Winsten (1983) of the Harvard School of Public Health also recommended that scientific journals release authors reporting on major public health concerns from constraints on discussing their work with the popular press before their papers are published.

Scientific Versus Nonscientific Communications

Conflicting pressures come to bear on the public communication behavior of academic scientists when they participate in industry-supported research or offer their views on other scientists' work.

Andreopoulos (1980) recounted how certain scientists had announced to the press (before peer review) that they had developed clones of interferon-producing bacteria, a claim that "was widely reported and led to a gratifying boost in the share prices of Biogen's [the genetic engineering company's] major corporate shareholders" (p. 744).

According to Andreopoulos, this trend helps neither science nor the reporters covering it:

No matter how sincere a scientist's belief is that he has accomplished a particular goal, other scientists may view the data differently. Providing a critical analysis of the data from an independent point of view is the function of referees for scientific journals. Press conferences bypass this critical analysis. It is, of course, the journalist's job to publish facts, to call on others to verify claims or obtain different points of view. But how can other scientists offer reporters informed opinions on the basis of someone's unpublished data? The answer is that they can't." (p. 745)

Another problem for both journalists and the public is created by academic scientists whom industry hires as consultants or whose research industry helps sponsor. Jacobson (1983), referring particularly to nutrition and food additive debates, wrote:

When profits are threatened by legislation, lawsuits, or bad publicity, many companies like to have their positions bolstered by academic scientists. . . . When there's a debate, the companies will make sure their favored scientists are heard. Often the financial tie remains undisclosed.

Stamp (1979) suggested that public trust in scientists on matters of controversy has eroded because of scientists' speaking out on subjects not within their realm of special expertise, without distinguishing "between ex cathedra and amateur [that is, simply in exercise of a citizen's right of free speech] statements." He noted that "if the public has reservations about the infallibility of these social pronouncements, then these doubts will probably carry over to [comments that] fall cleanly in the areas of the individual's expertise" (p. 15). Cohn (1965) similarly decried scientists "who 'expertize' wildly in fields far removed from their area of competence and command our notice because of their names or positions" (p. 752).

The unfortunate result is the tendency within science to disapprove of any commentary by scientists on subjects outside their prescribed fields of expertise, even when such commentary would provide useful perspective for the public--thereby contributing to enhanced knowledge "about" science.

Colglazier (in La Follette, 1981) reported on the American Physical Society's criticism of scientists who speak to the press about a subject outside their narrow professional specialties:

One [Panel on Public Affairs] member proposed that scientists should pass a competency test before they are allowed to speak on a certain issue. Many such proposals are really rather thinly veiled attempts to repeal the First Amendment, and this says something about the sophistication of some scientists--even very eminent ones--in dealing with the media and the public. (p. 28)

Discussion of the social and ethical consequences of health-related research, an area of focus of this study, is becoming increasingly relevant in light of current research trends. As Pfund and Hofstadter (1981) observed,

Over the past thirty years, advances in the biomedical disciplines have significantly narrowed the gap between basic research and its applications, and current research developments appear to be dramatically accelerating this process. (p. 138)

The changing nature of medical research is also reflected in the relatively recent trend among scientists to form multidisciplinary teams, in which each subject specialist contributes his or her own expertise to the solution of a common, multifaceted problem. Extrapolating this trend, it appears reasonable to hypothesize that scientists participating in such teams, a synthesis of specializations for the common good, would be more inclined to participate in a cooperative way with journalists toward a general common problem: public understanding.

Young (1981) pointed out that the closer research becomes to affecting human life, the more debate can be expected on both scientific and nonscientific issues. (Figure 2 depicts the flow of information between various stages of medical research.) In contrast with the clear rules for scientific debate that exist in the basic research communication network, the communication system linking research to the practitioner does not provide a clear forum or rules for debate on nonscientific issues.

Perhaps as a result of this lack of rules, scientists are reluctant to admit that science is "a human activity . . . perfectly capable of good and bad outcomes and that scientists like all other human beings . . . are thus necessarily involved in value judgments" (Bevan, 1976, p. 481). Gladstone (1980) also objected to the portrayal of science as ethically neutral: "Scientists tend to gloss over, or simplify, or overdramatize the ways in which conscience affects them in their work" (p. 7).

"Science--always--is surrounded by moral questions," asserted Prewitt (1983). "Life-extending technologies in medicine, for example, while resolving certain biomedical questions, raise in the process numerous ethical issues" (p. 60). Nature editor John Maddox (in Balk, 1983) ventured that the most difficult issue facing all of science in the not-too-distant future will be the ethics surrounding genetic screening and gene control in humans. Still, he maintained that most scientists believe that merely to ask questions about potential negative effects of their research is to discharge their social responsibility.

My prime complaint against scientists is that they are so reticent. When a new development poses some risk they slip a

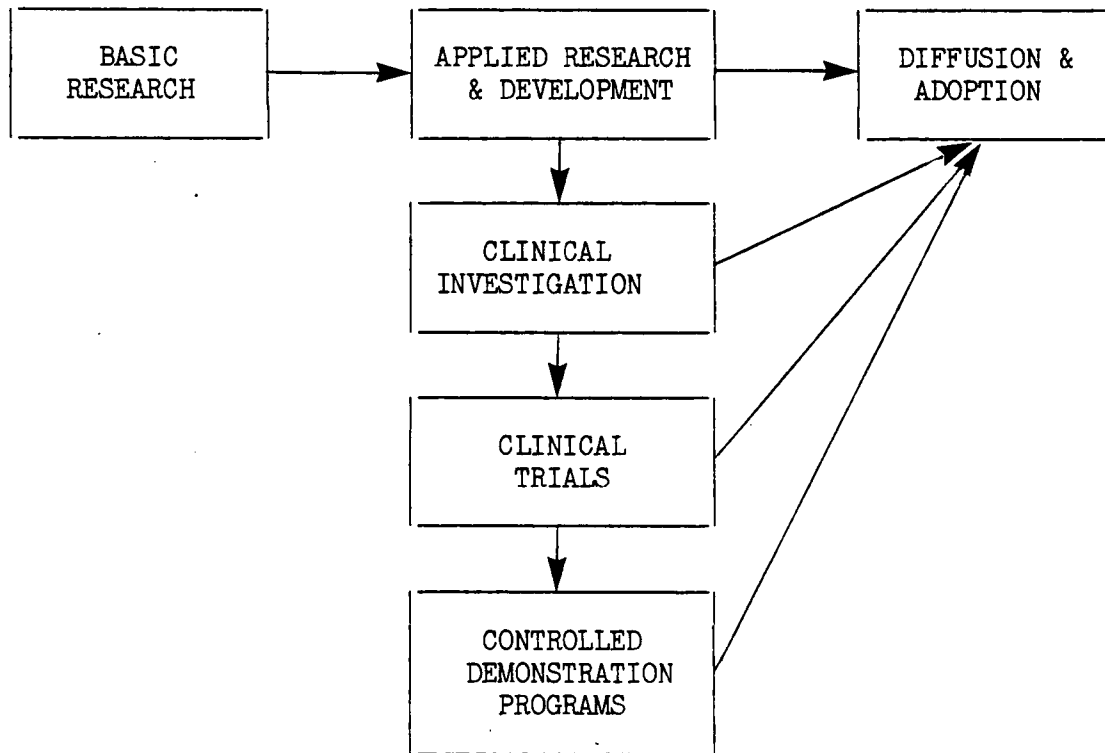


Figure 2. Information Flow from Research to Application

(In practice, the flow may not be linear and sequential, and at each site there may be information feedback. Source: Young, 1981, p. 179)

sentence into a research article and believe that is sufficient.
. . . I wish more members of the scientific community were able to talk about the larger problems [that science raises] as convincingly to the public as they seem to do among themselves. (pp. 32, 33)

To date, most public activity by scientists has come in response to perceived threats to the process of science itself, not necessarily in response to a concern for society at large. In addition to continuing lobbying efforts to prevent cuts in the federal science budget, recent issues enlisting the political participation of many scientists include proposed regulations on recombinant DNA research, mandatory teaching of creationism with evolution in public schools, and restriction or abolition of animal research.

According to Goodell (1977), scientists stay out of danger while engaging in public communication and other public activities if they follow at least six key rules: (1) Confine activities to the Washington advisory system if at all possible; (2) limit public activities to a small percentage of their time; (3) try to postpone most of their public efforts until after their most productive research years are over; (4) restrict public communications to those that can be considered in their area of expertise; (5) confine remarks and activities to those that will enhance the public's image of science and thus the public's willingness to provide funding; and (6) keep political opinions--if they must be expressed--in the moderate range of the political spectrum, avoiding extremes.

As Goodell reported, the visible scientists tend to violate many of these rules by virtue of their "unscientific" personality characteristics mentioned above (controversial, articulate, and colorful) and

their involvement with "hot topics," necessitating their "speaking out in areas of general concern, talking not about their research but about its ramifications" (p. 19). However, these individuals have met perhaps the most important criterion for their peers' acceptance of their public activities: They have established credible reputations. Goodell wrote:

One form of protection for the visible scientist is academia's version of job security: tenure. Nearly all the visible scientists were tenured professors and scientifically successful before their popular activities began to demand much time or attention. (p. 98)

This stricture becomes problematic for young scientists who wish to exercise their public communication responsibilities. Whereas they may perceive the need for greater public understanding of science, they are relatively constrained from acting on their recognition of the problem. Paradoxically, established scientists--while relatively free of constraints--may be less sensitive to the needs of the media and the public (cf. Farago, 1976).

Sensing this dilemma, Dismukes (1979) called for scientists to take a more active role in public communication--making clear "where the facts leave off and our subjective evaluation starts"--and for science to make it professionally acceptable for young researchers to spend part of their time working on science-and-society issues without being penalized in their competition for tenure.

Melnick and Melnick (1978) wrote that there are at least five factors that govern a scientist's impact on public policy. These same factors, reinforcing many of the observations made above, also help define a scientist's public communication role.

First, is the scientist an authority or merely an expert? "An expert becomes an authority when his expertise is recognized outside the

scientific community and he is called upon to give advice and counsel to the public" (p. 9).

Second, do other scientists think the person is influential in public policy issues? The authors found that the official status of an individual (such as dean, department chairman, or professional society president) was widely regarded as a key to his or her influence "although many may have been too long away from contact with average biomedical scientists to know their views" (p. 10).

Third, does the scientist define his or her work as serving a public broader than the scientific community? This factor, Melnick and Melnick explained, depends not so much on the nature of the scientific work as on the scientist's interpretation of its implications:

For example, a scientist doing work on ultraviolet irradiation might explain his work in terms of biophysical phenomena alone, whereas another scientist doing the same work might view it as part of an effort to understand the implications of changes in the ozone layer [which] might lead him to make the connection between his "basic" research and "remote" policy issues such as the advisability of building an SST. (p. 10)

Fourth, does the scientist wait to be called upon or does he or she come forward with new ideas about the way society can benefit from research?

Fifth, does the scientist use a variety of channels to get his or her point across? These include scientific journals, meetings, study group sections, advisory bodies, Congress, and the public media.

Clearly, the literature points to a number of constraints facing scientists who venture into public communication--constraints stemming both from the familiar scientific "rules of the game" and from the unfamiliar journalistic process itself. However, it is also clear that

some scientists do manage--some of them quite successfully--to tell the story of science in a wider forum through the mass media. Although empirical evidence is lacking, such efforts seem likely to increase public understanding of science and possibly to enhance public support of science. The next section reviews the nature and extent of these interactions between science and the news media.

Scientists' Public Communication Attitudes and Behavior

An accumulating body of empirical evidence in the literature helps dispel the image conjured by numerous anecdotal accounts that scientists and journalists are sworn enemies--or, at best, mutually recognized "necessary evils."

Scientists' Contact with the Media

Studies show, first of all, that scientists are not necessarily strangers to the press, and that the trend is toward greater interaction.

Tichenor et al. (1970) found that scientists quoted in their sample of 73 mass media articles "had rather extensive experience with the mass media," with more than half (57%) reporting contacts with five or more different newsmen in the previous year, and nearly a fourth having contacts with 10 reporters or more.

In a study of 111 randomly selected university scientists in Ohio, Dunwoody and Scott (1982) found that 67.6% had granted at least one interview (on the average, four interviews) with a journalist, rejecting the authors' hypothesis that scientists are more likely not to have been in contact with reporters. Moreover, 75% said they "would welcome the contact" with a journalist in the future. Further evidence

of closer-than-expected links between scientists and the media was found: Fifteen percent of the respondents said they had initiated contact with a reporter, and 30% said they had written at least one story themselves (possibly as a news release) for mass media dissemination. Sixty-one percent reported initiating stories about their work via public information personnel.

As Dunwoody and Scott (1982) concluded, "Such activities are certainly in direct contrast to the 'passive' scientist so often pictured by science writers" (p. 57).

In a national survey of 287 physical and life scientists conducted by Dunwoody and Ryan (1985), 63% of the respondents reported they had dealt with at least one journalist (median = 1.7) within the previous year. In a separate analysis of the survey data, however, the authors found that only 37% of their sample said they had suggested story ideas to their public information officers, and 16% said they had initiated stories with journalists within the past year--although 85% of the scientists felt free to initiate stories (Dunwoody and Ryan, 1983).

Van Duzee (1977) likewise found that 90% of her sample of biological scientists in the Washington, D.C., area would be willing to help a science writer get information, even though 43% had never been interviewed by a science writer. Moreover, Alan McGowan, president of the Scientists' Institute for Public Information, reported an overwhelmingly favorable response from scientists asked if they would be willing to answer media questions (La Follette, 1981). More than 95% of the scientists asked have agreed to participate in the media service.

Nearly all of the scientists in Dunwoody and Ryan's (1983) sample (97%) agreed that it is important for scientists to learn to communicate with nonscientists. Moreover, 71% agreed that scientists should be free to deal with the popular media without interference or pressure from their institutions, and 52% even agreed with the statement, "Scientists are just as responsible for making their research findings available to the public as they are for making their results available to their colleagues."

Data in the authors' 1985 report, however, conveyed the general impression that science as a culture still provides few rewards for public communication efforts. As many respondents agreed as disagreed with the statement that scientists who allow their work to be publicized in the popular media are more likely to be criticized than praised by fellow scientists.

It is interesting to note from the study by Tichenor et al. (1970) how generally positive scientists were about scientific information concerning their own research when they knew what their readers got out of it--as compared to their negative opinions of scientific information in general. Fewer than two-thirds of scientists (59%) interviewed rated science news as a whole as "generally accurate," whereas nearly all (94.5%) rated sample newspaper articles quoting them as accurate. Similarly, while only half of the scientists said they felt "very willing" to help other reporters in the future, nearly two-thirds were "very willing" to help the same reporters who wrote the sample article. (There was little "self-selection" by scientists; only 12.3% of the

scientists said they knew anything about the reporter's reputation before the article was written.)

As Dunwoody and Scott (1982) wrote, consistent with various remarks presented earlier, "Openness to further contact suggests that mass media publicity may be viewed as a valuable resource among researchers who depend in part on public support for maintenance of their status as scientists" (p. 58).

Dunwoody and Ryan (1985) found that scientists in their study perceived a positive relationship between media visibility and obtaining research funds. Respondents also said that scientists dependent on outside funding were more likely to deal with the media than those not forced to seek such funding. In fact, the pronounced difference between the perceived rewards of public communication within science and outside of science (i.e., research funding) was one of the study's most notable findings.

Interestingly, Dunwoody and Scott found that scientists in their study would much rather prefer to deal with a magazine reporter than a newspaper or broadcast journalist, even though they "were not at all likely to have come into contact with a magazine journalist" (p. 59). Scientists apparently associate this mode of mass communication (magazines) with their principal mode of scientific communication (refereed journals).

La Follette (1983) claimed that the dearth of quality science programming on television exists "in no small part because of scientists' ingrained attitudes toward popularization" (p. 42), especially a mistrust of the electronic media:

Although television can better show the sights and sounds of science, and commercial television serves larger, more diverse audiences . . . the scientific community in general prefers to do its popularizing in magazines and books. (p. 42)

Grunig (1980) suggested:

This difference seems to reflect a preference for coverage by the instrumental [functional] media rather than the consummatory [entertainment] media. Consummatory coverage of science appears to be the source of the complaints of scientists about sensationalism and humorous treatment of science in the media. (p. 195)

Wade and Schramm (1969) hypothesized that science and health information presented on television was more likely to be related to events (knowledge "of" science), while that of newspapers tended to be more interpretative and to place concepts in perspective (knowledge "about" science). Sachs (1979) concluded that for medical news, the medium is the message--and "newspapers can provide that message with better comprehension, broader scope, and greater depth [than can television]" (p. 1231).

Findings from a Systems Approach

Tichenor and his colleagues, who were among the first to apply a systems perspective to the study of science communication, analyzed communication behavior as a function of both energetic factors, such as incentive and motivation, and control factors, such as organizational constraints and feedback. Although their research centered on the behavior, perceptions, and values of reporters (channels), they also paid attention to scientists (sources) and to source-channel interactions. The measured effect of all these variables was science news accuracy.

Of particular interest, Tichenor's team hypothesized that the accuracy of science articles in the mass media (determined by scientists' evaluations of readers' statements about the stories) would be higher

1. Where there is more personal interaction between the scientist and reporter. The data only partly supported this hypothesis, but were more positively conclusive for stories assigned to the reporter by his or her editor. Articles based on coverage of scientific meetings, without face-to-face conversations with the scientist, were shown to be by far the most poorly understood by readers, that is, the least accurate.
2. "When scientists and their organizations place a high value on reporting to the public, approve of the mass media role in this process, and possess a more differentiated view of the social action process in which mass media might play a part" (p. 674). This hypothesis was supported.
3. When the scientists' institutions are structured to support reporting to the public (e.g., through having public information staffs). Study findings supported this hypothesis, based on scientists' perceptions of strict organizational policy for research reporting. Moreover, stories originating from press releases (and journal articles) were shown to be more clearly understood.
4. When scientists have administrative or teaching functions (which usually involve more experience and skill in communication). The study partly supported this hypothesis, as a scientist's administrative function, much more so than his or

her teaching function, was strongly correlated with communication accuracy. Dunwoody and Scott (1982) also found a scientist's administrative position (rank) to be positively correlated with his or her public communication activity.

As Tichenor et al. concluded, "It appears that factors that point to more specific, purposive control of public communication in the science organization contribute to the production of more accurately understood messages when these scientists come into contact with media professionals" (p. 683). In fact, they found that in both the channel (e.g., editor assignment) and source subsystems, factors that indicate closer control over reporting seem to contribute to more accurate communication. Cronholm and Sandell (1981) noted that although one of the most important factors found in studies of the accuracy of regular news stories is the amount and quality of contact between the source and the journalist, this factor was not strongly correlated with accuracy in Tichenor et al.'s or Tankard and Ryan's (1974) investigations. The only factor to have any significant effect on error rates was prior review of the science articles by the scientist. Cronholm and Sandell explained that "it is important to bear in mind that the definition of error is the source's. It is therefore not surprising that any factors that increase the influence of the source also will increase adjudged accuracy" (p. 90).

Dunwoody and Scott (1982) noted that how scientists interact with reporters "may be influenced by perceptions of who's in power in a news-gathering situation" (p. 58). In his study of medical doctors, Carter (1958) found that the scientists perceived a large status gap between

themselves and reporters, meaning that in most situations the scientists are "in power" and control interactions. Yet, as Carter suggested, in an interview situation "the power balance may be the other way around" (p. 138), with the reporter controlling interactions. To counter this deficiency, Dunwoody and Scott suggested, "the scientist may develop tactics designed to maintain as much control as possible over the interaction" (p. 58)--such as asking to review the reporter's story before publication, as Ryan (1979) found. Indeed, several of the opposing attitudes expressed by scientists in Ryan's study (e.g., that they alone should point out the significance of their research) appeared to be related to their desire to increase their control over the shaping of messages reaching the public.

Scientists in Dunwoody and Ryan's 1985 study were evenly split in response to a statement that peer review always should precede journalistic contact. However, they clearly disagreed with statements that public responsibility could occasionally override peer review. Thus, results reinforced scientists' priority of communicating with fellow scientists.

The Public Information Connection

A number of authors have pointed to the important role of institutional public information officers (mediators) in the science communication process. As Dunwoody and Scott noted, "Mediators probably minimize potentially negative aspects of interactions between scientists and journalists (p. 54). As mentioned above, Tichenor et al. found that mass media articles originating from press releases and other mediator-generated information are more likely to be accurate than those based

purely on personal contact. However, Dunwoody and Scott reported that the degree to which a scientist enlisted the help of public information officers had no relationship with his or her subsequent evaluation of the quality of science coverage. The authors, finding this difficult to understand, wrote, "Scientists are concerned about accuracy but yet do not seem to embrace an available mechanism that can enhance accuracy" (p. 59).

Addressing this seeming inconsistency, Dunwoody and Ryan (1983) found that public information officers have only "a marginal status" among scientists. Although generally positive about public information personnel, scientists preferred direct contact with journalists and believed information officers in their organizations play only a minor role in disseminating research results. In fact, nearly two-thirds of the scientists believed that public information personnel sometimes hinder scientists who want to be completely open about their work. The authors also found that younger scientists depended on the public information office less than did their older colleagues, despite the fact that younger scientists--lacking scientific prestige, experience, and journalistic knowledge and confidence--arguably have greater need for communication support.

In the 1985 report of their survey results, Dunwoody and Ryan found that respondents generally agreed that they should be free to make decisions about media interactions without pressure from their employers. Somewhat unexpected was the general agreement that scientists employed even by public institutions sometimes were constrained indirectly in popularizing their research.

The marginal organizational status of public relations personnel affects how they function with both scientists and reporters. Dunwoody and Ryan (1983) pointed to a government task force report on the Three Mile Island incident, which found that public information personnel--held in relatively low regard by industry and government officials--"often were not privy to current conditions and supplied confusing and even contradictory reports" (p. 656). Indeed, Nimmo (1964) reported that information officers become frustrated when their agencies recognize them as "just there" (p. 26), a status problem that transfers to their interactions with mass media personnel: "The officer is useful to the reporter in direct proportion to the amount of 'inside dope' which he can reveal to the press" (p. 63).

Bronson (1979), in fact, urged the scientific community to "make information available through primary sources"--not through public relations officials. "While these folks are useful for arranging for interviews or double checking facts at the last minute, they are a dubious mechanism for telling a story. . . . They immediately conjure up suspicion in many reporters' minds, rightly so or not" (pp. 1175-1176).

Reporter-Scientist Coorientations

A number of studies examining the relationships among actors in the scientific communication process cast further doubt on the seriousness with which generalized criticism of the mass media and mass media professionals is made by scientists.

Johnson (1963) found that scientists use the same semantic dimensions, or frames of reference, in judging science stories as do both science writers and members of the public (readers and nonreaders

alike); only editors (the "weak links" of the scientific communication chain described earlier) differed in fundamental outlook of "newsworthiness."

Laing (in Tannenbaum, 1963) found that the scientist and science writer are quite compatible semantically. They agreed in their estimation of the distance between their views, there was evidence of an "empathetic bond" between them, and they even agreed in their estimates of the distance between the views of the science reader and those of the scientist. Van Duzee (1977) found that the scientists in her study could distinguish between the news value and the scientific value of research--thus failing to confirm another accepted generalization about scientists.

Somewhat variant results were reported by both Carter (1958) and Tichenor et al. (1970), who found that reporters' rankings of news values were more similar to scientists' rankings than they were to scientists' estimates of reporters' values. The results showed, however, that the actual differences between scientists and reporters were less than the perceived differences--further supporting an empathetic, rather than hostile, relationship.

Ryan (1979), in an effort to learn more about potential barriers to science news communication, used the coorientation research model (Pearce & Stamm, 1973) to study the attitudes of scientists and journalists toward media coverage of science. Specifically, he examined: To what extent do science journalists and scientists agree about science coverage and its problems (agreement)? To what extent are the attitudes of journalists and scientists toward science coverage similar to their

perceptions of each other's attitudes (congruency)? And to what extent do journalists and scientists correctly perceive each other's attitudes toward science news (accuracy)? (see Figure 3).

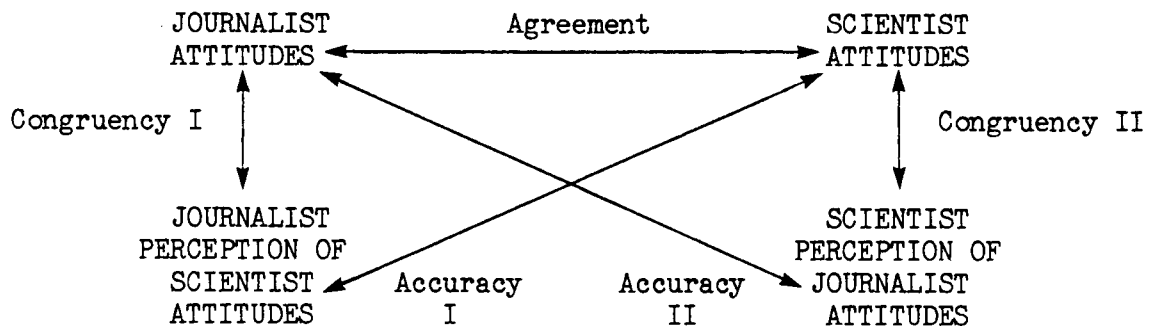


Figure 3. Coorientation Model of Journalists and Their Scientist-Sources

Results of the study showed that the attitudes of the two groups were "remarkably similar," Ryan reported. Interestingly, he found that "each group perceived a larger gap than actually existed" (p. 26).

Responses to a number of survey items demonstrated unexpectedly (according to conventional wisdom) similar orientations toward the overall process of communicating with the public. In particular, both scientists and journalists strongly agreed (in some cases giving exactly the same answers) with the following statements:

1. Scientists should help reporters translate technical jargon into lay terms.
2. Newspaper articles are largely responsible for developing the professional image of scientists in the eyes of nonscientists.

3. Scientists who deal regularly with the press should have some training in the fundamentals of news communication.
4. Newspaper coverage of science news is important for the public.
5. Scientists have an obligation to work with news reporters to get the results of their research before the public.
6. Scientists should not expect the same level of precision in newspaper science reports that they expect from reports in scientific journals and periodicals.
7. Newspaper coverage of science news is important for scientists.

Ryan did discover several areas of definite disagreement.

Science writers strongly disagreed that they should have their stories read by scientists quoted in the articles before publication, that story headlines should be written by the reporters themselves, that a science writer should rely completely on a scientist to point out the most important contribution of the scientist's research, that a scientist should release scientific research results to the press only after the information has appeared in a scientific publication, and that a science writer should not interpret a scientist's technical conclusions.

Scientists strongly agreed with each of those ideas, causing potentially serious communication barriers. The data revealed an apparent desire of scientists to restrict science coverage to knowledge "of" science. However, Ryan noted, "each group at least perceives the extent and nature of the disagreements accurately" (p. 26).

The reader must still interpret Ryan's findings with caution, however, because the scientists surveyed were chosen by virtue of their being named as a major source in a newspaper article. Thus it could be argued that their appearance in the mass media makes them atypical of the "average" scientist and more favorably oriented toward the values of journalism.

Other Predictors of Scientist-Source Behavior

Shepherd (1979) showed that the world of scientific research portrayed in the media has a significant pecking order. Journalists in search of an eminent quote (about marijuana research, for example) seek out those individuals in prominent positions (heads of health-related agencies or institutions, or known in a number of areas tangentially related to the subject), even though others lower in the hierarchy may be doing all the research and know vastly more about the subject. Goodell (1977) found that the same dynamics operated to define the "visible scientists" in her study.

Likewise, in attempting to explain scientists' interactions with the press, Dunwoody and Scott found that higher-ranking scientists had been in contact with journalists more often than had lower-ranking scientists. Of note, this relationship held within age levels--that is, a full professor was more likely to have been interviewed by a reporter than was an associate professor of the same age, who in turn was more likely to have been interviewed than was an assistant professor of the same age. Similar results were reported by Boltanski and Maldidier (1970) among French scientists; these authors, like Goodell (1977), suggested that lower-ranking scientists are pressured to prove them-

selves first within the scientific community before becoming involved in the public domain.

In contrast to scientific rank, Dunwoody and Scott (1982) found no relationship between the scientific productivity of scientists, measured by number of published journal articles, and their level of contact with reporters. The authors wrote that "it seems that success as a scientist is not a good predictor of a respondent's likelihood of being tapped for a media story" (p. 58).

Interestingly, Dunwoody and Ryan (1983) found that public information personnel, acting much like media science writers, also tended to interact with only a few scientist-sources in their organizations, "most likely those who are older, prominent and more organizationally powerful than others" (p. 656).

According to Melnick and Melnick, scientists and administrators also differ in their views of the purpose of science--helping to explain their different levels of interaction with the media. Whereas bench scientists view the scientific process as inherently noble and necessary, administrators "confront the need to justify and support their activities in terms of the 'practical' results that . . . will benefit society" (p. 5).

In their 1985 report, however, Dunwoody and Ryan found no evidence that higher-ranking scientists were rewarded more than lower-ranking individuals for popularizing their work. Respondents also split nearly evenly on the statement that established scientists make better "spokespersons" for science than do younger scientists.

In an attempt to relate the attitudes of scientists toward mass media science coverage with their rank and frequency of reporter contact, Dunwoody and Scott found mixed associations. While both rank and frequency of contact appeared to be moderately related to a scientist's evaluation of the quality of science news in general, rank was more strongly related to a scientist's evaluation of science coverage within his or her specialty area, and simple frequency of contact was more strongly related to a scientist's evaluation of science coverage outside his or her area of expertise. As a group, scientists were more critical of coverage of their own areas than they were of coverage of science in general or of science outside their specialty areas. It appears, then, that the less knowledgeable a scientist is about a topic, the less able he or she is to recognize reporting and judgment errors in related mass media stories and thus, the less critical he or she will be about coverage of that topic.

The above findings, like those of Tichenor et al.'s (1970) which showed a similar discrepancy in scientists' evaluations of general versus specific science stories, suggest that general attitudinal measures are of questionable value in science communication research. Dunwoody and Scott submitted:

It is important to begin to examine what we in fact are measuring with general attitudinal questions and perhaps to begin to place more emphasis on attitudes of sources about objects or processes with which they are reasonably knowledgeable. (pp. 58-59)

The following section of this literature review reviews a communication model that attempts to address these theoretical concerns.

The Situational Theory of Communication

The need for a theoretical underpinning that attempts to explain differences in scientists' communication behavior reflects an overall observation of Farago's (1976): "No analysis of scientific communications can succeed without a firm realization that scientists, audiences, and transmission mechanisms are all emphatically heterogeneous" (p. 1).

According to Grunig (1980), most of the research on interactions among the various actors in the science communication process has been based on, or can be interpreted in terms of, the coorientation model presented earlier. By and large, however, these studies have not provided a theoretical explanation for the presence or absence of the coorientation variables. "For example," Grunig wrote, "they have not explained why scientists and science writers do and do not understand* each other" (p. 200).

Similarly, research on the effects of science communication has been dominated by two theories, according to Grunig: diffusion theory and attitude theory. But neither, he contended, offers the power to explain people's communication behavior.

Shortcomings of Diffusion and Attitude Research

As one critic of diffusion research observed, "If we continue to generate studies at even the present rate, without a major 'leap forward'

*Understanding, defined as the extent to which two people's ideas or cognitions are similar (as opposed to attitudes, or evaluations of those cognitions), was not measured in Ryan's (1979) study and thus was not depicted in Figure 3.

in terms of integrative theory, we shall drown in our own data" (McGrath & Altman, 1966). Grunig believes the most important shortcoming of diffusion research, which describes how people hear about and adopt new ideas and practices, "is its presupposition that communication is something that a person or agency does to get other people to do what he or she wants them to do" (p. 177). Indeed, in his review of more than 3,000 studies on the diffusion of innovations, Rogers (1983) acknowledged that diffusion researchers share the "myopic view" of the social-influence process held by most persuasion scholars, a process "seen as a linear, unidirectional communication activity" (p. xvii).

Oskamp (1977) pointed to the same problem in attitude research: a pervasive assumption that communications, in domino-like fashion, change attitudes that in turn change people's behavior. As Grunig (1980) observed, research

does show that people who communicate about an issue are more likely to have an attitude on that issue and are more likely to do something (behave) about that issue. But one message seldom leads to one attitude and one behavior. The dominos do not always fall in the same direction. (p. 178)

In a more recent review and critique, Grunig (1983a) stated that "the lack of consistency between attitude and behavior has emerged as one of the most important contemporary controversies in social science" (p. 5). Indeed, Festinger's (1964) theories of cognitive balance and dissonance attempted to explain why people selectively expose themselves to information consistent with their attitudes rather than to information that would change their attitudes. Although dissonance theory itself has its own inconsistencies, Grunig noted, it "reversed the temporal relationship between communications and attitude. Instead of

attitudes being a function (at least in part) of communications, communication behavior became a function of attitude" (pp. 7-8). The problem remains, however, that most attitude and communication theories are still cross-situational--that is, behavior in specific situations is considered to be "a function of attitudes that a person carries from situation to situation and that predisposes him to behave in each situation in a way consistent with his attitudes" (p. 1).

The Situational Perspective

As an alternative to the cross-situational model, Grunig has developed a situational theory of communication that takes into account that individuals sometimes control their own behavior and that sometimes the constraints of their environment control their behavior. The relative effect of self control versus environmental control will depend on the situation:

People exercise free will in situations that permit it or in which they think rational judgment is necessary. In other situations they must conform to authority, social rules, or physical limitations. In still other situations, people move serendipitously, because the movement simply does not mean that much to them (as for example, in the lack of serious attention to environmental problems). (Grunig, 1983a, p. 9)

In assuming that people communicate about specific situations or issues, the theory assumes that cross-situational concepts like attitudes and personality traits do not consistently explain the reasons why people communicate. Rather, people communicate when a situation arouses their interest or when they must deal with a problem in that situation. In the former case, people may communicate for consummatory purposes. In the latter case, people communicate in an effort to improve their

control over a situation--that is, they communicate for functional reasons.

In the situational theory, three independent variables are used to predict the frequency and activeness of people's communication behavior. These variables conceptualize ways in which people perceive situations: (1) problem recognition--whether people stop to think about a situation; (2) constraint recognition--whether people think they can personally do something about a situation; and (3) level of involvement--whether people connect themselves with a situation.

The concept of problem recognition derives from the idea that people do not think or communicate about a situation unless it is problematic to them--that is, unless they recognize that something is missing or indeterminant in the situation. Conversely, constraint recognition as a predictor of communication behavior is based on the idea that if people believe their freedom to do something about a situation is limited, they have little reason to acquire information that helps them to plan and make decisions about what to do in that situation. As problem recognition increases and constraint recognition decreases, the situational theory posits, communication activity increases. Thus, these two variables explain when a person communicates.

The third independent variable, level of involvement, explains not only when a person communicates, but also how a person communicates. The theory predicts that as perceived involvement increases, active communication increases, with little effect on passive communication. In terms of audience behavior, which the situational theory has been used to explain, active communication is equated with information

seeking, whereas passive communication is defined as information processing. Thus, people seldom seek information about situations that do not involve them, but they will randomly process information about such a situation, especially if they also recognize the situation as a problem.

The Theory Extended: Application to Source Behavior

From the perspective of source behavior, which this study attempts to explain, active communication is defined as initiation of contact with the news media or a public information officer; passive communication is equated with response to an inquiry from the news media or to a request from a public information officer to help with a story.

To date, the only study using the situational theory to examine the communication behavior of information sources was conducted by Turner (1981). She found that the information-giving behavior of agricultural linking agents (who act equally as receivers and sources of information on specific topics) resulted mainly from the agents' own perceptions of the situational variables, rather than the agents' estimations of client perceptions of the variables. The study focused, however, on the information-processing and information-seeking behavior of the agents; analysis of information-giving behavior was limited to agents' responses to client information needs ("passive" source communication).

In previous research using the situational theory, "situations" are subject-specific topics or issues about which people communicate--such as the break-up of the Bell system, the extinction of whales, and the siting of nuclear power plants. In this study, situations are

conceptualized somewhat differently. They are defined as the varying levels of effects or consequences of a scientist's research, from its immediate applications (one "situation") to its social and ethical implications (another "situation").

None of the survey studies of scientists' communication behavior have discriminated among the potential range of topics (situations) about which an individual scientist may choose to communicate. Rather, they have asked simply about the extent of actual or desired contact with mass media representatives--on any topic. They have sought to explain such contact in terms of various personal characteristics (age, organizational status, etc.) and general or cross-situational attitudes about science reporters and science reporting.

From a situational perspective, there are two major limitations to these studies. First, they assume that general attitudes (and orientation states) will predict a scientist's communication behavior in any given situation. Based on the review of the literature, cross-situational attitudes in fact appear to be weak predictors of actual behavior. Second, these studies fail to recognize that the communication behavior of information sources (in this case, scientists) likely is influenced by the specific nature of the information for which they are being tapped as experts (the specific situation), just as the communication behavior of audiences clearly varies according to the specific topic of information being presented (again, the specific situation).

Consider the following example: A young investigator is openly talkative with a reporter about the theoretical implications of his

research in genetic engineering (one situation), but declines an interview about the ethical implications of his research (another situation).

In the former situation, it can be hypothesized that the investigator's problem recognition and level of involvement both are high, and his constraint recognition low. As an expert in the field, he feels free to discuss the scientific import of his work--short of disclosing details of preliminary, unpublished data. In the latter situation, it can be conjectured, the investigator's problem recognition is still high, but his constraint recognition is even higher. He knows his place as an upward-advancing basic scientist. Fearing censure from his established peers, he avoids making pronouncements not clearly within his area of expertise--even though he holds strong opinions about the potential impact of his work on society. His level of involvement in such matters is low, increasing the passiveness of his communication in the situation.

To provide further insight into such behavioral dimensions of the public communication process in science, a mail questionnaire was developed for the study based on the research findings presented above and on the special circumstances of scientists conducting health-related research. In addition to the situational variables, questions in the survey addressed such independent variables as age, number of publications, academic standing, membership in political action groups, and training in communication skills. Other questions were directed to scientists' attitudes/evaluations related to such variables as the quality of mass media reporting of their research specialty areas (as opposed to science in general), the importance of science communication

for both scientists and the public, and the prospects for continued public funding of their research.

To enable comparisons with other study findings and other study populations, selected questions from several key papers (Dunwoody & Scott, 1982; Ryan, 1979; Dunwoody & Ryan, 1983; Tichenor et al., 1970) were incorporated into the mail survey.

CHAPTER III

METHODS AND PROCEDURES

A notational description of the research plan for this study is as follows (Haskins, 1981):

	t_1	t_2	t_3	
Pla	--	--	M1	(One-shot descriptive study)

where

t_1, t_2, t_3 = sequential points in time; the time during which the survey questionnaire was administered is represented by t_3 .

P1 = scientists named as principal investigators on research projects receiving grant funding in FY 1983 from the National Institutes of Health.

Pla = systematic sample of P1.

M1 = public communication beliefs, attitudes, and behaviors of survey respondents as measured by a mail questionnaire.

Population Definition

Each fiscal year, NIH publishes a directory of all grant awards active during that year (newly awarded, competitively continued, or non-competitively continued). For all awards listed in this NIH Research Grants volume (NIH, 1984) are given the names and general mailing addresses (institution, city, ZIP code) of the corresponding principal investigators, arranged alphabetically by state. These individuals comprised the total study population; for individuals sampled (see below), additional address information (street number or P.O. box) was

obtained from the NIH Research Awards Index (NIH, 1983a), which lists all projects (grants and contracts) by an administrative funding number.

Fiscal year 1983 was selected not only because it was the latest year available in directory format, but also because projects begun during that year would have had time to yield at least preliminary results which the principal investigators reasonably could be expected to start discussing with their peers and possibly with the press.

Selection of this population for study means that the findings can be generalized only to scientists who (1) receive some NIH funds for their research projects and (2) are named officially as principal investigators for those projects. Not represented, therefore, are (1) scientists other than those working on health-related projects (however directly or remotely), (2) scientists working on health-related projects who did not seek and/or receive NIH funding, and (3) scientists working on NIH-funded projects who are not listed as principal investigators. However, these limitations may actually enrich study findings by allowing questions to be focused on topics about which the respondents are reasonably knowledgeable. Moreover, these restrictions can help screen those individuals who are not active researchers and/or who have just begun their research careers and therefore have not had occasion to meet a reporter or time to develop thoughtful attitudes about the press.

It should also be noted that many researchers whose new grant applications are not funded during a certain fiscal year already are principal investigators for one or more projects funded in previous years, and therefore are represented in the sampling frame anyway.

Sampling Method

In the computation of an appropriate sample size (Babbie, 1973), it was arbitrarily decided that for the purposes of the study a confidence level of 95% (plus or minus 1.96 standard errors--rounded to 2) and a sampling variance of 5% were desired. Thus, because 2 standard errors = 5%, 1 standard error (S) = 2.5%. Assuming a binomial percentage distribution (PQ) of 50/50 (e.g., for some questions such as "Have you ever sought or granted an interview with a news reporter?" there may be an even split between "yes" and "no" answers), the formula to determine sample size (n) became:

$$S = \sqrt{\frac{PQ}{n}} \quad ; \quad 2.5 = \sqrt{\frac{(50)(50)}{n}} \quad ; \quad n = 400.$$

Thus, for the precision desired, a sample size of 400 respondents was required. Because the total population (sampling frame) exceeds 8,000, as described below, the sampling fraction (sample size divided by total population) is less than 5% and no downward adjustment in sample size (finite population correction) was called for (Cochran, 1977, p. 25).

However, because it is unrealistic to expect a 100% response rate, the drawn sample needed to exceed 400. Assuming a 75% return rate, n became 533. According to Dillman (1977), extensive use of his "total design method" in designing and implementing mail surveys "convincingly demonstrates that a response rate of nearly 75% can be attained consistently in mail surveys of the general public and that

even higher response rates are probable in surveys of more specialized populations, such as . . . members of a profession" (p. viii). In Ryan's (1979) mail survey of 140 scientists, 78.6% responded to one of his three mailings. A return rate over 75% would drop the sampling variance to below 5% (4.18% variance for a 100% response rate).

For drawing the required sample of 533 names from the sampling frame, it was decided to use the systematic (interval) sampling technique with a random start. This technique is appropriate for estimating the characteristics of a population when individuals are arranged in an effectively random order, one that will not bias the resulting sample. According to Cochran (p. 212), this is so in sampling from alphabetical lists, such as the listing of PI's in the NIH Research Grants, if the items being measured have no relation to the surname of the individuals.

The number of different scientists listed in the grants volume, or sampling frame, was approximately 14,900. With the determined sample size of 533, the sample interval became $14,900/533 = 28$. A table of random numbers (in Babbie) was used to select the starting point (7th name). Thus, that individual and each additional 28th distinct name was selected to comprise the study sample. This sampling procedure yielded 535 names.

Data Gathering Method

For the study, use of a mail questionnaire was chosen over personal and telephone interviewing for a number of reasons, as suggested by Erdos (1970) and Dillman (1977):

1. It allows for a wider distribution, with no special problems attendant with a national survey.
2. It allows a better chance for a thoughtful reply; it is done at the convenience of the respondent, not of the interviewer.
3. It is time-saving, both in preparation (many copies printed from a single original) and administration (the mail does the work).
4. It provides for centralized control; there is greater ease of keeping the quality of data gathering uniformly high.
5. It is cost-saving; on any given budget, one can afford to produce a larger number of completed questionnaires through the mail method.

The authors also noted that the problem of nonrespondents is no more related to mail surveys than to other types of surveys, and that overall item nonresponse does not represent a significant problem for mail surveys. Moreover, self-administered questionnaires have been used in most previous studies using the situational theory of communication to measure respondents' perceptions of the situational variables.

Techniques to Increase Response Rate

Planning and implementation of the mail survey followed Dillman's "total design method." This approach is based on the principles of social exchange theory, which states that people will behave in a desired manner (such as completing a mail questionnaire honestly and returning it promptly) only if the rewards they expect to receive from doing that activity outweigh the perceived costs of doing it. Thus, according to Dillman, there are three things that must be done to maximize survey

response: Minimize the costs for responding, maximize the rewards for doing so, and establish trust that those rewards will be delivered. The following paragraphs summarize how these principles were translated into specific techniques for improving the response rate to the mail survey reported here.

Rewards were maximized by:

1. Showing positive regard--explaining that the respondent was part of a carefully selected sample and that his or her response was critical to the study's success; using the personalization techniques of real signatures ("pressed blue ball point pen method") and individually typed salutations.
2. Giving verbal appreciation--using such phrases as "our grateful appreciation" and "our sincere thanks in advance."
3. Making respondents feel they were being consulted--using such messages as, "It's not known what scientists think on these important issues, so we are attempting to find out."
4. Supporting respondent values--appealing to the respondents' desire to have their opinions included in a study with obvious "social usefulness."
5. Offering tangible rewards--offering a copy of survey findings to the respondents.
6. Making the questionnaire interesting--putting the most important, interesting questions first; putting demographic questions last; using graphic devices on the front cover.

Costs were minimized by:

1. Making the task appear brief--making the questionnaire clear and concise; giving it a less formidable appearance by reducing its size, making it into a booklet format, and using an attractive layout (consistent response ordering, vertical flow, and questions tailored to fit each page).
2. Reducing the physical and mental effort required--avoiding complex questions and directions that are difficult to understand; using questionnaire transitions for continuity; grouping similar items together; supplying stamped return envelope.
3. Eliminating chances for embarrassment--avoiding overly direct, personal questions.
4. Eliminating any implication of respondent subordination--using such messages as "Will you please do us a favor?" to imply that the researcher was in some way subordinate to the respondent.
5. Eliminating any direct monetary cost--supplying a stamped return envelope.

Finally, trust was established by:

1. Providing a token of appreciation in advance--promising to send a copy of results and putting the results to good use.
2. Identifying with a known organization that has legitimacy--using the University of Tennessee Communication Research Center's letterhead and return address.

Survey Instrument

Based on the above principles and the objectives of the proposed study, a questionnaire was developed consisting of three major sections: (1) questions to measure scientists' perceptions of the three situational levels of passive and active communication behavior, and evaluations of media coverage of their research areas; (2) questions to determine scientists' beliefs about key science communication issues; and (3) questions to characterize the demographics and personal attributes of the responding scientists.

The completed questionnaire, constructed to fit Dillman's booklet format (12 pages, including front and back cover and blank inside front page), is included in Appendix A. According to Dillman, questionnaires up to 12 pages, or 125 items, have as high a response rate as do shorter questionnaires. However, these measures of length "represent plateaus beyond which response rate reductions can be expected" (p. 55).

Questionnaire Pretest

Prior to fielding of the mail survey, the questionnaire was pretested twice and revised both times based on how the questions were answered and on comments received.

The first draft, with 10 pages of questions, was pretested in November 1984 among three NIH intramural (staff) scientists. Based on this pretest, the wording of several questions and response categories was changed slightly to improve clarity and consistency.

The second draft was pretested in May 1985 among five University of Maryland scientists unknown to the writer, selected from the NIH

Research Grants volume. Based on this pretest, more extensive revisions were made, primarily to reduce the questionnaire's overall length and the monotony of the situational questions. The number of situations was reduced from five to three. The two deleted situations, which the scientists had difficulty dealing with, related to scientists' perceptions of the impact of "other, related research," as opposed to their own research. A few other questions were deleted or recast, and items in Part I were reorganized to leave the inside front page blank, making the beginning appear less intimidating and shortening the final instrument to nine pages of questions.

In addition, two scientists noted that use of the term "bio-medical scientist" throughout the survey instrument and correspondence might not be appropriate for many respondents (such as botanists and psychologists), even though they are funded by NIH. Thus, simply "scientist" was used.

Copies of the final questionnaire, mailout and return envelopes, and cover letters were printed on an offset press.

Components and Timing of Survey Mailings

Original mailing. The first mailout package, sent on May 7, 1985, to all 535 scientists in the sample, consisted of the following elements:

1. Cover letter--explained the study's purpose and attempted to convince the respondent that the study was useful.
2. Questionnaire--printed on three sheets of paper, folded in the middle, and stapled to form a 12-page booklet.

3. Stamped, pre-addressed reply envelope.
4. Monarch size business envelope--contained the cover letter, questionnaire, and return envelope, with first-class postage (stamps) affixed and the names and addresses individually typed using a word processor.

As Dillman recommended, Tuesday mailout dates were selected for all mailings to avoid contributing to weekend mail buildup while assuring that nearly all respondents received the packet the same week.

Follow-up mailings. Two survey follow-up mailings were conducted, identified below by the number of weeks that elapsed after the original mailout.

1. One week: A postcard reminder sent to everyone (May 14, 1985). It served as both a thank you for those who responded and as a friendly and courteous reminder for those who had not.
2. Three weeks: A letter and replacement questionnaire sent only to nonrespondents, at that point 298 individuals (May 28, 1985). Nearly the same in appearance as the original mailout, it had a shorter cover letter that informed nonrespondents that their questionnaire had not been received, and appealed for its return.

Dillman recommended a final mailing at seven weeks, similar to the one that precedes it except that it is sent by certified mail to emphasize its importance. Because of time limitations for analyzing and reporting the survey data, however, this extra mailing was omitted.

The original survey cover letter, follow-up postcard, and follow-up letter are included in Appendix A.

Data Preparation and Analysis

Following receipt of all completed questionnaires up to the data collection cutoff date, questionnaires were checked and edited as necessary. (In three cases, respondents skipped over two facing pages of the questionnaire and were sent the appropriate replacement pages to complete and return.) Responses to Q-4, Q-12, and Q-16 were hand tabulated as a quality-control check of the subsequent computer tabulation.

A coding form was then devised to assist the keypunch operators who entered and verified the data and the computer programmer who formatted the output tables. The computer program itself was written using the SAS statistical package to yield a variety of summary statistics, frequency counts, crosstabulations, and regression data as presented in the following chapter.

CHAPTER IV

RESULTS

Survey Response Rate

At the time of the data collection cutoff date, 356 completed questionnaires of the original 535 mailed out had been returned to the Communications Research Center, for an overall response rate of 66.5%. Of the questionnaires not completed, 19 were undeliverable (eight were returned with no forwarding address; five scientists were out of the country; and six individuals were deceased). Subtraction of these questionnaires yielded an adjusted response rate of 356/516, or 69.0%. Nine scientists declined to participate in the survey because of lack of time, lack of interest, or because they were no longer active researchers.

Of the 356 completed questionnaires, 339 were received by the writer in time for the computer analyses summarized below. Thus, most of the summary statistics (except where data are missing due to respondents' skipping one or more questionnaire items) are based on a sample size (n) of 339.

Research Questions 1 and 3

To provide a composite profile of the scientists responding to the survey, the following data summaries are presented to address research questions 1, scientists' communication activity and evaluation of media performance, and 3, scientists' demographic and personal attributes. (Research questions are given in Chapter I, p. 12.)

Public Communication Activity

Nearly seven of every 10 respondents (69.3%) reported having had some contact during their careers with a journalist regarding their research. Half (49.8%) reported having had some contact in the past year, a majority of them with one or two different reporters (Table 1). Of all respondents, somewhat more than a fourth (27.1%) had had contact with one or two reporters, and somewhat less than a fourth (22.8%) with three or more reporters.

As shown in Table 2, scientists were much more likely to have come into contact with a newspaper reporter (84.7%) than with other mass media representatives. The proportions of scientists having had contact with magazine and television journalists were very close (58.3% and 57.9%, respectively). Radio reporters were the least frequently encountered.

Instead of showing frequencies of actual media contacts, Table 3 presents the types of media contacts most and least desired by survey scientists. Of respondents expressing a single preference, half said they would be most willing to help a magazine reporter seeking information for an article about their research. Almost as large a proportion (44.4%) said they would be least willing to help a television reporter, while only 3.7% said they would be most willing to help a radio reporter.

Other aggregate measures of scientists' communication activity (public and scientific) related to their research are shown in Table 4. Nearly all respondents had presented a paper at a scientific meeting, while only 15.3% had testified for public support of science. Slightly more than half of the scientists in the sample (54.9%) had had contact

Table 1. Scientists' Mass Media Contacts
in Past Year

Proportion of Scientists Seeking or Granting Interviews			
Number of Reporters Contacted	All Respondents (n = 339)	Respondents Reporting Contact Ever (n = 235)	Respondents Reporting Contact in Past Year (n = 169)
None	50.1%	28.1%	-
One or Two	27.1	39.1	54.4%
Three or Four	14.2	20.4	28.4
Five or Six	4.7	6.8	9.5
Seven to 10	2.4	3.4	4.7
More than 10	1.5	2.1	3.0

Table 2. Types of Reporters Most Frequently
in Contact with Scientists (n = 235)

Type of Reporter	Proportion of Scientists Reporting Contact Ever ^a
Newspaper Reporter	84.7%
Magazine Reporter	58.3
Television Reporter	57.9
Radio Reporter	43.8

^aPercentage total exceeds 100 because of multiple responses.

Table 3. Types of Reporters Most and Least Desired
for Contact by Scientists

Type of Reporter	Proportion of Scientists Reporting <u>Most</u> Willing To Help		Proportion of Scientists Reporting <u>Least</u> Willing To Help	
	All Respondents (n = 339)	Respondents With Single Preference (n = 268)	All Respondents (n = 339)	Respondents With Single Opinion (n = 257)
Magazine Reporter	39.8%	50.4%	4.7%	6.2%
Newspaper Reporter	27.4	34.7	14.2	18.7
Television Reporter	8.8	11.2	33.6	44.4
Radio Reporter	2.9	3.7	23.3	30.7
Multiple/No Bias	20.9	-	24.2	-

Table 4. Scientists' Involvement in Other Science
Communication Activities (n = 339)

Activity	Proportion of Respondents
Presentation of Paper at Scientific Meeting	99.4%
Participation in Study Group Section/Advisory Body	84.1
Speech Before Public Group	83.2
Contact with Institution's Public Information Office	54.9
Participation in Press Conference	35.1
Testimony on Issue Related to Science and Public Policy	20.0
Testimony for Public Support of Science	15.3

with their institutions' public information offices, a topic that will be considered later in greater detail, and more than a third (35.1%) had participated in a press conference.

Evaluation of Media Performance

Of the 235 scientists reporting some contact with the mass media, most (61.3%) rated their overall experiences with journalists as very or somewhat positive. Less than a fourth (23%) rated their experiences negatively, while 15.7% of the respondents were neutral. On a scale of 1 (very positive) to 5 (very negative), the mean score was 2.5--halfway between somewhat positive and neutral.

Responses to two other attitude questions revealed somewhat less positive evaluations of journalistic treatment of scientists' research. Slightly more than half of the respondents (53%) agreed to some extent that mass media coverage of their research is generally accurate, while slightly more disagreed than agreed (42.6% vs 41.1%) that results of their research are being disseminated satisfactorily to the public. On a scale of 1 (strongly agree) to 7 (strongly disagree), with a value of 4 at the midpoint, the mean score on the accuracy statement was 3.78; on the dissemination statement it was 4.12.

Asked to evaluate the performance of specific mass media in covering their research, respondents gave highest ratings to magazines and lowest ratings to television. As shown in Table 5, nearly half (45.8%) of scientists expressing a single opinion said magazines did the best job, and a similarly large proportion (47%) said television did the worst job. Radio ranked last in the best-job category (3.8%) but well behind television as doing the worst job (23.5%).

Table 5. Mass Media Rated Best and Worst
in Covering Scientists' Research

Type of Media	Proportion of Scientists Rating As <u>Best</u> Job		Proportion of Scientists Rating As <u>Worst</u> Job	
	All Respondents (n = 339)	Respondents With Single Opinion (n = 288)	All Respondents (n = 339)	Respondents With Single Opinion (n = 281)
Magazines	39.0%	45.8%	6.2%	7.5%
Newspapers	32.4	38.2	18.3	22.1
Television	10.3	12.2	38.9	47.0
Radio	3.2	3.8	19.5	23.5
Multiple/No Opinion	15.0	-	17.1	-

Demographic and Personal Attributes

From Table 6, the "average" survey respondent is a 46-year-old male basic scientist who has earned the Ph.D. He is employed by a college or university as a full or associate professor and, in addition to research, has teaching and/or administrative responsibilities. He is principal investigator on two to three active research projects and has authored perhaps 50 scientific articles, but is not likely to hold an official organizational position. He also is not likely to have been hired by industry as a consultant, less likely to be involved in industry-supported research, and still less likely to belong to a social action group related to science. However, he is likely to be part of a multidisciplinary research team. He has not had formal training in mass media relations or public communication skills, and English was his first language learned.

Table 7 presents summary data from five survey questions designed to measure scientists' beliefs about themselves and their own research, providing additional personal data about the respondent population. For this tabulation, responses to the questionnaire's seven-point scale (1 = strongly agree, 7 = strongly disagree) were collapsed into three categories: agree (1 - 3), neutral (4), and disagree (5 - 7). In addition to frequency counts for these categories, the table shows mean scores (based on the seven-point scale), standard deviations for item responses, and "adjusted" mean scores. The adjusted scores, used by Ryan (1979) to avoid artificially inflating the means, disregards responses at the midpoint of the scale (4 = don't know/no opinion) and recalculates the mean based on a six-point scale (5 becomes 4, 6 becomes 5, and 7 becomes

Table 6. Selected Demographic Characteristics
of Scientist RespondentsAge (mean = 46.2; n = 338)

35 or Younger	10.9%
36 - 40	21.0
41 - 45	22.5
46 - 50	15.4
51 - 55	13.3
56 - 60	7.1
61 or Older	9.8

Sex (n = 338)

Male	88.5%
Female	11.5

Research Focus (n = 339)

Basic	72.0%
Applied Research and Development	9.1
Clinical Investigation	11.8
Controlled Clinical Trials or Demonstration/Education Programs	6.2
Other	0.9

Highest Academic Degree (n = 339)

Ph.D.	64.9%
M.D.	26.8
M.D./Ph.D.	5.6
Other (D.V.M., D.D.S., No Degree)	2.6

Employer (n = 339)^a

College or University	90.3%
Nonprofit Research Organization	9.7
Government Research Organization	2.4
Other (For-Profit, Self, Labor Union)	0.9

College/University Position (n = 308)

Full Professor	56.2%
Associate Professor	24.0
Assistant Professor	16.9
Other (Research, Teaching)	2.9

Table 6 (Continued)

Principal Responsibilities (n = 339)

Full-Time Research	15.3%
Research and Teaching	39.2
Research and Administration	7.1
Research, Teaching, and Administration	33.0
Clinical Care	5.3

Projects as Principal Investigator (n = 337)

None ^b	0.6%
One	27.9
Two	30.0
Three	26.4
Four	7.4
Five or More	7.7

Scientific Articles Published (n = 338)

Fewer than 11	2.7%
11 - 25	20.4
26 - 50	25.1
More than 50	51.8

Other Research-Related Roles (n = 337-339)

Member of Multidisciplinary Research Team	68.7%
Consultant to Industry	41.3
Holder of Official Organizational Position	36.6
Worker on Industry-Sponsored Research	27.4
Member of Social Action Group	17.7
Public Communication Training	5.6

First Language Learned (n = 339)

English	83.1%
Other	16.9%

^aPercentage total exceeds 100 because 13 respondents reported dual university/non-university employment.

^bTwo scientists in sample were formerly but not currently principal investigators on NIH grants.

Table 7. Scientists' Beliefs About Themselves
and Their Research

Statement	Agree	Neutral	Disagree	Mean ^a	Standard Deviation	Adjusted Mean ^b
Continued public support of your research is fairly secure	32.0%	12.7%	55.3%	4.60	1.794	4.06
Based on current public interest, your research is a "hot topic"	54.3	10.6	35.1	3.71	1.821	3.29
Based on current public opinion, your research is controversial	16.6	12.4	71.0	5.33	1.635	4.71
Your colleagues would consider you a relatively controversial figure	10.9	12.1	77.0	5.60	1.432	4.93
Other scientists would recognize you as a credible spokesperson on scientific topics outside your specific area of expertise	27.3	33.2	39.5	4.25	1.596	3.79

^aScores less than 4.0 indicate agreement.

^bScores less than 3.5 indicate agreement.

6). For the original means, scores of less than 4 indicate overall agreement among respondents; for the adjusted means, scores of less than 3.5 indicate agreement.

Most respondents (71%) did not believe their research is controversial, and an even greater proportion (77%) did not believe they personally are controversial. Even though most scientists (54.3%) thought their research is a "hot topic," less than a third (32%) believed that continued public support of their research is fairly secure. Finally, most respondents did not believe they would be recognized as credible scientific spokespersons outside their specific areas of expertise, although fully one-third of the scientists had no opinion on the matter.

Research Question 2

In a series of other questionnaire items, scientists indicated on the same seven-point scale their attitudes and beliefs about a number of issues related to the public communication of science. These findings are summarized below by general topic area.

Career and Peer Pressure

Table 8 presents response frequencies and means for seven questions concerning the effect of scientific career pressure and peer pressure on public communication activity, particularly scientists' perceptions of the peer review process.

Scientists generally were split on their perceptions of constraints imposed by career considerations. Slightly more disagreed than agreed (44.2% versus 41%) that the conditions for career advancement in science tend to restrict scientists' public communication activity.

Table 8. Scientists' Perceptions of Scientific Pressures on Public Communication Activity

Statement	Agree	Neutral	Disagree	Mean ^a	Standard Deviation	Adjusted Mean ^b
The conditions for career advancement in science tend to restrict scientists' public communication activity	41.0%	14.7%	44.2%	4.20	1.690	3.71
Scientists face peer pressure against popularizing their research in the mass media	70.2	5.0	24.8	3.16	1.743	2.86
Coverage of a scientist's research results in the lay press would endanger subsequent publication of those results in a scientific journal	44.1	8.3	47.6	4.05	2.019	3.53
A scientist should release scientific research results to the press only after the information has appeared in a scientific journal or scholarly publication	75.2	5.3	19.5	2.46	1.827	2.17
A scientist should release scientific research to the press after the paper has been accepted for journal publication, but before it is actually in print	41.6	15.3	43.1	4.04	1.916	3.54
Scientific findings related to immediate public health and safety problems should be released to the public before they undergo complete peer review	17.2	3.6	79.2	5.55	1.820	4.79
Scientists are hesitant to discuss their results with news reporters after presenting the results for the first time at a scientific meeting	33.3	29.2	37.5	4.14	1.541	3.67

^aScores less than 4.0 indicate agreement.

^bScores less than 3.5 indicate agreement.

In contrast, seven in 10 respondents believed that scientists face peer pressure against popularizing their research.

Respondents' views on the publishing restrictions of peer review differed widely. Scientists only slightly disagreed with statements that coverage of their results in the lay press would endanger subsequent journal publication of those results (47.6% disagreed, 44.1% agreed) and that scientists are hesitant to discuss their results with news reporters after presenting the results for the first time at a scientific meeting (37.5% disagreed, 33.3% agreed). For the latter item, a large proportion of respondents (29.2%) was unsure.

Scientists did show fairly strong consensus on when research should be published, however. Three-fourths of the sample agreed that a scientist should release findings to the press only after the information has been published in the scientific literature. Similarly, an even greater proportion (79.2%) disagreed with the statement that scientific findings related to pressing public health issues should be released publicly before undergoing complete peer review. Scientists were split on a "compromise" policy that they should release findings to the mass media after the paper has been accepted for journal publication but before it is actually in print (43.1% disagreed, 41.6% agreed).

In a separate questionnaire item, scientists were asked whether they had heard the term Ingelfinger rule or Relman rule used to describe a journal's policy of accepting only original research papers. Among the 136 respondents (40.1%) who replied yes (including four scientists who reported they were aware of the rule but not by name), perceptions varied widely on what scientific journals adhere to the principles of

this rule. The largest proportion of respondents believed the rule applies to most journals; smaller but considerable proportions believed it applies to some journals or to the New England Journal of Medicine only:

<u>Journals Believed Adhering to Policy</u>	<u>Proportion of Respondents</u>
New England Journal of Medicine only	19.0%
Some peer-reviewed journals	23.4
Most peer-reviewed journals	38.0
All peer-reviewed journals	13.9
Unsure	5.8

To determine the relationship between scientists' awareness of the Ingelfinger rule and expressed attitudes and beliefs concerning the peer review process, answers to the above awareness question were cross-tabulated with those to six of the seven-point items already described. As shown in Table 9, scientists aware of the prepublication rule agreed that media coverage of research results would endanger subsequent scientific publication (adjusted mean = 2.90), whereas other scientists disagreed (adjusted mean = 3.98). The other item on which "aware" and "unaware" scientists were on different sides of the scale was on the "compromise" policy permitting popularized treatment of a scientific report after its acceptance but before its publication by a journal. The "aware" group tended to disapprove of such a policy, while the "unaware" group tended to approve (adjusted means = 3.83 versus 3.34). "Aware" scientists also agreed more strongly than the others that research results should be released publicly only after they have appeared in a professional publication (adjusted means = 1.97 versus 2.32).

Table 9. Scientists' Beliefs About Scientific Publication Norms^a

Communication Issue	All Scientists (n = 339)	Scientists Aware of Ingelfinger Rule (n = 136)	Scientists Not Aware of Ingelfinger Rule (n = 203)
Scientists face peer pressure against popularizing their research in the mass media	2.86	2.73	2.97
Coverage of a scientist's research results in the lay press would endanger subsequent publication of those results in a scientific journal	3.53	2.90	3.98 ^c
A scientist should release scientific research results to the press only <u>after</u> the information has appeared in a scientific journal or scholarly publication	2.17	1.97	2.32 ^b
A scientist should release scientific research to the press <u>after</u> the paper has been accepted for journal publication, but <u>before</u> it is actually in print	3.54	3.83	3.34 ^b
Scientific findings related to immediate public health and safety problems should be released to the public before they undergo complete peer review	4.79	4.84	4.74
Scientists are hesitant to discuss their results with news reporters after presenting the results for the first time at a scientific meeting	3.67	3.56	3.77

^aAdjusted means; scores less than 3.5 indicate agreement.

^bT-test significant at p less than 0.05.

^cT-test significant at p less than 0.001.

Value of Science News

As shown in Table 10, survey scientists attached high values to the public communication of science. Scientists strongly agreed that mass media coverage of science is important for the public. Nearly as strongly, respondents agreed that such coverage is important for scientists and is largely responsible for developing the public's professional image of scientists. Nearly three-fourths of the sample (73.2%) also agreed that scientists have an obligation to work with journalists, and more than half (51.9%) even agreed that scientists are just as responsible for making their findings available to the public as to their colleagues.

Scientist-Journalist Relations

Responses to a series of attitudinal questions about scientist-journalist interactions revealed a quite moderate view among survey scientists (Table 11). Nearly two-thirds of respondents agreed both that scientists who deal regularly with the press should have some communication training (65.8%) and that scientists who deal with the press often inflate the value of their work (64.6%). Less than a third of the sample believed that most scientists understand the problems reporters face in communicating science news, but an even smaller proportion (23.9%) believed that most reporters understand scientists' public communication problems.

By a 10% margin, reflecting a somewhat more distrustful attitude, more scientists agreed than disagreed (46% versus 36%) that they should refuse to cooperate with reporters with inadequate science training.

Table 10. Scientists' Expressed Values of Science News

Statement	Agree	Neutral	Disagree	Mean ^a	Standard Deviation	Adjusted Mean ^b
Mass media coverage of science is important for scientists	83.4%	3.2%	13.3%	2.93	1.615	2.20
Mass media coverage of science is important for the public	95.6	1.8	2.6	1.74	1.024	1.68
Scientists have an obligation to work with news reporters to get the results of their research before the public	73.2	8.3	18.6	2.87	1.699	2.57
Scientists are just as responsible for making research results available to the public as to their colleagues	51.9	10.6	37.5	3.75	1.863	3.30
Mass media coverage of science is largely responsible for developing the professional image of scientists in the eyes of nonscientists	82.3	7.4	10.3	2.38	1.405	2.14

^aScores less than 4.0 indicate agreement.

^bScores less than 3.5 indicate agreement.

Table 11. Scientists' Views Toward Interactions with Journalists

Statement	Agree	Neutral	Disagree	Mean ^a	Standard Deviation	Adjusted Mean ^b
Scientists who deal regularly with the press should have some training in the fundamentals of news communication	65.8%	19.8%	14.4%	3.03	1.521	2.61
Scientists who give information to news reporters often inflate the value of their own work	64.6	18.9	16.5	3.13	1.397	2.72
Most scientists understand the problems reporters face in writing for the public	31.8	20.0	48.1	4.32	1.492	3.80
Most reporters understand the problems scientists face in communicating their research results to the public	23.9	18.9	57.2	4.75	1.527	4.21
Scientists should refuse to cooperate with reporters who appear inadequately trained in science	46.0	18.0	36.0	3.67	1.656	3.16
It would be a good general policy for science writers to have their articles read by scientists quoted in the articles before publication	93.5	2.1	4.4	1.58	1.150	1.48
Mass media coverage of your own and related research is generally accurate	53.0	10.4	36.7	3.78	1.505	3.35
Results of your own and related research are being disseminated satisfactorily to the public	41.1	16.3	42.6	4.12	1.497	3.63

^aScores less than 4.0 indicate agreement.^bScores less than 3.5 indicate agreement.

Moreover, virtually all scientists (93.5%) believed it would be a good general policy for them to review mass media articles citing their work prior to publication. The mean score on this item, 1.58 (adjusted mean = 1.48), was the lowest among all 36 attitudinal questions in the survey, indicating the highest general level of agreement.

As noted earlier, more than half of the respondents (53%) rated news coverage of their research as generally accurate, while a smaller proportion (41.1%) believed results were being communicated satisfactorily to the public.

Social Responsibility of Scientists

As shown in Table 12, large proportions of scientists responded positively to each of the survey questions related to the public communication of broader implications of research. Nearly all respondents (97.7%) agreed that scientists have a responsibility to help the public make informed judgments about science policy issues, and 82% disagreed that science policy issues are best handled by scientists past their active research years. Eight of 10 survey scientists believed they should publicly discuss the social and ethical implications of their research, and 77.6% agreed that they should openly discuss the meaning and value of others' research. However, 83.5% agreed that public comments should be restricted to topics within scientists' immediate areas of expertise. Seven of 10 respondents even agreed that scientific conflict and controversy should be covered in the public press. Finally, two-thirds of the sample disagreed that scientists should justify public support for their research in terms of its practical results.

Table 12. Scientists' Perceptions of Social Responsibility

Statement	Agree	Neutral	Disagree	Mean ^a	Standard Deviation	Adjusted Mean ^b
Scientists have a responsibility to help the public make informed judgments about science policy issues	97.9%	0.6%	1.5%	1.77	0.909	1.74
Resolution of policy problems in science is best left to scientists past their active research years	10.4	7.7	82.0	5.65	1.411	4.90
Scientists should offer to the public their views on the social and ethical consequences of their research	79.9	11.8	8.3	2.65	1.349	2.37
Scientists should offer to the public their informed views on the meaning and value of others' research	77.6	10.6	11.8	2.79	1.376	2.51
A scientist should comment publicly on others' research only if the research is within his or her immediate area of expertise	83.5	4.4	12.1	2.37	1.540	2.17
Conflict and controversy within the scientific community should be reported in the public press	69.8	10.4	19.8	3.12	1.560	2.80
Scientists should justify public support for their research in terms of its practical results	28.6	5.3	66.1	5.12	1.974	4.48

^aScores less than 4.0 indicate agreement.

^bScores less than 3.5 indicate agreement.

Role of Public Information Office

Survey scientists gave mixed marks to the function and value of their organizations' public information offices (Table 13). About half of the respondents agreed that these offices play an important role in the public communication of science, but only 28% agreed that public information workers appear adequately trained in science (35.4% disagreed, 36.6% were neutral). Most scientists (57.1%) said they should be free to deal with journalists without institutional interference or pressure, and only 7.4% believed their public information offices sometimes hinder that activity (53.7% disagreed, 38.9% were neutral).

In separate questionnaire items, 56.5% of the respondents indicated they felt free to initiate contact with a journalist, but nearly the same proportion (55.8%) preferred working through their institutions' public information offices. Finally, asked whether their institutions have a specific policy calling for the reporting of research results to the public, only two of 10 sample scientists (20.4%) replied yes; equally large proportions replied no (40.1%) and don't know (39.5%).

Hypotheses 1 and 2

The first two hypotheses predicted that probabilities of scientists' public communication behavior will be consistent with the situational theory. The first step to provide preliminary data relevant to testing these hypotheses was to calculate the mean scores on the three situational perception variables (questionnaire items Q-1, Q-2, and Q-3), indicating which of the three "research effects" situations are most likely to bring forth communicating scientist-source groups.

Table 13. Scientists' Perceptions of Role of Public Information Office

Statement	Agree	Neutral	Disagree	Mean ^a	Standard Deviation	Adjusted Mean ^b
Your organization's public information office plays an important role in getting research results before the public	49.0%	16.5%	34.5%	3.87	1.818	3.43
Your public information office sometimes hinders scientists who want to discuss their work openly with the public	7.4	38.9	53.7	4.98	1.345	4.72
Scientists should be free to deal with journalists without interference or pressure from their institutions	57.1	10.9	32.0	3.38	1.771	2.94
Workers in your public information office appear adequately trained in science	28.0	36.6	35.4	4.16	1.461	3.69

^aScores less than 4.0 indicate agreement.

^bScores less than 3.5 indicate agreement.

This analysis was to show whether scientists' perceptions of the situational variables in fact differed according to the specific aspect of their research being discussed.

As shown in Table 14, there was considerable variance in the three situational variables across issues, particularly from the first (immediate applications) to the second and third issues (health care and social/ethical implications), thus supporting the situational conceptualization of the theory. These data indicate that problem recognition and level of involvement are highest for the immediate applications situation and lowest for the social/ethical implications situation; constraint recognition follows an opposite pattern. It should be noted, however, that differences in the mean scores on constraint recognition and level of involvement are slight, albeit in the predicted direction, between the second and third situations.

The second preliminary step of the analysis was to calculate response frequencies for positive communication behavior for each of the three situations. The data summarized in Table 15 show convincingly that scientists are more likely to communicate both "passively" and "actively" about the first situation than the second, and about the second situation than the third. On all indicators, survey respondents indicated communicating one-and-a-half to two times more frequently about the immediate practical or theoretical applications of their research than about the impact of their research on the delivery of health care, and three to four times more frequently than about the social and ethical implications of their research.

Table 14. Mean Scores on Situational Variables
for Scientific Issues^a

Situation	Problem Recognition		Constraint Recognition		Level of Involvement	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Immediate Applications	1.41	0.571	3.07	0.745	1.88	0.841
Impact on Health Care	1.89	0.802	2.57	0.775	2.44	0.866
Social/Ethical Implications	2.01	0.860	2.54	0.829	2.46	0.973

^aRange = 1 to 4 (high to low).

Table 15. Proportions of Scientists Communicating About Research Situations

Research Situation	Passive Communication Indicators			Active Communication Indicators		
	Granted Reporter Contact	Helped PIO	Desired Reporter Contact ^a	Initiated Reporter Contact	Suggested Idea to PIO	Written Article
<u>All Scientists (n = 339)</u>						
Immediate Applications	64.9%	47.8%	89.4%	22.7%	20.0%	14.7%
Impact on Health Care	42.2	31.0	78.5	15.6	12.4	7.1
Social/Ethical Implications	21.2	15.0	72.0	6.2	6.2	3.8
<u>Scientists Having Had Reporter Contact (n = 235)</u>						
Immediate Applications	93.6	87.1	b	32.8	36.6	26.9
Impact on Health Care	60.8	56.4	b	22.6	22.6	12.9
Social/Ethical Implications	30.6	27.4	b	8.9	11.3	7.0

^aVery or somewhat willing to speak to a news reporter.

^bAsked of all scientists; not a measure of actual behavior.

The table also shows that passive communication is a much more typical behavior for survey scientists than active communication. In general, for all situations, respondents were three times as likely to have granted an interview with a news reporter as to have sought one, and about two-and-a-half times more likely to have helped a PIO with an article than to have suggested an idea for one. The proportion of scientists who indicated they had written an article themselves for mass media dissemination was low for all situations--about 15% for the first situation, 7% for the second, and 4% for the third. In contrast, the proportion of scientists willing to discuss their research with a reporter was high for all situations; 72% of the respondents were very or somewhat willing to discuss even the social and ethical implications of their research.

Following these preliminary analyses, Hypotheses 1 and 2 were tested principally by calculating "conditional probabilities" of active and passive communication associated with each of eight kinds of communication behavior that result from combinations of the three situational variables split into high and low categories. Two of the independent variables--problem recognition and constraint recognition--were combined to yield four distinct behavior types, named by Grunig (1982) as follows:

1. Problem-facing: High problem recognition, low constraint recognition.
2. Constrained: High problem recognition, high constraint recognition.
3. Routine: Low problem recognition, low constraint recognition.

4. Fatalistic: Low problem recognition, high constraint recognition.

Each of these four behavior types was then divided by level of involvement--for example, high-involvement, problem-facing behavior--to produce eight subgroups. The situational theory predicts that individuals who fit into the same subgroups arising from these combinations of the three situational variables will have approximately the same communication behavior for an issue or situation.

The conditional probabilities tested this prediction as it applies to the communication behavior of scientists having similar situational perceptions of the effects of their research. First, the situational variables appearing as four-point scales on the survey questionnaire were collapsed into two-point scales (high = 1 or 2, low = 3 or 4). Second, these dichotomized scores were correlated with the "yes" or "no" responses to the questionnaire items concerned with scientists' communication behavior corresponding to each of the three "research effects" situations (e.g., "Have you ever sought an interview with a news reporter concerning the impact of your research on the delivery of health care?"). In the one case where scientists were asked to indicate their willingness to communicate with reporters, rather than their actual past behavior, the four-point response scale was dichotomized for data analysis (high = somewhat or very willing, low = not willing or unsure).

Each of the three situations was treated as a single unit of analysis in calculating these probabilities. Thus, the probabilities were based on 1,017 situations (three situations times 339 respondents).

For example, a scientist may have fit the problem-facing category for all three situations or for none or only some of the situations.

Table 16 presents summary results from the above analysis, providing overall support for Hypotheses 1 and 2. The probabilities generally are consistent with the predictions of the situational theory as specified, namely that both active and passive communication will increase with an increase in problem recognition and decrease with an increase in constraint recognition. High involvement should increase active communication but not affect passive communication. The only deviation from the theory in Table 16 is a tendency for passive communication to drop off more from high to low involvement than it has in most of Grunig's previous studies, specifically for the problem-facing and fatalistic behavior typologies. In line with the theory, however, passive communication does remain relatively high under all low-involvement conditions. For problem-facing scientists, moreover, those with high-involvement scores are about twice as likely to communicate actively as are those with low-involvement scores.

The first column, "Proportion of Total Respondents," shows that some typologies are found more often than others: high-involvement, problem-facing behavior (37%); low-involvement, constrained behavior (16%); and low-involvement, fatalistic behavior (20%) characterize the three most common typologies. Indeed, the somewhat inconsistent findings for both routine and fatalistic high-involvement scientists can be attributed in part to the small number of scientists exhibiting these behaviors (1.8% and 3%, respectively). The bottom row, "Total

Table 16. Conditional Probabilities of Scientists' Communication^a

Behavior Typology	Proportion of Total Respondents	Passive Communication Indicators			Active Communication Indicators		
		Granted Reporter Contact	Helped PIO	Desired Reporter Contact ^a	Initiated Reporter Contact	Suggested Idea to PIO	Written Article
Problem-Facing ^b							
High Involvement	37.0%	55.1%	39.5%	89.9%	20.8%	20.0%	12.8%
Low Involvement	8.0	39.5	27.2	76.6	12.3	11.1	6.2
Constrained ^c							
High Involvement	9.5	44.8	29.0	79.2	13.5	9.7	5.4
Low Involvement	16.0	34.5	29.7	80.0	11.1	6.1	7.4
Routine ^d							
High Involvement	1.8	44.4	11.1	83.3	0	0	0
Low Involvement	4.7	31.2	20.8	83.3	1.2	6.2	0
Fatalistic ^e							
High Involvement	3.0	46.7	46.7	73.3	2.9	13.8	16.7
Low Involvement	20.1	29.4	22.9	63.2	9.3	10.5	5.9
Total Probability	100.0	42.8	31.4	79.9	14.9	13.0	8.6

^aNumber of situations = $339 \times 3 = 1,017$.

^bHigh problem recognition, low constraint recognition.

^cHigh problem recognition, high constraint recognition.

^dLow problem recognition, low constraint recognition.

^eLow problem recognition, high constraint recognition.

Probability," reinforces the earlier finding that scientists engage in passive communication much more frequently than in active communication.

Hypothesis 3

Hypothesis 3, which predicted that the situational variables will be stronger predictors of passive and active communication behavior than will cross-situational attitudinal and demographic variables, was tested principally by use of logistic regression analysis (Harrell, 1983). This statistical procedure, a special modification of multiple regression analysis, was chosen because it was developed specifically to test single binary (0-1) dependent variables such as the passive and active communication indicators presented in Tables 15 and 16.

Canonical correlation, the statistical technique preferred by Grunig for testing the situational theory among communication audiences, or publics, was judged inappropriate for this study because it assumes that values for the dependent variables are normally distributed (such as those for the seven-point attitude scales). Use of canonical correlation, though it may have yielded persuasive data, thus would have been a statistical misapplication for analyzing the binary behavioral data provided by the scientist survey.

Eighteen separate logistic regression analyses were performed (three situations times six communication indicators). Independent variables entered into these analyses included the three situational variables and a variety of scientist attitudinal and demographic measures, as summarized earlier. Results are presented below by research situation.

Immediate Applications Situation

For the six passive and active communication indicators related to the first research situation--immediate practical or theoretical applications--the following independent variables were found to be statistically significant at a probability (p) of less than 0.05 for at least one indicator; for those measures that were significant for more than one indicator, the number is indicated in parentheses:

1. Level of involvement (high to low) (4)
2. Research as hot topic attitude (agree to disagree) (2)
3. Mass media accuracy attitude (agree to disagree) (2)
4. Public responsibility attitude* (agree to disagree) (2)
5. Basic research focus (yes or no) (2)
6. Security of funding attitude (agree to disagree)
7. Multidisciplinary research worker (yes or no)
8. Consultant to industry (yes or no)
9. Full professor (yes or no)
10. Official organizational position (yes or no).

Table 17 presents the results of the logistic regression analysis for the first situation, using shorthand labels for the above variables. The R values indicate the strength of the relationship between independent and dependent variables, either positive or negative. Statistical probabilities below 0.005, 0.001, and 0.0001 are also indicated.

*"Scientists are just as responsible for making research results available to the public as to their colleagues."

Table 17. Logistic Regression Analysis Relating Predictor Variables to Scientists' Communication About "Immediate Applications" Situation (p less than .05)

Predictor Variable	R Values for Passive Communication Indicators			R Values for Active Communication Indicators		
	Granted Reporter Contact	Helped PIO	Desired Reporter Contact ^a	Initiated Reporter Contact	Suggested Idea to PIO	Written Article
Level of Involvement		+ .072		+ .110	+ .149 ^b	+ .116
Research as Hot Topic Attitude	+ .218 ^d	+ .142 ^c				
Mass Media Accuracy Attitude			+ .175 ^b			- .124
Public Responsibility Attitude			+ .139		+ .082	
Security of Funding Attitude		+ .064				
Basic Research Focus	- .095					- .081
Multidisciplinary Research Worker	+ .088					
Consultant to Industry			- .140			
Full Professor		+ .094				
Official Organizational Position						+ .099

^aVery or somewhat willing to speak to a news reporter.

^bp less than 0.005.

^cp less than 0.001.

^dp less than 0.0001.

Data show that for the "immediate applications" situation, one situational variable--level of involvement--was positively associated with four of the six communication indicators, including all three active indicators. Perception of a scientist's research as a hot topic was positively related to helping both reporters and public information workers. Evaluations of science news as generally accurate was positively related to desired reporter contact, but negatively related to writing an article for mass media dissemination. A positive attitude concerning scientists' public communication responsibility was positively related both to desired reporter contact and to interaction with PIO's. Conversely, a basic research focus was negatively associated with both reporter contact and writing an article for the media.

Impact on Health Care Situation

For the second research situation, a different situational variable--problem recognition--was positively associated with all three passive communication indicators (Table 18), and constraint recognition was negatively related to two of them. Scientists' positions as a medical doctor and full professor were positively related to both reporter contact and news article writing. Initiating reporter contact and suggesting article ideas to PIO's were related to single independent variables--being a member of a multidisciplinary research team and holding an official organizational position. Interestingly, security about continued public support of their research was positively associated with scientists' reported interaction with PIO's.

Table 18. Logistic Regression Analysis Relating Predictor Variables to Scientists' Communication About "Impact on Health Care" Situation (p less than .05)

Predictor Variable	R Values for Passive Communication Indicators			R Values for Active Communication Indicators		
	Granted Reporter Contact	Helped PIO	Desired Reporter Contacta	Initiated Reporter Contact	Suggested Idea to PIO	Written Article
Problem Recognition	+.091	+.124 ^c	+.169 ^d			
Constraint Recognition	-.073		-.080			
Medical Doctor	+.122 ^c					+.115
Full Professor	+.129 ^c					+.111
Level of Involvement			+.105			
Research as Hot Topic Attitude	+.071					
Public Responsibility Attitude			+.210 ^e			
Security of Funding Attitude		+.121 ^c				
Basic Research Focus						-.168 ^b
Multidisciplinary Research Worker				+.090		
Official Organizational Position					+.097	

^aVery or somewhat willing to speak to a news reporter.

^bp less than 0.01.

^cp less than 0.005.

^dp less than 0.001.

^ep less than 0.0001.

Social/Ethical Implications Situation

Table 19 presents results of the logistic regression analysis of scientists' communication behavior related to the social and ethical implications of their research. Compared with the first two situations, there were relatively few independent variables having statistically significant relationships to the dependent behavioral variables. In fact, none of the independent variables helped predict the active behavior of suggesting an article idea to a PIO. For two other dependent variables, single predictor variables emerged: Believing their research to be relatively controversial was positively related to scientists' contact with reporters, while perceived peer pressure against science popularization was negatively related to scientists' article writing for mass media dissemination. Controversial research also was positively related to initiating reporter contact. One independent variable, level of involvement, was positively related to both desired reporter contact and initiated reporter contact.

On balance, none of the attitudinal or demographic variables were good predictors of communication behavior as measured in the survey. Having a hot research topic appears to be the best attitudinal predictor of passive communication behavior, while being a member of a multidisciplinary research team seems to be the best demographic predictor of overall communication activity. However, neither of these shows consistent associations across research situations or for different communication indicators. A positive attitude toward public communication responsibility was positively related in all three situations to desired reporter contact (itself an attitude), but in only one situation

Table 19. Logistic Regression Analysis Relating Predictor Variables to Scientists' Communication About "Social/Ethical Implications" Situation (p less than .05)

Predictor Variable	R Values for Passive Communication Indicators			R Values for Active Communication Indicators		
	Granted Reporter Contact	Helped PIO	Desired Reporter Contact ^a	Initiated Reporter Contact	Suggested Idea to PIO ^b	Written Article
Level of Involvement			+.133 ^c	+.133		
Controversial Research Attitude	+.149 ^c			+.206 ^c		
Problem Recognition			+.083			
Mass Media Accuracy Attitude			+.083			
Research as Hot Topic Attitude		+.096				
Public Responsibility Attitude			+.132 ^c			
Perceived Peer Pressure Attitude						-.193
Multidisciplinary Research Worker			+.083			
Medical Doctor		+.113				

^aVery or somewhat willing to speak to a news reporter.

^bNo predictor variables statistically significant.

^cp less than 0.005.

did it help predict actual behavior (suggesting an article idea about immediate research applications).

These data provide overall support for Hypothesis 3. The situational variables were more predictably related to communication behavior than the other independent variables examined. For the first situation, as the situational theory would predict, level of involvement was related to all three active communication indicators; for the second situation, also as the theory would predict, problem recognition was related to all three passive communication indicators. Scientists' low levels of communication activity concerning the social and ethical implications of their research may help explain the weaker observed relationships between situational and behavioral variables for that situation.

Cross-Situational Communication Behavior

The relative lack of fit of the attitudinal and demographic variables to the logistic regression model described above should not dismiss the need to understand the influence of these variables on scientists' overall communication activity. Indeed, a number of these variables have relatively strong associations with scientists' reported interactions with journalists and public information workers, as summarized below.

Demographic variables. Table 20 presents the results of selected cross-tabulations between demographic and behavioral variables not related to particular research situations. Chi-square statistics were

Table 20. Cross-tabulation Analysis of Selected Demographic
and Behavioral Variables for Survey Scientists

Behavioral/Demographic Variable	Proportion of Respondents Reporting Communication Activity		
	Reporter Contact Ever	PIO Contact Ever	Press Conference Participation
<u>Reporter Contact Ever</u>			
Yes (n = 234)	-	70.5% ^e	
No (n = 104)	-	19.2	
<u>PIO Contact Ever</u>			
Yes (n = 185)	89.2% ^e	-	
No (n = 153)	45.1	-	
<u>Principal Responsibilities</u>			
Full-Time Research (n = 52)	51.9 ^c	32.7 ^d	
Research/Teach (n = 133)	64.7	51.1	
Research/Admin (n = 24)	87.5	79.2	
Research/Teach/Admin (n = 111)	77.5	65.2	
Clinical Care (n = 18)	77.8	50.0	
<u>Formal Communication Training</u>			
Yes (n = 19)	68.4	79.0 ^a	
No (n = 320)	69.3	53.4	
<u>Industry-Funded Researcher</u>			
Yes (n = 246)	82.6 ^c		48.4% ^c
No (n = 93)	64.2		30.4
<u>Consultant to Industry</u>			
Yes (n = 140)	79.1 ^d		54.0 ^e
No (n = 199)	62.3		22.3
<u>Multidisciplinary Researcher</u>			
Yes (n = 233)	77.6 ^e	59.7 ^b	
No (n = 106)	50.9	44.3	

Table 20 (Continued)

Behavioral/Demographic Variable	Proportion of Respondents Reporting Communication Activity		
	Reporter Contact Ever	PIO Contact Ever	Press Conference Participation
<u>Social Action Group Member</u>			
Yes (n = 60)	73.3		40.0
No (n = 279)	68.4		34.4
<u>College/University Employment</u>			
Yes (n = 297)	67.2	55.6	
No (n = 31)	80.6	48.4	
<u>Sex</u>			
Male (n = 298)	71.5 ^a		
Female (n = 39)	51.3		
<u>First Language Learned</u>			
English (n = 280)	71.7 ^a		
Other (n = 57)	57.9		
<u>Organizational Official</u>			
Yes (n = 124)	82.1 ^e	67.7 ^d	52.0 ^e
No (n = 215)	61.9	47.4	25.8
<u>Research Focus</u>			
Basic (n = 244)	61.1 ^e	49.6 ^c	
Other (n = 95)	90.4	68.4	
<u>Scientific Articles Published</u>			
50 or Fewer (n = 164)	56.4 ^e	46.3 ^c	
More than 50 (n = 175)	81.1	62.9	
<u>Academic Degree</u>			
M.D. (n = 110)	80.7 ^c	61.8	49.5 ^d
Other (n = 229)	63.8	51.5	28.6

Table 20 (Continued)

Behavioral/Demographic Variable	Proportion of Respondents Reporting Communication Activity		
	Reporter Contact Ever	PIO Contact Ever	Press Conference Participation
<u>Age</u>			
29-44 (n = 177)	60.8 ^d	48.0 ^b	
45-75 (n = 160)	78.1	62.5	
<u>Academic Position</u>			
Full Professor (n = 173)	79.6 ^e	64.2 ^d	46.5 ^e
Other (n = 166)	58.4	45.2	23.8
<u>Age and Position</u>			
29-44 Full Professor (n = 43)	81.0 ^e	69.8 ^e	
29-44 Other (n = 134)	54.5	41.0	
45-75 Full Professor (n = 129)	79.1	62.8	
45-75 Other (n = 31)	74.2	61.3	

^aChi-square significant at p less than 0.05.

^bChi-square significant at p less than 0.01.

^cChi-square significant at p less than 0.005.

^dChi-square significant at p less than 0.001.

^eChi-square significant at p less than 0.0001.

used for testing the significance of differences in observed variable scores for each cross-tabulation.

Results show first of all that scientists' reported contact with journalists was highly correlated with their reported contact ever with public information workers, and vice versa. Respondents with administrative responsibilities in addition to research and teaching were much more likely to have encountered both reporters and PIO's. The same was true for older scientists, scientists not involved exclusively in basic research, those who are members of multidisciplinary research teams, and those who have published extensively in the scientific literature. Full professors and scientists with official organizational positions were also much more likely than others to have participated in a press conference. Conversely, from data not shown in the table, strictly basic scientists were significantly less likely than others to have testified on a science policy issue (12.4% versus 40%, p less than 0.0001) and for public support of science (12.4% versus 23.2%, p less than 0.05).

In contrast to some earlier research findings, full professor status was correlated with reporter and PIO contact only for younger scientists; among older scientists, full professors did not report significantly more contact than associate or assistant professors. Demographic variables associated with journalist contact and participation in press conferences included being a medical doctor, conducting some industry-sponsored research, and being hired by industry as a consultant. Having formal public communication training was correlated with PIO contact but was completely unrelated to journalist contact.

Personal attribute variables. Positive responses to all of the personal belief questions in the survey were significantly related to scientists' reported contact ever with a news reporter (Table 21). For these cross-tabulations, the attitudinal responses were dichotomized as agree and disagree; neutral responses, rather than dropped from the analysis, were included in the latter category.

Having a hot research topic was highly related to participation in a press conference, while conducting controversial research and being perceived as a widely credible scientific spokesperson were also associated with testifying on a science policy issue and testifying for public support of science. Perceived security of continued public funds for their research was not related to scientists' having testified on either science policy or science funding topics.

Attitudinal variables. As shown in Table 22, scientists' responses to selected attitude questions generally had weak or no relation to their likelihood of ever encountering a journalist. Respondents who agreed that their own and related research results are being disseminated satisfactorily to the public were more likely to have had reporter contact than those who disagreed. Somewhat surprisingly, respondents who said that scientists face peer pressure against popularizing their research indicated relatively greater contact with reporters than those who did not perceive such constraints. On a separate questionnaire item, another unexpected finding was that scientists' awareness of institutional policies calling for public communication of

Table 21. Cross-tabulation Analysis of Selected Personal Attribute and Behavioral Variables for Survey Scientists

Personal Attribute Variable	Proportion of Respondents Reporting Communication Activity			
	Reporter Contact Ever	Press Conference Partic'n	Testimony on Public Support of Science	Testimony on Science Policy Issue
<u>Research Funds Secure</u>				
Agree (n = 108)	79.6% ^c	40.2%	20.4%	13.9%
Disagree (n = 229)	64.2	32.9	19.7	15.8
<u>Research Hot Topic</u>				
Agree (n = 184)	84.2 ^e	46.2 ^e	21.7	17.4
Disagree (n = 155)	51.6	22.4	18.3	13.1
<u>Research Controversial</u>				
Agree (n = 56)	89.1 ^d	46.4 ^a	30.4 ^a	25.0 ^a
Disagree (n = 282)	65.2	33.3	18.2	13.6
<u>Personally Controversial</u>				
Agree (n = 37)	88.9 ^b	54.0 ^a	35.1 ^a	24.3
Disagree (n = 302)	66.9	33.1	18.3	14.3
<u>Widely Credible Spokesperson</u>				
Agree (n = 92)	87.0 ^e	56.0 ^e	33.0 ^d	28.6 ^e
Disagree (n = 245)	62.7	28.0	15.2	10.2

^aChi-square significant at p less than 0.05.

^bChi-square significant at p less than 0.01.

^cChi-square significant at p less than 0.005.

^dChi-square significant at p less than 0.001.

^eChi-square significant at p less than 0.0001.

Table 22. Cross-tabulation Analysis of Selected Attitudinal Variables and Journalist Contact for Survey Scientists

Attitudinal Variable	Proportion of Respondents Having Reporter Contact Ever
<u>Perceived Career Advancement Constraints</u>	
Agree (n = 139)	68.4%
Disagree (n = 200)	69.8
<u>Perceived Peer Pressure Constraints</u>	
Agree (n = 238)	73.8 ^b
Disagree (n = 101)	58.4
<u>Accurate Media Coverage of Research Area</u>	
Agree (n = 179)	71.9
Disagree (n = 159)	66.0
<u>Satisfactory Dissemination of Research Results</u>	
Agree (n = 139)	76.8 ^a
Disagree (n = 199)	63.8
<u>Importance of Science News to Scientists</u>	
Agree (n = 282)	69.8
Disagree (n = 56)	66.1
<u>Responsibility to Public Equal to Colleagues</u>	
Agree (n = 176)	72.2
Disagree (n = 163)	66.0
<u>Refuse Cooperation with Untrained Reporter</u>	
Agree (n = 156)	70.3
Disagree (n = 183)	68.3
<u>Research Needs Practical Justification</u>	
Agree (n = 97)	70.8
Disagree (n = 242)	68.6

Table 22 (Continued)

Attitudinal Variable	Proportion of Respondents Having Reporter Contact Ever
<u>Awareness of Institutional Public Communication Policy</u>	
Aware (n = 69)	63.8
Unaware (n = 270)	70.6

^aChi-square significant at p less than 0.05.

^bChi-square significant at p less than 0.005.

research results was inversely related to their reported contact with journalists; this difference, however, was not statistically significant.

A final cross-tabulation analysis (Table 23) compared scientists' attitudes and behavior related to their institutions' public information offices. Positive responses to two of the four attitude questions were related significantly to PIO contact: a belief in the importance of the office's role and, even more strongly, a belief that PIO's are trained adequately in science. In the separate questionnaire item mentioned above, awareness of institutional public communication policies was not significantly related to actual PIO contact.

Additional Respondent Comments

Additional insights into scientists' thoughts and experiences regarding public communication were gained through their responses to the optional open-ended question on the back cover of the questionnaire. Seventy-five respondents (22%) offered comments; their verbatim remarks, edited only for grammar, appear in Appendix B.

Overall, as would be expected from voluntary responses, these remarks were decidedly critical. They echoed the key criticisms of mass media coverage of science identified in the literature: distortion, especially sensationalism and improper emphasis; inaccuracy; oversimplification; superficiality; failure to report the tentative nature of scientific findings; and lack of perspective, both scientific and historical (Borman, 1978; Broberg, 1973; Krieghbaum, 1967; Pulford, 1976; Tankard & Ryan, 1974).

Table 23. Cross-tabulation Analysis of Selected Attitudinal Variables and PIO Contact for Survey Scientists

Attitudinal Variable	Proportion of Respondents Having PIO Contact Ever
<u>Importance of Public Information Office</u>	
Agree (n = 166)	61.4% ^a
Disagree (n = 173)	48.6
<u>Public Information Office Sometimes Hindrance</u>	
Agree (n = 25)	44.0
Disagree (n = 314)	55.7
<u>Need for Scientists to Deal with Press Freely</u>	
Agree (n = 193)	54.9
Disagree (n = 145)	55.2
<u>Adequate Scientific Training of PIO's</u>	
Agree (n = 95)	71.6 ^b
Disagree (n = 244)	48.4
<u>Awareness of Institutional Public Communication Policy</u>	
Aware (n = 69)	58.0
Unaware (n = 270)	54.1

^aChi-square significant at p less than 0.05.

^bChi-square significant at p less than 0.0001.

Another central theme was scientists' desire to exert greater control over the news process, either through personal prepublication review of articles or through "screening" of mass media articles by a scientific panel or "institution." Whereas such comments reflected a somewhat naive understanding of media function and process, other remarks demonstrated considerable perception. A number of scientists, for example, expressed their reluctance to generalize about media types and reporters because of their immensely variable quality. Others called on their peers to be more responsive to the task of science popularization and to avoid "overselling" their research to reporters.

CHAPTER V

DISCUSSION AND CONCLUSIONS

Comparisons with Previous Research

Findings related to survey scientists' demographic and personal attributes and to their attitudes and behavior concerning public communication reveal some striking similarities to those of previous studies, as well as some notable differences.

The proportion of scientists having had contact with a journalist ever (69.3%) was just slightly higher than the 67.6% total reported by Dunwoody and Scott (1982) and considerably higher than the 57% total reported by Van Duzee (1977). On the other hand, the proportion of respondents reporting contact within the previous year (49.9%) was considerably lower than that (63%) in Dunwoody and Ryan's 1985 study (which, like the authors' 1983 study, reports on findings from a survey actually conducted in 1981).

Concerning scientists' relative attitudes about different types of mass media and mass media reporters, survey results exactly paralleled those of Dunwoody and Scott. Scientists in both studies rated magazines first, followed by newspapers, television, and radio, as doing the best job in covering science news; as doing the worst job, they rated television first, followed by radio, newspapers, and magazines. Both studies also found that scientists would prefer contact, in order, with magazine, newspaper, television, and radio reporters.

A number of scientists' verbatim comments on the survey questionnaire, in fact, singled out television as a problem area. "My strongest

feelings are on the inadequacy of television reporting of science and medicine," wrote one respondent. Another scientist capsulized: "TV--blah--time consuming, sensationalism, inaccurate, too much hype. I think they underestimate the American public." As a third respondent added, "TV representatives commit even more grossly incompetent acts by compressing time allocations for scientific news reports."

Although scientists in Dunwoody and Scott's survey indicated they rarely encountered a magazine reporter, 40.4% of all respondents in the present study reported interacting with magazine journalists--a larger proportion than for either television or radio reporters. Perhaps the surge of monthly science and health magazines in the early 1980's (such as Discover, Science 80--now 85, and American Health) is partly responsible for this surprising level of contact with magazine reporters. Another factor might be increased science and health coverage by the major newsmagazines with large field staffs.

About 23% of survey respondents reported initiating contact with a reporter, compared with 15% in Dunwoody and Scott's study; 20% had suggested article ideas to their public information offices and 15% had written an article themselves, each proportion considerably lower than the 37% and 30% totals, respectively, reported by Dunwoody and Ryan (1983) and Dunwoody and Scott.

Compared with scientists in Dunwoody and Ryan's 1983 study, respondents in this survey generally were more positive about the role of their institutions' public information offices. In the previous study, 85% of respondents said they felt free to initiate contact with a reporter and nearly two-thirds indicated that their public information

offices sometimes were a hindrance to scientist-reporter relations. In the present survey, however, only 56.5% said they felt free to initiate reporter contact ("It's not proper," wrote one respondent), and only a rare scientist (7.4% overall) perceived occasional interference from his or her institution's information office. Moreover, whereas most scientists in the earlier study said that such offices play a minor role in disseminating research results, only about a third of scientists in the present study had a similar attitude.

Overall, respondents in the 1983 study preferred direct contact with journalists; in this study, they preferred working through PIO's. Finally, a somewhat smaller proportion of respondents in the present survey believed that scientists should be free to deal with journalists independent of institutional interference or pressure (57% versus 71% in the 1983 study), but exactly the same proportion in each study--52%--believed scientists are just as responsible for making research results available to the public as to their colleagues.

A comparison of responses to the 11 attitude questions in this study that were replicated or modified slightly from Ryan's 1979 survey showed very similar perceptions between the two scientist populations on a variety of science news issues. Adjusted mean scores on these items (less than 3.5 = agree) are presented below, with Ryan's results bracketed; where item wording was modified, Ryan's original wording also is bracketed.

1. A scientist should release scientific research results to the press only after the information has appeared in a scientific journal or scholarly publication: 2.2 [3.1].

2. It would be a good general policy for science writers to have their articles [stories] read by scientists quoted in the articles before publication: 1.5 [1.6].
3. Mass media coverage of your own and related research [Science news coverage] is generally accurate: 3.4 [3.5].
4. Mass media [Newspaper] coverage of science [science news] is important for scientists: 2.2 [2.4].
5. Mass media [Newspaper] coverage of science [science news] is important for the public: 1.7 [1.4].
6. Scientists have an obligation to work with news reporters to get the results of their research before the public: 2.6 [2.2].
7. Mass media coverage of science is [Newspaper articles are] largely responsible for developing the professional image of scientists in the eyes of nonscientists: 2.1 [2.1].
8. Scientists who deal regularly with the press should have some training in the fundamentals of news communication: 2.6 [2.5].
9. Scientists who give information to news reporters often inflate the value of their own work: 2.7 [3.3].
10. Most scientists understand the problems reporters face in writing for the public: 3.8 [4.0].
11. Scientists should refuse to cooperate with reporters who appear inadequately trained in science: 3.2 [4.3].

Only on the last statement were scientists in the two studies on different sides of the agree-disagree scale.

Findings related to scientists' desired contact with reporters were generally consistent between the present study and two others. Half of the scientists in Tichenor et al.'s 1970 study were "very willing" to help other reporters in the future, compared with 43% of respondents in this study who were very willing to discuss with a reporter the immediate applications of their research. Dunwoody and Scott found that 75% of scientists in their sample would welcome contact with a journalist and 11% would agree to such contact "as a necessary evil"; in the present study, 72 to 89% of the respondents were very or somewhat willing to discuss their research with a reporter, depending on the situation, and 2 to 12% were unsure.

The scientific productivity of respondents in Dunwoody and Scott's study was markedly lower than that of respondents in the present study--an average of four published journal articles versus about 50, respectively, despite both populations having an average age in the mid-40's. Moreover, whereas Dunwoody and Scott found no relationship between number of scientific articles and contact with reporters, there was a significantly positive association in this study.

Both Dunwoody and Scott and the French authors Boltanski and Maldidier (1970) found that higher-ranking scientists were more likely to have encountered a journalist than were lower-ranking scientists of the same age; in the present survey, this trend held only for younger scientists. Viewed from the perspective of constraint recognition, it may be that at a certain point in a scientist's career, age itself becomes an insulating factor against negative peer influence on public communication activity.

Because of the different types of scientist populations surveyed in the present study and those of earlier years, it is difficult to identify trends or make generalizations with confidence. However, a distinct impression formed from this series of studies, in which this survey of health-related research scientists is the most recent, is that of an improving climate of cooperation between scientist and both journalist and public information officer. Rather than viewing communications practitioners with hostility, scientists are giving increasingly higher marks to mass media performance, exhibiting greater willingness to interact with science popularizers, and accepting heightened responsibility for interpreting for the public the social, ethical, and policy implications of scientific work.

Research Hypotheses

Results of this study strongly suggest that the tenets of the situational theory of communication can be applied systematically to the study of scientist-source behavior. From the first to the third "research effects" situations examined--immediate applications, impact on health care, and social and ethical implications--survey scientists indicated decreasing problem recognition and level of involvement and increasing constraint recognition. Consistent with these trends, respondents' communication activity decreased markedly from the first to the second situation and from the second to the third situation. These findings held for all six passive and active communication indicators.

A calculation of "conditional probabilities" of communication behavior supported these results and provided the primary test of

Hypotheses 1 and 2. Based on their perceptions of the three situational variables, respondents were grouped into four predicted behavior categories: problem-facing, constrained, routine, and fatalistic, each further divided by high and low involvement. Correlating these categories with reported communication behavior for each research situation provided overall support for the predictions of the situational theory. Both active and passive communication increased with an increase in problem recognition and decreased with an increase in constraint recognition; active communication increased markedly with an increase in level of involvement. Departing from the theory's prediction, passive communication also increased with increasing involvement; the degree of increase, however, was not as noticeable as for active communication.

Logistic regression analyses were then performed to test the strength of various independent variables, including the three situational variables, as predictors of active and passive communication behavior about each research situation. As Hypothesis 3 predicted, the situational variables, particularly level of involvement, had consistently stronger associations with actual behavior across situations than did the other demographic and attitudinal variables examined. Moreover, it is important to note that these regression analyses treated the three situational variables independently, rather than as components of the overall behavior typologies noted above. It is likely, then, that the calculated R values are underestimates of these variables' contribution to observed behavior. Entering high-involvement/problem-facing behavior into the regression model as an independent variable, for example,

likely would have yielded a very strongly positive R value, much higher than problem recognition or level of involvement alone.

Following these regression analyses, a series of cross-tabulations was conducted to determine how various demographic and attitudinal measures correlated with various cross-situational communication indicators. The most significant overall finding was the inability of general attitude measures to help explain public communication behavior. Scientists who agreed that there is peer pressure against popularizing research findings, for example, actually had greater reported contact with journalists than those who did not perceive such constraints.

Nearly all significant associations between cross-situational variables and actual behavior emerged from variables that tapped measures of scientists' personal situations. From the perspective of the situational theory of communication, all of these variables could be viewed as increasing problem recognition, reducing constraint recognition, and/or increasing level of involvement. Significant demographic variables associated with increased communication activity included:

1. Conduct of research other than strictly basic research (e.g., applied research and development, clinical investigation).
As Melnick and Melnick (1978) suggested, basic scientists tend to have a restricted perspective of the overall role of science in society and therefore are less likely to offer their views to the public or make themselves available to workers in mass media.
2. Involvement with industry, either in conducting industry-sponsored research or in serving as a consultant to industry.

This finding may appear perplexing in light of findings by sociologists of science that industry often constrains its scientists from communicating freely with other scientists, constraints that Dunwoody and Ryan (1985) found may be broadened to include the public communication process as well. However, there appears to be a big difference between being employed by industry and being an "outside" scientist working with industry. In the latter case, again from a situational perspective, scientists' problem recognition and level of involvement may increase through work on applying science to meet a profit-motivated need.

3. Participation on a multidisciplinary research team. Such workers likely become exposed to and involved in problems and the consequences of those problems, larger than their own immediate areas of expertise.
 4. Responsibility for teaching and, more important, administration (especially as an organizational official), where the implications of research are as salient as "science for science's sake."
 5. Having an extensive scientific publishing record. In contrast to previous findings, this characteristic may increase scientists' expertise and resultant problem recognition, as well as decrease their constraint recognition.
 6. Being middle-aged or older and/or being a full professor.
- These characteristics may increase scientists' public

visibility and communication motivation and reduce their dependency on peer approval and the social system of science.

7. Having a medical degree. Public communication is a more routine, even expected, behavior of M.D.'s than of Ph.D.'s; moreover, responsibility for direct patient care likely is a strong stimulant for increased problem recognition and increased involvement.

In addition to these demographic variables, all of which can be measured reliably, a variety of more qualitative personal attributes were significantly associated with one or more measures of public communication. The positive effects of four of these attributes are as predicted from the literature, particularly from Goodell's (1977) work: having a hot research topic; conducting controversial research; being perceived as personally controversial; and being perceived as a widely credible spokesperson (an authority) on topics outside one's circumscribed area of specialization.

Findings related to a fifth variable, however, run counter to the conventional wisdom that scientists concerned about sustaining their research will be motivated to "go public" to enhance public support for their work. The logistic regression and cross-tabulation analyses showed that scientists who feel secure about continued public support were more likely than others to have had contact with a journalist and public information worker. Two possible explanations for this finding are that secure scientists (1) may be those conducting "hot" (highly funded) research and (2) may be relieved from competing for scarce research dollars and thus have more freedom and motivation for public

communication activity. Indeed, Melnick and Melnick observed that among the factors limiting the participation of scientists in health policy issues are "fears of budgetary cuts that inhibit outspokenness" (p. 7).

Suggestions for Further Study

The above discussion assumes that various demographic and personal attribute variables contribute in some way to forming scientists' perceptions of problem recognition, constraint recognition, and level of involvement. A research question to be posed, then, is: What demographic and personal attributes best predict scientists' perceptions of the three situational variables? For such an analysis, the situational variables could be treated as dependent variables in a multiple regression model; the observed R values would indicate those variables most highly correlated with responses to the four-point situational variable questions.

Research is also needed to explore the meaning and application of the "research situation" concept for other scientific disciplines. For example, what are different situations for an astronomer? Perhaps the "impact on health care" situation used in the present study could be translated to "impact on the manned space program."

Finally, a crucial methodological issue in applying the situational theory to source behavior is how best to measure the behavioral indicators of active and passive communication. It could be argued that the survey instrument "forced" behavioral responses to be in the desired direction by repeating, word for word, situation descriptions for both the situational and behavioral questions. Moreover, consideration also

could be given to replacing the "yes-no" communication choices with wider multiple-choice items. Such an approach might increase the sensitivity of the questions as well as make the questionnaire less repetitious and more interesting to answer. Multiple-point scales also would yield more normally distributed data, allowing for canonical correlation analyses consistent with those used in testing the situational theory among communication publics.

Recommendations for Science Writers

Survey results, bucking conventional wisdom, suggest convincingly that scientists are willing to accept responsibility for guidance to the public on matters of science policy and ethics--even to comment on others' research if those comments fall within the source's area of expertise. The finding that relatively few scientists have discussed the social and ethical implications of their research with reporters, in fact, may reflect less their reluctance to discuss such issues than the lack of opportunity to discuss them. Journalists simply may not ask scientists routinely about the less-immediate implications of their work, and because scientists remain cautious about initiating reporter contact, such views are seldom offered to the public.

A number of studies support this conclusion. In a content analysis of heart transplant stories in three newsmagazines, Oates (1973) found that coverage of the social and ethical implications of the medical work fell off almost as rapidly as the hard news itself, with little interpretative follow-up. He pointed to the "continuing need for newspaper interpretation that runs deeper than passing commentary on

'hot' issues" (p. 684). Tichenor et al. (1970) found that journalism's "over-emphasis on the unique" was what scientists perceived as the greatest problem with science reporting. Similarly, Glynn and Tims (1982) reported that press coverage of Tennessee's Tellico Dam/snail darter controversy gave undue emphasis to "peripheral issues" that did little to enhance public understanding of the complex struggle.

The vast majority of scientists in this survey agreed that mass media coverage of science is important for both scientists and the public, but most respondents did not agree that results of their work are being disseminated satisfactorily to the public. A key recommendation for science writers, then, is to take greater initiative in seeking scientific viewpoints on both the immediate and long-term implications of research projects--even from basic scientists with low public visibility and from scientists doing separate but related work. Journalists likely will be surprised at the accommodating attitude of these scientists. As one survey respondent offered, "Science writers may not portray the research ambivalence of colleagues well. The scientist should be able to explain both sides of controversial issues." Added another: "The scientist must undertake the responsibility for public communication about science; otherwise it becomes a conspiracy of silence."

A companion recommendation is that journalists better equip themselves with background information before approaching scientist-sources for a story. Scientists' relentless demands for prepublication review of news articles appears to be largely a reaction to perceived media deficiencies in covering their work. Consider this strong but typical

opinion of a basic scientist responding to the survey:

I feel that basic research reporting must be handled differently from the typical daily news. The reporter must be a scientist by training; the questions for an interview must be written down previously; and the proofed article must be edited by the researcher (who should have deletion prerogative) before going to press.

If reporters elect not to review their articles with scientists, they should be certain to check key facts with their sources--especially when articles are based entirely on information presented orally, either from a scientific presentation or a personal interview. The fact that only 24% of scientists in the survey agreed that most reporters understand the problems scientists face in "going public" also indicates the continuing need for journalists to become familiar with the methods, protocols, and limitations of science.

"The biggest problem with reporters," noted one respondent, "is their lack of basic scientific training and their limited understanding of the slow, deliberate progress of work in an area. They imagine one grant cures a disease." Another scientist wrote, "Just as many scientists are ill-equipped to communicate with the public, many reporters are poorly prepared to deal accurately with science--but neither group seems aware (on an individual basis) of their lack of competence."

Recommendations for Information Officers

Although a majority of scientists in this study (56%) indicated they would prefer working through their institutions' public information offices rather than having direct contact with journalists, considerably more respondents reported having had actual contact with a news reporter than with a PIO (70% versus 55%). One reason for this seeming discrep-

ancy appears to be scientists' overall perception that the PIO's are not adequately trained in science. Scientists who evaluated the scientific training of PIO's positively were much more likely to have interacted with a PIO than those who had neutral or negative evaluations.

Accordingly, the message to PIO's is that they must demonstrate professional competency before being "accepted"--and utilized--by scientists in their institutions. Enrollment in continuing education courses on scientific topics of special relevance, attendance at selected sessions of professional society meetings, and regular scanning of major scientific journals likely would be valuable investments for PIO's wishing to sharpen their scientific acumen.

Perhaps more important, PIO's--like reporters--must do their homework thoroughly before entering interview situations. Only with a sound background understanding of the subject at hand can a PIO ask critical, intelligent questions of scientists, demonstrate his or her full value to scientists in the public communication process, and earn scientists' trust as a professional ally. For example, one scientist noted on his questionnaire, "Our PI officer does not have a science background but makes considerable effort to learn about various research projects."

Based on available evidence, scientists appear welcome to embrace the information office function in communicating to the public; it is the office workers' responsibility to cover their institutional science beats with the energy and creativity of any good science journalist. Moreover, PIO's can be constructive intermediaries between scientists and the press. In working with television reporters, one scientist

wrote, "It would be great if the university's public information people were a source of advice."

Recommendations for Scientists

Even though it did not appear to affect their actual public communication behavior, most scientists in the survey (70%) did perceive some degree of peer pressure against science popularization activities. Reasons for such prevailing attitudes are complex, embedded in the nature and culture of science itself. However, one factor contributing to scientists' skepticism about their peers' "going public" appears to be a concern that media attention may short-circuit the peer review process, giving the "visible scientists" an unfair advantage over their more reticent but equally qualified colleagues in competition for public research monies. Nearly two-thirds of the survey respondents, for example, agreed that scientists often inflate the value of their work when they grant news interviews.

"In recent years some scientists, more than in the past, have abused their access to the press," was a comment typical of several respondents. "The quest for research money which is becoming more scarce is a primary motivation behind these abuses." In accepting such "self-promotional" contacts, another scientist wrote, "the media very easily play the fool." As one respondent offered, "We don't seem to challenge the newspaper even when we would a scientific journal. Some scientists even go above scientific study sections by publishing in the New York Times before a journal."

To ameliorate this situation, scientists should avoid going to the opposite extreme of the stereotypical "silent scientist" and overstating the immediate or long-term implications of their research. Offering a balanced perspective of their own and related research will help minimize cynicism from journalists and criticism from peers, and public understanding of science will be served.

Another recommendation for scientists is that they learn more about the process of journalism. Just as science writers and PIO's are admonished to improve their scientific competence, scientists should be challenged to become more "media literate," particularly with regard to the "poor cousins" of science journalism: radio and television. An appreciation of journalism's own culture and limitations likely would temper scientists' demands for greater control over the news product. Skills in public communication and media relations also would help scientists tell their story more succinctly, understandably, and personally, thereby minimizing risks of distortion in the media translation process.

Professional society officials and scientific journal editors should be encouraged to focus continuing attention on nurturing such skills among their members and readers. Promising examples of educational initiatives include a recent lengthy New England Journal of Medicine feature on scientists meeting the press (Bander, 1983) and a special session on media relations at this year's annual meeting of the American College of Physicians. A specific message that scientists need to receive, this study suggests, is that mass media coverage of their work, in general, neither compromises the scientific validity of the

research nor endangers subsequent publication of the results in a peer-reviewed scientific journal.

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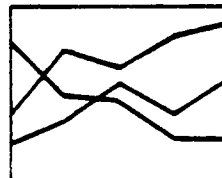
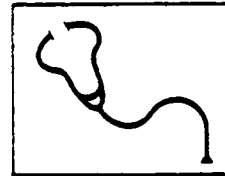
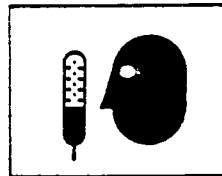
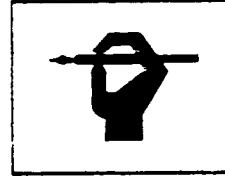
APPENDIXES

APPENDIX A

SURVEY QUESTIONNAIRE AND CORRESPONDENCE

**Special
Study:**

**SCIENTISTS
&
PUBLIC
COMMUNICATION**



A national effort to determine scientists' attitudes and practices regarding public communication: How do you feel about the need to communicate your research results to the public? about journalists and how they cover your area of research? about the public information officers in your institution? about commenting publicly on your colleagues' work? about news reporting of conflict and controversy in science?

Please answer all of the questions, as freely as you can. Remember that your first reaction to a question is generally the best.

If you wish to comment on any questions or qualify your answers, please feel free to use the space in the margins or on the back cover.

Return this questionnaire to:



Communications Research Center
College of Communications
University of Tennessee
Knoxville, TN 37996-0313

-1-

PART I. As an active scientist, you may deal with and give thought to a number of issues related to your research. In this first series of questions, we would like to know how you perceive some of these issues.

Q-1 How often do you stop to think about the following:

	Do you stop to think about each: (Circle your answer)			
1 The immediate practical or theoretical applications of your research.	OFTEN	SOMETIMES	RARELY	NEVER
2 The impact of your research on the delivery of health care.	OFTEN	SOMETIMES	RARELY	NEVER
3 The social and ethical implications of your research	OFTEN	SOMETIMES	RARELY	NEVER

Q-2 How much do you think you can do, personally, to influence the following:

	About each, can you personally do: (Circle your answer)			
1 The immediate practical or theoretical applications of your research.	A GREAT DEAL	SOMETHING	VERY LITTLE	NOTHING
2 The impact of your research on the delivery of health care.	A GREAT DEAL	SOMETHING	VERY LITTLE	NOTHING
3 The social and ethical implications of your research	A GREAT DEAL	SOMETHING	VERY LITTLE	NOTHING

Q-3 Finally, to what extent do you see a connection between yourself, personally, and the following (Have they affected you or could they affect you?):

	Is your connection with each: (Circle your answer)			
1 The immediate practical or theoretical applications of your research.	STRONG	MODERATE	WEAK	NO CONNECTION
2 The impact of your research on the delivery of health care.	STRONG	MODERATE	WEAK	NO CONNECTION
3 The social and ethical implications of your research	STRONG	MODERATE	WEAK	NO CONNECTION

-2-

PART II. Next, we would like to learn about your experiences with, and attitudes toward, the mass media.

Q-4 Have you ever sought or granted an interview with a news reporter regarding your research? (Circle the number of your answer)

- 1 NO
2 YES

IF NO, SKIP FROM HERE
TO Q-9 ON THE NEXT PAGE

Q-5 Overall, how would you rate your experience(s) with journalists in newsgathering situations? (Circle only one number)

- 1 VERY POSITIVE
2 SOMEWHAT POSITIVE
3 NEUTRAL
4 SOMEWHAT NEGATIVE
5 VERY NEGATIVE

Q-6 With which of the following types of reporters working for mass media have you had contact? (Circle all numbers that apply)

- 1 NEWSPAPER REPORTER
2 MAGAZINE REPORTER
3 TELEVISION REPORTER
4 RADIO REPORTER

Q-7 In the past year, with how many different mass media reporters have you had contact? (Circle number; your best guess is fine)

- 1 NONE
2 1 OR 2
3 3 OR 4
4 5 OR 6
5 7 TO 10
6 MORE THAN 10

Q-8 Please indicate which of the following have been subjects of interviews that you have ever sought or granted with a news reporter.

	Subject of interview <u>sought</u> with reporter? (Circle answer)		Subject of interview <u>granted</u> with reporter? (Circle answer)	
1 The immediate practical or theoretical applications of your research.	NO	YES	NO	YES
2 The impact of your research on the delivery of health care.	NO	YES	NO	YES
3 The social and ethical implications of your research	NO	YES	NO	YES

-3-

- Q-9 In your opinion, which of the following media does the best job and which does the worst job of covering your own and related research? (Circle number of only one choice in each of the two columns)

<u>Best Job</u>	<u>Worst Job</u>	
1	1	NEWSPAPERS
2	2	MAGAZINES
3	3	TELEVISION
4	4	RADIO

- Q-10 How willing would you be to discuss with a news reporter the following:

How willing are you to discuss each:
(Circle your answer)

- | | | | | | |
|---|---|--------------|------------------|-------------|------------------|
| 1 | The immediate practical or theoretical applications of your research. | VERY WILLING | SOMEWHAT WILLING | NOT WILLING | UNSURE/NOT APPLY |
| 2 | The impact of your research on the delivery of health care. | VERY WILLING | SOMEWHAT WILLING | NOT WILLING | UNSURE/NOT APPLY |
| 3 | The social and ethical implications of your research | VERY WILLING | SOMEWHAT WILLING | NOT WILLING | UNSURE/NOT APPLY |

- Q-11 Of the following individuals who were seeking information for an article (or a TV/radio piece) about your research, whom would you be most willing and least willing to help? (Circle number of only one choice in each of the two columns)

<u>Most willing to help</u>	<u>Least willing to help</u>	
1	1	NEWSPAPER REPORTER
2	2	MAGAZINE REPORTER
3	3	TELEVISION REPORTER
4	4	RADIO REPORTER

- Q-12 Have you ever heard the term "Ingelfinger rule" or "Reiman rule" used to describe a journal's policy of accepting only original research papers? (Circle number)

- 1 NO
2 YES

IF NO, SKIP FROM HERE
TO Q-14 ON THE NEXT PAGE

- Q-13 As you understand it, what journals adhere to the principles of this rule? (Circle number)

- 1 "NEW ENGLAND JOURNAL OF MEDICINE" ONLY
2 SOME PEER-REVIEWED SCIENTIFIC JOURNALS
3 MOST PEER-REVIEWED SCIENTIFIC JOURNALS
4 ALL PEER-REVIEWED SCIENTIFIC JOURNALS
5 UNSURE/NO OPINION

-4-

Q-14 Do you feel free to initiate contact with a journalist? (Circle number)

- 1 NO
2 YES

Q-15 Given a choice, would you prefer direct contact with journalists rather than working through your institution's public information office? (Circle number)

- 1 NO
2 YES

Q-16 Have you ever helped your organization's public information office with an article (or a TV/radio piece) about your research, suggested an article idea to your organization's public information office, or written an article yourself (such as a news release or a health column) for mass media dissemination? (Circle number)

- 1 NO
2 YES

IF NO, SKIP FROM HERE
TO Q-18 BELOW

Q-17 Please indicate which of the following have been subjects of articles you have helped with, article ideas you have suggested, or articles you have written yourself.

	Helped w/ article?	Suggested idea?	Written article?
	(Circle answer in each column)		
1 The immediate practical or theoretical applications of your research.	NO YES	NO YES	NO YES
2 The impact of your research on the delivery of health care.	NO YES	NO YES	NO YES
3 The social and ethical implications of your research	NO YES	NO YES	NO YES

Q-18 Have you ever undertaken any of the following activities related to your research?

	Have you ever: (Circle your answer)
1 Presented a paper at a scientific meeting?	NO YES
2 Participated in a scientific study group section or advisory body?	NO YES
3 Testified on an issue related to science and public policy?	NO YES
4 Testified for public support of science?	NO YES
5 Spoken before a public group?	NO YES
6 Participated in a press conference?	NO YES

-5-

PART III. In the next series of questions, we would like your opinions concerning various public and scientific communication issues.

Q-19 Please indicate whether you agree or disagree with each of the statements listed below.

- 1 means strongly agree
 2 means agree
 3 means somewhat agree
 4 means don't know/no opinion
 5 means somewhat disagree
 6 means disagree
 7 means strongly disagree

	Extent of agreement/disagreement (Circle number)						
	STRONGLY AGREE		NO OPINION			STRONGLY DISAGREE	
1 The conditions for career advancement in science tend to restrict scientists' public communication activity	1	2	3	4	5	6	7
2 Scientists face peer pressure against popularizing their research in the mass media.	1	2	3	4	5	6	7
3 Coverage of a scientist's research results in the lay press would endanger subsequent publication of those results in a scientific journal	1	2	3	4	5	6	7
4 A scientist should release scientific research results to the press only <u>after</u> the information has appeared in a scientific journal or scholarly publication	1	2	3	4	5	6	7
5 A scientist should release scientific research to the press <u>after</u> the paper has been accepted for journal publication, but <u>before</u> it is actually in print.	1	2	3	4	5	6	7
6 Scientific findings related to immediate public health and safety problems should be released to the public before they undergo complete peer review.	1	2	3	4	5	6	7
7 Scientists are hesitant to discuss their results with news reporters after presenting the results for the first time at a scientific meeting.	1	2	3	4	5	6	7
8 It would be a good general policy for science writers to have their articles read by scientists quoted in the articles before publication	1	2	3	4	5	6	7

-6-

Q-19 (continued)

		Extent of agreement/disagreement (Circle number)						
		STRONGLY AGREE			NO OPINION			STRONGLY DISAGREE
9	Mass media coverage of your own and related research is generally accurate.	1	2	3	4	5	6	7
10	Results of your own and related research are being disseminated satisfactorily to the public.	1	2	3	4	5	6	7
11	Mass media coverage of science is important for scientists.	1	2	3	4	5	6	7
12	Mass media coverage of science is important for the public.	1	2	3	4	5	6	7
13	Scientists have an obligation to work with news reporters to get the results of their research before the public	1	2	3	4	5	6	7
14	Scientists are just as responsible for making research results available to the public as to their colleagues	1	2	3	4	5	6	7
15	Mass media coverage of science is largely responsible for developing the professional image of scientists in the eyes of nonscientists.	1	2	3	4	5	6	7
16	Scientists who deal regularly with the press should have some training in the fundamentals of news communication.	1	2	3	4	5	6	7
17	Scientists who give information to news reporters often inflate the value of their own work.	1	2	3	4	5	6	7
18	Most scientists understand the problems reporters face in writing for the public.	1	2	3	4	5	6	7
19	Most reporters understand the problems scientists face in communicating their research results to the public.	1	2	3	4	5	6	7
20	Scientists should refuse to cooperate with reporters who appear inadequately trained in science.	1	2	3	4	5	6	7
21	Scientists have a responsibility to help the public make informed judgments about science policy issues	1	2	3	4	5	6	7
22	Resolution of policy problems in science is best left to scientists past their active research years	1	2	3	4	5	6	7

-7-

Q-19 (continued)

	Extent of agreement/disagreement (Circle number)						
	STRONGLY AGREE			NO OPINION			STRONGLY DISAGREE
23 Scientists should offer to the public their views on the social and ethical consequences of their research.	1	2	3	4	5	6	7
24 Scientists should offer to the public their informed views on the meaning and value of others' research	1	2	3	4	5	6	7
25 A scientist should comment publicly on others' research only if the research is within his or her immediate area of expertise	1	2	3	4	5	6	7
26 Conflict and controversy within the scientific community should be reported in the public press	1	2	3	4	5	6	7
27 Scientists should justify public support for their research in terms of its practical results	1	2	3	4	5	6	7
28 Continued public support of your research is fairly secure	1	2	3	4	5	6	7
29 Based on current public interest, your research is a "hot topic".	1	2	3	4	5	6	7
30 Based on current public opinion, your research is controversial.	1	2	3	4	5	6	7
31 Your colleagues would consider you a relatively controversial figure	1	2	3	4	5	6	7
32 Other scientists would recognize you as a credible spokesperson on scientific topics outside your specific area of expertise . .	1	2	3	4	5	6	7
33 Your organization's public information office plays an important role in getting research results before the public.	1	2	3	4	5	6	7
34 Your public information office sometimes hinders scientists who want to discuss their work openly with the public	1	2	3	4	5	6	7
35 Scientists should be free to deal with journalists without interference or pressure from their institutions.	1	2	3	4	5	6	7
36 Workers in your public information office appear adequately trained in science.	1	2	3	4	5	6	7

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PART IV. Finally, we would like to ask a few questions about yourself for statistical purposes and to help us interpret your other answers.

Q-20 How would you describe your primary type of research? (Circle number)

- 1 BASIC RESEARCH
- 2 APPLIED RESEARCH & DEVELOPMENT
- 3 CLINICAL INVESTIGATION
- 4 CONTROLLED CLINICAL TRIALS
- 5 DEMONSTRATION/EDUCATION PROGRAMS
- 6 OTHER (please specify) _____

Q-21 How many scientific articles would you estimate you have published (either as primary author or co-author)? (Circle number; your best guess is fine)

- 1 FEWER THAN 5
- 2 5 TO 10
- 3 11 TO 25
- 4 26 TO 50
- 5 MORE THAN 50

Q-22 What are your principal responsibilities? (Circle number)

- 1 FULL-TIME RESEARCH
- 2 RESEARCH & TEACHING
- 3 RESEARCH & ADMINISTRATION
- 4 RESEARCH, TEACHING & ADMINISTRATION
- 5 OTHER (Please specify) _____

Q-23 On how many active research projects supported by any funding source are you listed as Principal Investigator? (Write in number; your best guess is fine)

_____ PROJECTS

Q-24 Are you involved in any research projects partly or wholly sponsored by industry? (Circle number)

- 1 NO
- 2 YES

Q-25 Have you ever been hired by industry as a consultant? (Circle number)

- 1 NO
- 2 YES

Q-26 Is any of your research done as part of a multidisciplinary research team? (Circle number)

- 1 NO
- 2 YES

Q-27 Do you belong to one or more social action groups related to science (such as Scientists for Responsible Genetic Engineering)? (Circle number)

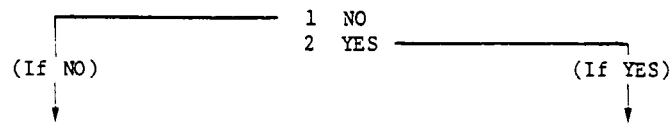
- 1 NO
- 2 YES

-9-

Q-28 What is your highest academic degree? (Circle number)

- 1 M.A. or M.S.
- 2 M.D.
- 3 PH.D.
- 4 MULTIPLE (Please specify) _____
- 5 OTHER (Please specify) _____

Q-29 Are you employed by a college or university? (Circle number)



Q-29a What is the type of institution that employs you? (Circle number)

- 1 GOVERNMENT HOSPITAL/RESEARCH INSTITUTE
- 2 NONPROFIT HOSPITAL/RESEARCH INSTITUTE
- 3 FOR-PROFIT RESEARCH INSTITUTE
- 4 OTHER (Please specify) _____

Q-29b What is your academic position? (Circle number)

- 1 FULL PROFESSOR
- 2 ASSOCIATE PROFESSOR
- 3 ASSISTANT PROFESSOR
- 4 OTHER (Please specify) _____

Q-30 Do you hold an official position in your institution (dean, department chairman, etc.) or other scientific organization (professional society officer, etc.)? (Circle number)

- 1 NO
- 2 YES

Q-31 Have you had any formal training in mass media relations or public communication skills? (Circle number)

- 1 NO
- 2 YES

Q-32 Does your institution have a specific policy calling for the reporting of research results to the public? (Circle number)

- 1 NO
- 2 YES
- 3 DON'T KNOW

Q-33 What is your age?

_____ YEARS

Q-34 What is your sex? (Circle number)

- 1 MALE
- 2 FEMALE

Q-35 Was English your second language to learn? (Circle number)

- 1 NO
- 2 YES

Is there anything else you would like to tell us about your feelings toward or experiences with the mass media? If so, please use this space for that purpose.

Also, any comments you wish to make that you think may help us in future efforts to understand the public communication behavior of scientists will be appreciated, either here or in a separate letter.

*Your contribution to this effort is very greatly appreciated.
If you would like a summary of results, please print your name
and address on the back of the return envelope (NOT on this
questionnaire). We will see that you get it.*

College of Communications

THE UNIVERSITY OF TENNESSEE, KNOXVILLE, TENNESSEE 37996-0313

Graduate Studies and
Communications Research Center
(615) 974-6651

May 7, 1985

Numerous studies show that Americans know very little about science. The implications are serious if you believe as we do that only an informed public can make valid judgments on scientific issues and ensure that science remains healthy and responsibly independent. One way for scientists to help build public understanding of science is to become involved in the process of reporting science news in mass media, the main sources of scientific information for most people.

You are one of a small number of scientists we are asking to complete a questionnaire to help us learn why scientists choose or choose not to "go public" with their views and findings. We selected your name randomly from a 1983 list of NIH grantees. For our sample to be truly representative of all NIH-supported scientists, it is important that each questionnaire be completed and returned. Scientists who helped us test the questionnaire finished it in about 15 minutes.

You may be assured of complete confidentiality. The questionnaire has an identification number for mailing purposes only. We will never place your name on it, and we will report only aggregate data.

We plan to publish our findings in both the scientific and journalism literature as a starting point for mutual efforts to improve the science communication process. You may receive a summary of results by writing "copy of results requested" on the back of the return envelope and printing your name and address below it. Please do not put this information on the questionnaire itself.

I would be most happy to answer any questions you might have. Please write or call. The telephone number is (615) 974-6651.

Thank you for your assistance.

Sincerely,

Jeffrey W. McKenna
Project Director

May 14, 1985

Last week you were mailed a questionnaire asking about your attitudes and practices regarding the public communication of science. Your name was drawn randomly from a 1983 list of NIH grantees.

If you have already completed and returned the questionnaire to us, please accept our sincere thanks. If not, please do so today. Because we sent it to only a small, but representative, sample of scientists, it is extremely important that yours be included in our study if the results are to reflect accurately the opinions and experiences of all NIH-supported scientists.

If by some chance you did not receive the questionnaire, or it got misplaced, please write or call me right now (615-974-6651), and I will get another one in the mail to you immediately.

Sincerely,

Jeffrey W. McKenna
Project Director

College of Communications

THE UNIVERSITY OF TENNESSEE, KNOXVILLE, TENNESSEE 37996-0313

Graduate Studies and
Communications Research Center
(615) 974-6651

May 28, 1985

About three weeks ago I wrote to you seeking your thoughts concerning the public communication of science. As of today we have not yet received your completed questionnaire.

Our research center has undertaken this study because of the belief that increased interaction between scientists and journalists is necessary for improving science reporting in the mass media--and ultimately the public's understanding of science. By beginning to identify those factors that facilitate or impede scientists' communication with the public, we hope to offer a baseline against which individuals and organizations involved in both the making and reporting of science news can begin working to improve the process.

I am writing to you again because of the significance your response has to the usefulness of this study. Your name is one of a random sample drawn from the 1983 NIH research grants listing. Only about one of every 28 grantees is being asked to complete this questionnaire. For the results of our study to be truly representative of the attitudes and practices of all NIH-supported scientists, it is essential that each person in the sample return his or her questionnaire.

In the event your questionnaire has been misplaced, we are enclosing a replacement.

Your cooperation is greatly appreciated.

Cordially,

Jeffrey W. McKenna
Project Director

P.S. A number of respondents have written to ask when results will be available. We hope to have them out early in the Fall.

APPENDIX B

VERBATIM SURVEY RESPONSES--ADDITIONAL REMARKS

1. Ideally it would work out if the reporters had some background knowledge of the specific area prior to the interview. The best results are when reporters can send in a rough draft of the article prior to publication. Best results are achieved with least sensationalism.
2. The biggest reason research scientists fail to communicate with the public is the lack of time to spend, due to career pressures. Second, news media inherently are looking for headlines, more than thoughtful discussions.
3. Science reported by qualified individuals with a full appreciation of results and problems won't sell newspapers or warrant air time. It's too "dull." It's not sensational enough. We aren't all space shuttles!
4. The policy of the New England Journal in releasing articles to the media prior to publication is destructive.

The press is too interested in the "new" and unproven and not enough interested in the process of proof.
5. It seems that all media--newspapers, TV, radio--want sensational stories. That does not serve science or the public. The efforts by the American Association for the Advancement of Science, such as "Science '85," are in the right direction.
6. The general public is being duped by some industries (e.g., health food, mega-vitamin stores, etc.) because they do not understand the meaning of research, or lack of it. The approach to research and reason should be taught in high school science. A portion of biology/health should be devoted to this area.
7. Scientists should play a more active role in interpreting science to the public and in determining public policy.
8. The experience with mass media varies a lot: Some journalists/TV people who deal with science are truly excellent; some are terrible. The major problem in communicating with the public is that scientists should learn to avoid using scientific words and replace them with words from the common language. We can use a few scientific words if we define them carefully.
9. It is difficult to gauge the impact of our research on health care; we work on plant genetic engineering.

10. I am ill at ease with questions about the applicability of my research because I can't think of any applications. I can see sometimes that the research of others has applicability and I therefore prefer to talk about the research of others than my own. I also resent the feeling that my research is worthless and uninteresting if I cannot think of any applications.
11. Media people must, must, must have articles checked with the scientist they interview before release. A lot of misinformation is released all the time.
12. In recent years some scientists, more than in the past, have abused their access to the press. The practical implication of data is often exaggerated. More serious is the release of results to the press before they have been evaluated by scientific peers. This undermines the credibility of the scientific community as a whole. The quest for research money which is becoming more scarce is a primary motivation behind these abuses.
13. My experiences with mass media and public relations departments have been bad.
14. Equally important [to influencing nonscientists' image of scientists] is college contact, entertainment stereotypes.
15. My strongest feelings are on the inadequacy of television reporting of science and medicine.

I would very much like to write science review articles in my areas of specialization for the lay press but I simply do not have enough time. Lack of time is the "career pressure" that prevents me from doing so, not external forces such as peer pressure.

16. The public should be informed on how important our work is; how important it is to get funds for research; and that funds for basic research are more important for the community than funds for building "war planes." They should be strongly encouraged to support us in increasing the number of NIH grants each year.
17. I generally avoid reporters, except for bona fide science reporters, e.g., from Science. In my personal experience reporters seek for that which is sensational, commonly distorting fact and quoting out of context, leading to implications that are, at best, exaggerated and, at worst, frankly mistaken.
18. I appreciate the difficulty of attempting to communicate complex ideas to the vast public reading at the sixth grade level. But the science writers nearly always promise more than can be delivered or are "cute." Both fail at having the public understand what we do.

19. "Science" for public consumption should either be peer-reviewed or presented with balance provided by peer-review. It remains a major disappointment to spend time with reporters--who no doubt mean well--to find either inaccuracies, misquotes, or lack of proper emphasis/context. Just as many scientists are ill-equipped to communicate with the public, many reporters are poorly prepared to deal accurately with science--but neither group seems aware (on an individual basis) of their lack of competence.
20. It is very important that media give scientists an opportunity to read and correct an article (or TV statement) before it is released to the public.
21. The magazine Scientific American is probably head and shoulders above any other printed source of science information for the general public. On radio, the University of California's Science Reporter is excellent. On TV, only PBS is consistently good. For newspapers, the L.A. Times often has excellent science reporting, particularly in feature articles.
22. Scientific work is usually reported with great changes in emphasis (to serve the reporter) and with arbitrary omissions and rearrangements. I refuse to give interviews unless I have the right to look over and correct the manuscript before publication.
23. I think there are a number of problems in the way that scientific research is communicated in the mass media by science reporters:
 - a. There is a great emphasis on the "hot topics" of the day/month, etc., and the more glamorous, sensational aspects of research.
 - b. Science reporters, through their access to a very large readership, have a unique opportunity to educate and disseminate valuable information, but these goals are rarely addressed or even recognized.
 - c. The belief that research should have immediate practical applications frequently results in inaccurate reporting (i.e., ascribing applications to certain types of research when they don't reasonably pertain to it), raising false hopes, and the lack of recognition that frequently the research without immediate practical applications eventually has the greatest impact.
24. My work is frequently reported in the mass media. I have been appalled by the total lack of understanding of even very simple concepts by certain representatives of the media. In addition, TV representatives commit even more grossly incompetent acts by compressing time allocations for scientific news reports. Until the mass media devote more attention to the scientific competence of their representatives, I fear for any progress in scientific/media relations.

25. I was once "burned" by a young journalist with little scientific background who spoke with me about my research by telephone. My attempts to explain complex issues to him by simple analogies were poorly absorbed and abominably reported. His article was clearly a selfishly motivated piece to advance him in his publishing hierarchy. His unwillingness to recognize that his speculations were literally dangerous to the public was incredible to me.

On the basis of this and other experiences, I feel that basic research reporting must be handled differently from the typical daily news. The reporter must be a scientist by training; the questions for an interview must be written down previously; and the proofed article must be edited by the researcher (who should have deletion prerogative) before going to press.

26. The public and their elected politicians in D.C. really must have more and better awareness of the importance and progress of scientific research and scientific training. The mass media are the key to "spreading the word." We need more knowledgeable, sympathetic, and articulate spokespeople on TV, radio, and in the print media.
27. My research is so esoteric that I doubt if the general public would have much interest in it. It is more related to "pure science" than to medicine.
28. Our PI officer does not have a science background but makes considerable effort to learn about various research projects. My best experiences have been when a newspaper reporter brings copy back and lets me read and comment before final submission of the article to the editor.

TV--blah--time consuming, sensationalism, inaccurate, too much hype. I think they underestimate the American public.

I don't mind controversey (e.g., animal rights), but let's balance the debates or presentations.

29. Most science is pretty dull. It is difficult to sift out and present interesting things to the public.
30. I know from personal experience that certain scientists are particularly adept at manipulating the media to their own advantage. Media persons have difficulty understanding and interpreting complex scientific issues, and gravitate toward those scientists who simplify their task of reporting scientific news. However, the simplifications offered by the scientists usually amount to advertisements of the scientists' own work and tend to overinflate the importance of that work.

31. It is imperative that journalists understand the language and approach of science. We can't simply give them baby-talk!
32. Mass media tend to look for the public (or "human") interest of what they publish, and not necessarily the validity of its content. Not having a voice on what or how they report is a hindrance to the process of transferring research findings to the general public. I don't know if there is a practical solution to this problem.
33. Our university and my college want to promote the university and boost its image. Both the college and university have hired writers who are always looking for work. This is unfortunate because too many preliminary and unconfirmed findings are publicized.
34. Preliminary findings of urgent public health impact should be released by a public-supported body such as the Centers for Disease Control and not by individual scientists.
35. One important aspect of mass media coverage is that it also influences what research funding is given to a respective field--that is, fields that become fashionable usually receive more funding. One recent example is Alzheimer's Disease. This makes for unfortunate swings in the research emphasis of a lab from one year to the next.
36. I am fortunate to work in Boston, which has an excellent and responsible medical/scientific reporter staff at the Boston Globe. Most professional medical reporters are sensitive to scientists' interests in my small experience.

Medical findings should not be released before peer review publication (except in public health emergencies). It is not unusual to be deluged with phone calls from patients without having access to results to be able to interpret them to reassure the worried or affirm dangers. This can cause much distrust.

37. I feel very uneasy about the support of basic research in this country, where we once excelled, but now I begin to question this. The restriction of funding, particularly for young aspiring scientists, is one of the grim results of politically motivated fund-cutting.
38. I think I am, or try to be, equally willing to help all reporters. What we in science must see is that our roles and talents are different but complementary to those of the media. We need each other--for our mutual better understanding. Thanks for your help.
39. Mass media spectacularize everything. A lot of research is dull, even though important.

40. There is too much media coverage of everyday events that are not really news. Economic pressures on the media cause the sensationalism of much reporting, often leading to deliberate falsification of facts or misleading conclusions. 24-hour "news" coverage has led to unhealthy media practices.
41. Most scientist-media interactions are self-promotional on the part of the scientist. In the recent past, the media have accepted contacts engineered by scientists to promote their commercial interests, sell stocks for their companies, etc. Whether due to an interest in writing a "good story" or ignorance, the media very easily play the fool.
42. I see a real need for specially trained individuals to serve as communicators between scientists and the public (i.e., interact with "mass media"). Having seen how distorted and biased media coverage can be (advertently or inadvertently), I personally feel the need for a "lawyer-like spokesman" to interpose between "me and them" to ensure accuracy of communications. Perhaps senior scientists no longer actively involved with research activities could best fill this role.
43. Scientists should personally withhold comments on their studies until they are published unless they are of immediate public interest. The public has the right to know just about everything occurring in research, yet this must be balanced with public protection from the "hype" which usually goes with controversial findings. It is the role of media to scan publications and keep relevant contacts who will inform them of important developments. An unambiguous cure for a disease (e.g., leukemia) needs immediate media coverage; a new diet that may help blood pressure, for instance, needs time for scientific analysis.
44. In my experience, most scientists who seek publicity for their work are doing so for ego gratification alone. Most public reporting of research gives an impression of much faster progress than really occurs. Public reports of research do not permit proper judgments on the quality of the research involved.
45. Better trained science reporters are needed badly. Sensationalism must be strongly discouraged; the scientist must be taught to resist this temptation.
46. Dissemination of scientific knowledge and discovery is the responsibility of everyone in science. Thanks for doing this survey!
47. Education of the public and journalists in science has weakened over the past 30 years as sciences have become increasingly more developed, technical, and complex. Much of today's science cannot be meaningfully simplified to the level of education of the mass public and its journalists.

48. For the most part, radio, television, and newspapers are not very satisfactory. Exceptions: National Public Radio and National Educational Television are excellent. Mass media "communicators" appear to be more interested in what will grab people with a short attention span than in real education or information transfer.
49. Just like the scientific journal offices, an office/institution may be set up exclusively for "popularizing science," in the sense of communicating with the public. All mass media could contribute to setting up and management of this institution (instead of each retaining their own science writers). A scientist can then "submit" a popular science article to this institution, which will review it in-house; they can reject it on the grounds of relative lack of relevance to the public, or accept and rewrite it in a mass media style for circulation/release to mass media outlets (this institution need not or may choose to have its own publication). Most scientists are most likely to participate in this effort. If this proposal is liked and acted upon in one way or another, I would appreciate hearing about it.
50. My general negative attitude results from the frequent inability of reporters to report information accurately. Offers to proofread reports before publication are typically rejected.
51. Peer pressure against scientists publicizing their research is changing. Some groups are using the media to their advantage because the media have no peer review. Those channels are not acceptable to many of us, but they are very effective. We don't seem to challenge the newspaper even when we would a scientific journal. Some scientists even go above scientific study sections by publishing in the New York Times before a journal. Perhaps what is needed is a screening group of scientists to review statements before they go to the press.
52. With TV news coverage, it is essential to have full control over what is said both during the televised portion of the interview and before and after the interview. My research on epilepsy has analyzed cellular mechanisms that have malfunctioned in the brain. Yet, my TV interview in 1980 was introduced as "and in a few minutes, news about a new drug that cures epilepsy." This L.A. station caused a lot of false hope in many epileptics who phoned me or had their physicians phone me after the interview. In addition, some of my colleagues were upset over this interview.
53. The biggest problem with reporters is their lack of basic scientific training and their limited understanding of the slow, deliberate progress of work in an area. They imagine one grant cures a disease.
54. Your categories of research areas are too restricted and do not deal with basic science with tangential implications for human health care delivery or "ethical" issues, which is when all the crucial advances begin. (Of course, they are less newsworthy.)

55. Science writers may not portray the research ambivalence of colleagues well. The scientist should be able to explain both sides of controversial issues.
56. Either out of optimism or desire for a more exciting story, many media presentations are prepared in such a way as to give the public the impression that cures are just around the corner. Members of the media would do well to maintain a healthy critical perspective of scientific advances so as not to present overly optimistic views of future developments on a practical level.
57. To make my opinion very clear--I do not believe the public media are the proper places to report scientific results as the primary source.
58. Many areas of basic research can be made to sound esoteric by the media. The major point that the mass media do not communicate is that basic research generates new knowledge. Scientists involved in the application of new knowledge to new technology receive most media attention, and the public tends to believe that this is science. If public support for science continues to focus primarily on applied research and on projects that elicit media attention, development of new knowledge will decline. If this country is to retain its leadership in life science research, it must support a commitment to long-term, non-glamorous basic science. In order to maintain the quality of scientists in basic research, this support must provide a more stable work environment than has been experienced during the past 6 years.
59. Science reporting in the popular press has four main foci: cures for cancer, scandal, gossip, and potential dangers. I have never read a newspaper article about my own field or other fields on the basis of which I could deduce what experiment had actually been done, let alone what the result was. This vagueness, which pervades newspaper reporting of scientific advances, cannot possibly be of use to the layman. The most effective way to teach through the print media is the Scientific American approach. On occasion, the New York Times has devoted sufficient time and space to such an approach. I don't know of any other newspaper or magazine that has done so.
60. My experience is that the media often get and report incorrect information. That is, they seem to misunderstand what has been explained to them and report it incorrectly. In addition, they often inflate the real or potential significance of research findings.

61. Scientists' need to justify research depends on the meaning of the word "practical." Obviously, much research is directed to increasing our knowledge about systems. The immediate practicality of this knowledge is often not obvious until a critical mass of knowledge is obtained that allows its exploitation. The scientist is responsible to the public, in that he/she must demonstrate progress either in contributions to total information and understanding of systems or practical use of this knowledge. It is the job of scientific peer review to ensure that the research is novel and the contributions worthwhile. Some intermediate mechanism of review has to isolate the scientist from the public as long as the public is willing to support "basic" research. On the other hand, the scientist and journalist do have an obligation to demonstrate the long-term goals and the success in achievement of these goals for the public.
62. Scientists have a strong fear of being misquoted by reporters. Because health-related research can have a strong individual effect on a person who listens to a TV show or reads a newspaper (for example, a person dying of cancer who listens to a show on cancer), the scientist often fears that his work will not be kept in perspective. Scientists might be more inclined to talk to reporters if they could either assist in development of the article or in the editing of the article before it is given to the public.
63. One often sees serious distortions and inaccuracies in reports of scientific issues. Most scientists work in narrow, highly technical areas that have practical significance but would not be of particular interest to the public. And they have the good judgment to know this, thus they avoid publicity. "Educating the public" is inherently very arrogant. In addition, the amount of scientific information is so large that great care must be taken in selection.
64. New advances in cancer research are often heralded as "new cures" or "major new advances," giving hope or promise of rapid new therapeutic modalities. This "hype" begins to wear thin. Journalists need to avoid this--even at the expense of reduced readership. Misinformation leads to cynicism. Accurate reporting is the best we can do.
65. Science is not "technology." Technology is applied science. The press confuses these and consequently does not have an accurate picture of science and scientists per se.
66. You asked a lot of us to fill this out--I hope it will be worthwhile but I doubt it.
67. It is hard to answer this questionnaire in generalities. Some of my contacts with the media have been superb and others terrible and professionally disastrous.

68. The scientist must undertake the responsibility for public communication about science; otherwise it becomes a conspiracy of silence.
69. Parts of the questionnaire are not applicable as my work has no direct relation to health care delivery and involves no social or ethical considerations.

I am quite concerned with media coverage of pseudoscience (psychic powers, astrology, UFO's, etc.). Sensational claims are often reported with little critical examination. Skeptical scientific authorities should be consulted in the preparation of articles on these topics.

70. The press must report scientific data responsibly. This means not overinterpreting data so that the public is misinformed. I have no confidence that the press is capable of regulating itself adequately to achieve this balance between newsworthiness and responsible reporting on scientific subjects.
71. I was struck by the wide differences in the quality of messages delivered by different TV stations. Some TV people are excellent and some should be avoided at all cost. It would be great if the university's public information people were a source of advice.
72. There should be more reporters trained in science reporting.
73. I feel that the media absolutely destruct everything they get their hands on. What is needed are actually trained reporters, but such experts would probably be too expensive for the media to support.
74. The impact of small parcels of scientific information is not important. If synthesized, results should be reported to the public if they:
 - a. Are correct,
 - b. Have an impact on an appreciable number of people,
 - c. Can be translated for the non-reading lazy American.

I had a hard time thinking of the larger implications of my research since it involves plant cells and sand dollars.

75. The use of preliminary reports by the media and the exploitation by them of medical controversy should not be permitted. The harm done by the media to human life in wrong emphasis on the VA and NHLBI coronary artery surgery studies, the Humana artificial heart program, etc., is unsupportable and despicable. Medical and scientific advances must not be used for news purposes, and for selling of newspapers or TV watching. The science writers fail to seek balanced opinions, in general, and perhaps should be forced to do so.

VITA

Jeffrey W. McKenna was born in Chicago, Illinois, on June 27, 1953. He attended elementary schools in Louisville, Kentucky, and Indianapolis, Indiana, and was graduated from Cathedral High School in Indianapolis in May 1971. The following September he entered Purdue University, and in May 1975 he received a Bachelor of Science degree in Environmental Science. In March 1976 he accepted a position in the Technical Publications Department at Oak Ridge National Laboratory, Oak Ridge, Tennessee. He left in September 1978 to accept a Hilton A. Smith Graduate Fellowship at The University of Tennessee and began full-time study toward a Master's degree in Communications.

Before completing his thesis, Mr. McKenna in June 1979 accepted a position as a science writer at CDP Associates, Inc., a health care consulting firm in Rockville, Maryland. He re-entered The Graduate School of The University of Tennessee, Knoxville, as an out-of-state student in September 1984. He received the Master of Science degree with a major in Communications in December 1985.

The author is a member of Kappa Tau Alpha and the Society of Professional Journalists, Sigma Delta Chi. He will continue his employment at CDP Associates after graduation.