

**THROUGH THE LOOKING-GLASS:
HOW SCIENTISTS VIEW JOURNALISTS AND SCIENCE NEWS**

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The undersigned, appointed by the dean of the Graduate School, have examined the thesis entitled

THROUGH THE LOOKING-GLASS:
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and hereby certify that, in their opinion, it is worthy of acceptance.

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Acknowledgments & Dedication

From start to finish, this thesis has been a long, arduous journey. I've never faced more hardship in completing a task, but I've also never felt such reward from doing so. I could not have crossed the finish line in ~~2018~~ ~~2019~~ ~~2020~~ ~~2021~~ 2022 without the enduring support from my committee chair: Sara Shipley Hiles. She acted as a guidepost and mentor throughout my time on campus and continued to do so when I left Mizzou and began my career. She's weathered every storm with me over the course of four years, and I don't know how I could possibly thank her enough for believing in me, especially when I didn't believe in myself.

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Abstract

This research aims to better understand the relationship between scientists and journalists from a scientist's point of view, how scientists view science news, and how this view has changed or stayed the same over twenty years. Surveys were sent to scientists to ask their opinions about the role of the media and journalism, their opinions concerning scientist-journalist interactions, and their opinions about the role of scientists. The participants responded with "agree," "disagree," or "I don't know," and were prompted to offer written, long-form explanations as to why they chose their answer. Scientists largely agreed that journalists play an important role in disseminating science news, emphasizing the importance of staying informed and reporting in a matter-of-fact way. This group, all of whom were quoted in *The New York Times*, trusted journalists and outlets on a case-by-case basis. Lastly, scientists feel that, while it is important to do so, they may not always be the most equipped to discuss their own research with the public. This research allowed an untarnished view through the looking-glass and into scientists' thoughts on the role journalists play in disseminating science news. Although surveyed scientists weigh the pros and cons of journalists' science reporting, there are commonalities on which they all agree: It is critical for both journalists and scientists to accurately and effectively report on research in order to enhance the public understanding of science.

CHAPTER ONE

Introduction

Science Literacy and the Media

To the majority of Americans, science is a foreign country (Lief, 2015, 2). Yet science is an integral part of society, and surveys continue to show that the public turns to the mass media for science information (Ashwell, 2016, 379). For journalists to inform the public, they must first turn to scientists for information and deeper understanding.

News articles headlined “A New Study Finds” may imply that the information is undeniably true, but they often overlook a level of uncertainty that comes with every scientific study. Peters and Dunwoody (2016) state that uncertainty is central to science, making both journalistic representations and their impacts on audiences critical to understanding the science journalism process (p. 893). Probabilistic uncertainty—defined as uncertainty about the occurrence of specific events whose statistical distribution is known—“is neglected in the journalistic coverage of risk, creating a sense of certainty that the risk will actually cause damage, producing a tendency to overestimate low-probability/high-consequence risks that get the media attention” (p. 895). This understanding of uncertainty ties into critical science literacy that both journalists and citizens should possess.

Dunwoody (2014) says citizens now have few places to turn for independent, evidence-based information. “In a world where both citizens and advertisers increasingly control their own delivery of information via online channels, the kind of legacy mass media that have long served as the principal employers of science journalists—newspapers and magazines—are faltering in many countries (27).”

While there are avenues to find science research or science news, one must possess a general critical science literacy. Priest (2013) tackles science literacy, outlining a level of science knowledge that is part of everyday culture: Information that citizens and journalists should just know about science (p. 138). “Knowing ‘how science works’ as a set of social practices and a social institution is a skill that both scientists and citizens already possess” (Priest, 2013, 139). What science journalists write using these practices has the potential to nurture the further growth of critical science literacy among their audience. This is important, Priest (2013) suggests, because it includes success in terms of making wise personal choices and supporting wise social policies (p. 140). Priest (2013) argues that everyone needs this basic level of scientific understanding to make informed decisions on policy and other science-related topics. “The concept of critical science literacy can be fruitfully applied to the practice of science journalism as a way to characterize the skills needed by journalists to recognize scientific legitimacy and appropriately represent scientific claim” (Priest, 2013, 141). Journalism that reflects this literacy may also help promote such literacy in its audience. In order to pursue such a reflection, journalists must first interact with their sources: scientists.

Interaction between journalists and scientists is often referred to as a journalist-source relationship. Theorists have described the relationship between journalists and their sources variously as a tango, a relationship of trading, a mutual dependency, or a bargaining game (Hartley, 2015, 212). Navigating a mutual dependency is difficult because of longstanding differences between scientists and journalists. Both parties agree that science reporting and writing would benefit from more emphasis on accuracy, accessibility, and attention to audiences, but the agreement is nuanced and fraught with tensions and contradictions (216). Even so, journalists and scientists are like strangers to each other; unable to understand each other’s

languages and driven by differing agendas. Additionally, scientists have negative perceptions of general media coverage of science and technology (Markl, 2994; Cicerone, 2006).

Tandoc (2013) argues that science journalists serve as disseminators of complex scientific information (p. 2). Journalists have traditionally been the gatekeepers of scientific information, charged with surveilling and disseminating science news in ways that are accessible, instructive, and interesting (Dudo, 2015, 762). “Both occupations have needed each other; scientists have depended on journalists to communicate their research innovations and potential implications beyond the walls of the laboratory, and journalists have relied on scientists to cooperate with them so that they can craft news about science that is accurate and compelling” (p. 762). The relationship between scientists and journalists, however, is anything but straightforward.

These negative perceptions are commonly attributed to the different norms and values underlying both professions. Dudo (2015) says that scientists see news as a product of long-term, labored, vetted research, while journalists see news as current, dramatic, and entertaining. In terms of sources, some journalists desire celebrity science sources who talk beyond their field of expertise, while scientists tend to dislike these types of sources (p. 762).

Through the Looking-Glass

The title of this thesis stems from the disconnect between science and the people to which it is disseminated. The metaphorical expression—“through the looking-glass”—is similar to the twilight zone, where nothing is quite what it seems. In Lewis Carroll’s *Through the Looking-Glass, and What Alice Found There* book, it can mean “...a poor sort of memory that only works backwards.” For a scientist, whose goals typically consist of research and dissemination of said

research, reading science news through the lens of a journalist may feel akin to peering into Alice's wonderland. On the other hand, science can seem just as fantastical to those who do not know much of it.

Because of this disconnect, or looking-glass effect, the interpretation of science information may become unclear, skewed, or challenged without supporting evidence, especially in today's relentless information saturation. For example, over the last 150 years, climate scientists have repeatedly confirmed that greenhouse gas emissions—which science contributes to climate change—are human-caused (Lewandowsky et al., 2018, 175). Despite strong evidence, a small but vocal group of voices—primarily outside the scientific community—deny that evidence. Those who do not “believe” in climate change almost never provide peer-reviewed research to back such claims, and when they do, the research does not typically withstand scrutiny (p. 176).

Parents against vaccines and anti-GMO groups are two more examples of public denial of science research. Since GMO technology emerged in the 1970s, news coverage was and continues to be damaging (Erjavec, 2011, 75). Despite a shift when most biotechnologists changed their negative attitudes—or strengthened their positive attitudes—toward GMO technology, the views of consumers and mainstream media remained primarily negative (Shanahan, 2001, 267). Over time, the negative attitude among the public has only grown, concurrent with the point at which genetic engineering began to receive more media attention (p. 269). Gunter et al. (1999) found that scientists determined journalists' portrayal of GMOs was overly dramatic and sensational, with the majority of responders claiming there was too much emphasis on risk and the writing was too speculative (p. 382).

One U.S.-based survey conducted in the late 1990s showed that only 11 percent of scientists interviewed had a great deal of confidence in the press, 22 percent had hardly any confidence in journalists, and 90 percent thought few reporters understand the nature of science (Dudo, 2015, 762). Surveys based in the U.K. revealed similar findings, including results that showed only 10 percent of scientists respondents believed that media coverage of science helps to improve the public's understanding of science (p. 762).

National surveys have shown that large portions of Americans believe that scientific findings are hard to understand, and they have limited awareness of and knowledge about specific scientific questions (Dudo, 2015, 746). Scientists alone are rarely equipped to discuss their research in common terms, and the public is similarly ill-equipped to digest scientific jargon from specific disciplines. As aforementioned, a disconnect between scientists and the public rears its head time and time again. With scientists on one side of the looking-glass and journalists on the other, how do scientists view journalists and science news?

Purpose of Study

Scientific information is provided by scientists, translated by journalists, and consumed by the public. Confusion surrounding scientific claims—including misrepresentations and their apparent consequences in terms of public perception and misperception—is regularly blamed on journalists (Priest, 2013, 141). Hartz and Chappell (1997) say that the distance between science and journalism threatens America's future. However, both scientists and journalists are needed promote science literacy among the broader public and share findings and implications of scientific discoveries. More than 90 percent of the biomedical researchers surveyed in a five-

country study considered “a better educated general public” a very important motivation in agreeing to contacts with the media (Peters et al., 2008, 204).

Dudo (2015) argues that the science-media relationship has changed rapidly within the last couple of decades. Leaders of the scientific community have urged their colleagues to take a more proactive approach to the public communication of their research (p. 766). Despite taking a proactive approach in disseminating their research to the public, how do scientists view the role of journalists? How do scientists expect journalists to aid in science communication?

This study analyzes responses from surveys administered to scientists cited in science journalism stories to explore the factors that may influence their understanding and trust of journalists. Additionally, this research will provide insight into communication barriers that stand between scientists and journalists, and how each plays an important role in creating credible science news.

CHAPTER TWO

Literature Review

Defining Science Journalism

Science reporting has appeared in the mass media for as long as these channels have existed (Dunwoody, 2014, 27). In the late nineteenth century, for example, several popular science magazines had already been established. The mass media’s interest in science has remained steady throughout the centuries (p. 28).

The relevance of science journalism today is underlined by evolution of special science sections, the steadily increasing amount of scientific content in the media, and the significant discussion of the science of science communication (Summ, 2016, 775). Scientific findings are

now more relevant for society than ever, considering the important, complex issues of the present age, such as climate change and energy (775).

Summ (2016) argues that one must understand how the term science journalism is used and which content can be identified as science journalism. Although it is relatively easy to pinpoint the science journalists, it is difficult to specify what constitutes science journalism. It could be all content that is placed in the science sections or it could be content that is explicitly written by science journalists (p. 776), but not all science journalism is written by specialists.

A journalist reports scientific developments to an audience beyond academic journals, namely, the public. In doing so, a journalist may provide analysis of research, conduct investigations into the reliability of researchers, and break stories of major significance to a wider audience (Murcott, & Williams, 2021, 152).

Components of Science News

The news media play a critical role in informing the public about scientific and technological developments. Ashwell (2016) states that communication advisors and scientists believe most media outlets report science poorly (p. 379). Ashwell argues that media reporting of science cannot be ignored, as some of the most important science debates of our times were conducted on the front pages and in the headlines of the mainstream news. Although there has been a push for scientists to make their research media-friendly, on average there has been a decline of science in the news; the 'decreasing capacity in science journalism outlined only serves to increase stresses on those science journalists remaining' (p. 381). This deterioration may result in untrained journalists becoming reliant on material from government agencies and research institutes, thus leading to an erosion of journalistic independence (p. 390).

Specific journalistic practices and media structures are often overlooked by researchers studying science communication (Nisbet, & Fahy, 2015, 223). Nisbet and Fahy (2015) suggest that political reporters, columnists, editorialists, or op-ed writers increasingly write about science-related debates. “Political reporters and commentators tend to focus not on the more thematic substance of the issue at hand, but rather on the strategies and tactics employed by competing elected officials and interest groups, and how these strategies might play out politically” (p. 225). Such a focus undercuts the scientific facts at play and frames the story as a political one. In the case of climate change, for example, the public is hearing news about how political figures feel about climate change and the policies they plan to enact. The framing pits people against one another politically on the issue of climate change, rather than uniting the public in an understanding of what climate change is, what it does, and how it may or may not be of interest to humanity regardless of how a political party views it.

Point of View: Journalists

Dunwoody (2014) says science journalism is an increasingly imperiled occupation that is needed now more than ever (p. 27). William Laurence, a 1930s *New York Times* journalist, described science writers as the “true descendants of Prometheus who take the fire from the scientific Olympus, the laboratories and the universities, and bring it down to the people.” His depiction paints science journalists as almost mythical, in that conversing with scientists and translating their jargon is an enormous task.

While science journalism certainly is not a mythical act, the specialty exists to provide the public scientific insight that is easy to understand. Vestergaard and Nielsen (2016) reported that a survey among science journalists worldwide showed that science journalism is declining in

the U.S. (p. 662). Today's successful science writers often work from home, maintaining a popular blog, tweeting about science news, or writing freelance articles (p. 36). Freelancers fill in for the dwindling number of science journalists in newsrooms.

From 2007 to 2010, science and technology accounted for only 1.5 percent of all news stories, with the same percentage for environmental news. Both percentages dropped in 2011 (p. 2).

There were 58,000 reporters, correspondents, and broadcast news analysts in the U.S. in 2015, with only an approximated 5,000 of those to be science and environmental reporters, according to the Bureau of Labor Statistics. The number of reporters, correspondents, and broadcast news analysts in the U.S. dropped to 52,000 in 2019, with a projected 11 percent decrease over the next ten years.

Research conducted by Appiah et al. (2015) studied journalists in Ghana, where most science reporting is done by general reporters. They found that most respondents indicated that science journalism training would motivate them to report on science more (p. 23). General reporters who report on science news are faced with both individual and systemic challenges. Individual challenges include personal abilities, skills, and qualifications in science knowledge while systemic challenges include how newsrooms gather and edit science stories (p. 24).

Journalists are expected to follow a certain format when reporting and are pressured by meeting deadlines, finding reliable sources, remaining within budget, combatting staff cuts, and increasing commercialization (Secko et al., 2021, 62). Furthermore, as journalism increasingly moves toward the internet, science journalists are expected to be multi-skilled with numerous digital platforms (p. 63). Additionally, science journalism is consistently reproached by critics' claims of under-researched or unclear science reporting. Secko et al. (2012) suggest may be due to:

1. The lack of clear articulation of the role of science journalists in democracy;
2. a lack of agreement on what constitutes improved public understanding of science;
3. the divide between idealistic visions of what science journalism can offer and the practical limitations faced by professional journalists; and
4. insufficiently defined and theoretically informed guidelines, news standards, and fundamental norms for creating science journalism.

“It is apparent science journalism has yet to receive a clear, highly supported theoretical articulation in the literature that linked theory to practice” (p. 63). In the critiques provided by Secko et al. (2012), science journalists were accused of inaccuracy, sensationalism, oversimplification, and failing to engage the audience in a meaningful debate about scientific issues (p. 75).

Point of View: Scientists

Scientists have often been critical of journalists, perceiving their work as being oversimplified, inaccurate, highly sensational, or alarmist (Dudo, 2015, 762). Scientists prefer to communicate with caveats, context, and qualifiers, while journalists (and the public) want their communications to be simple and clear (p. 762).

Scientists’ view of journalists is predominantly critical, which led the scientific community to seek more influence on the process and product of science journalism. Dudo (2015) states that the scientific community realized that taking a more active role in the dissemination of scientific information to the public could ultimately function as self-preservation for the scientific endeavor itself (p. 763). This is evident in what are now some commonplace tactics through which scientific institutions exert some control of media coverage.

The relationship between scientists and the media has been characterized by metaphors and terms such as ‘distance,’ ‘gap,’ ‘barrier,’ ‘fence,’ ‘oil and water,’ and ‘creative tension.’

“Among factors impeding communication, scientists and journalists were like strangers to each other, not able to understand each other’s language, and driven by different agendas” (Peters, 2013).

The distrust of journalists by the science community is more pronounced than that of the clergy, corporate leaders, the military, or politicians (Brockway, Science Magazine, 2002). The general media, which is approximately 90 percent of journalists, almost never meet scientists or write about science (Lief, 2015, 2).

Brockway (2002) suggested that scientists can foster better relationships with the public and journalists by learning to translate science into understandable language. Additionally, Brockway states that scientists can help journalists understand the scientific peer-review process to avoid overplay of preliminary work (2002). In contrast to the fast-paced field of journalism, science is incremental and slow. While research repeatedly shows that a gap resides between science and journalism, there is room for further exploration as to why.

Gunter (1999) and Further Study

Gunter et al. conducted an exploratory survey in 1999 to investigate the perceptions and opinions of two important “expert” groups: scientists and journalists. This research showed that both groups agreed that the media have an important role to play in informing the public about biotechnology.

Gunter (1999) found that scientists were more likely than journalists to perceive coverage as too sensational and dramatic, too speculative, with too much emphasis on risks. Scientists did

not exhibit much trust in journalists. Both groups agreed that journalists need to ensure they are technically prepared when reporting on complex science issues. Both groups also agreed that scientists needed more media training and support from their own professional culture to facilitate more effective relations with the media and with the public (p. 1).

This research provides a good basis for further study because scientists and journalists would seem to still have a tumultuous relationship two decades later. Why? Gunter et al. offered an initial quantitative survey, and this study takes a deeper look into *why* scientists responded in a given way.

Research Questions

RQ #1: What are scientists' opinions about the role of the media and journalism, including journalist-scientist interactions and the role of scientists in relation to science news?

RQ#2: What themes exist within scientists' opinions on these topics?

RQ#3: How have scientists' opinions on these topics changed over 20 years?

CHAPTER THREE

Methodology

The goal of this research was to follow up on a study by Gunter et al. in 1999. According to the study that occurred more than 20 years ago, scientists and journalists were regarded as key players in the communication of information about scientific developments to the lay population (Gunter et al., 1999, 373). Gunter et al. (1999) found that scientists did not exhibit much trust in journalists and probably needed more media training and support from their own professional culture to facilitate more effective relations with media professionals and the public (p. 373).

This study was conducted to check in on today's scientists and see how and if their opinions have changed, and specifically, why they feel the way that they do.

The Gunter et al. survey was quantitative, surveyed both journalists and scientists, and covered many concepts. For this study, three of Gunter et al.'s six concepts that were chosen to replicate:

- Opinions about the role of journalists and the media
- Opinions about scientist-journalist interactions
- Opinions about the role of scientists

The three that were discarded referred specifically to biotechnology and did not apply to this research. The three that were chosen for survey focused on the relationship between scientists and journalists, which is the topic that is still very relevant today but focuses solely on the perceptions of scientists (i.e., this study did not survey journalists).

This research uses several of the same section titles and questions as the 1999 survey (Appendix B). Participants were asked to provide a quantitative answer, but they were also asked to explain their response to provide further insight through qualitative analysis into scientists' perceptions about the relationships between scientists and journalists.

Per Google Scholar, Gunter et al.'s 1999 paper has been cited 100 times since its publication. Building off the quantitative 1999 study, this paper sought to re-evaluate scientists' feelings 20-plus years later and gain a deeper understanding via qualitative analysis of their responses. Using several of the same questions from the 1999 survey, participants in the current study could elaborate on their opinions in-depth to provide a more detailed explanation of their perceptions about the relationship between and roles of scientists and journalists.

Sample Selection

Scientists who had interacted with journalists or whose work had been covered in media were chosen for this study in order to ensure journalist-scientist interactions. This section explains the reason for the sample selection.

The surveyed scientists were required to 1) be a scientist, 2) be quoted as an expert in *The New York Times*' science section (*NYT Science*), 3) have contact information readily available for the purpose of administering a survey, and 4) be quoted in an article between 2017 and 2018. This study selected *The New York Times*—a newspaper of record in the U.S. and around the world—to identify scientists who interacted with journalists. Scientists who were cited and interviewed as expert sources in science stories published in *NYT Science* were used as the sample in this study.

The New York Times, originally titled The New York Herald, was founded in 1835. By 1841, it received the name *New York Tribune*, and on September 19, 1851, the *New-York Daily Times* published its first issue. It was distributed every day, Sunday excluded, according to Britannica. In 1861, the paper began publishing illustrations. In 1865, the front page news alerted the world of Lincoln's assassination. In 1876, *The New York Times* received its first telephone number following Alexander Graham Bell's invention. In 1882, the newspaper gained electricity. *The New York Times* received its first Pulitzer Prize in 1918, and the crossword was introduced in 1950. In 1976, *The New York Times* first published the *NYT Science* section. While *The New York Times*' expansive history has not made it the largest-circulation newspaper in history, it has made it one of the world's greatest newspapers, according to Britannica. Clark & Illman state that the *NYT Science* is an important and influential entity in science journalism (2006). *NYT*

Science grew from 1.7 pages per issue on average in 1980 to 5.4 pages per issue in 2000 (Clark & Illman), displaying the significant growth in the 20 years since its first publication.

Survey Overview

Surveys involve a collection of information about opinions or attitudes via a questionnaire. In addition to efficiency, survey-based research maintains popularity because of its versatility and generalizability. A well-designed survey can substantially enhance the understanding of almost any issue (Stevanov, 2016, 106).

This research uses some of the survey questions laid out in a 1999 study by Gunter et al. I focused on the inquiries presented that study (Appendix B). These sections include opinions about the role of the media and journalism, opinions concerning journalist-scientist interactions, and opinions about the role of scientists. Gunter et al. studied both journalists and scientists, but this study will focus solely on scientists.

Gunter et al.'s (1999) quantitative study asked 25 questions. Because the nature of this research is qualitative, the number of questions was reduced to 12, allowing me to also pose open-ended questions that would elicit further explanation of answers to preceding closed-ended (quantitative) questions. The survey questions are reflected in Appendix B. Data from the 1999 study (Appendix C) was analyzed in comparison to the findings of this survey.

To collect data, online surveys (that took approximately 30 minutes to complete) were administered to scientists featured as subject matter experts in *NYT Science*. The survey—distributed using Google Forms and MailChimp—prompted both multiple choice and open-ended questions. This method collected both qualitative (open-ended) and quantitative (close-

ended) responses. The quantitative data is summarized below and the open-ended questions were analyzed qualitatively to examine common themes.

Research Design: Data Sampling

To qualify for participation in this survey, a science source 1) must have been directly quoted in a story or have as study they authored quoted in a story, 2) must have been in an article published online in *NYT Science* between June 2017 and June 2018, and 3) must have identified as a scientist. The timeframe was chosen based on the completion of the thesis proposal and narrowed down to a year for the sake of specificity.

To determine if a scientist was viable for surveying, he or she had to be quoted in a *NYT Science* article. Additionally, the scientist's contact information had to be linked to the article to ensure the correct person could be contacted for the study. A hyperlinked profile led me to a personal webpage or scientific study. If a scientist's contact information was not attainable by this two-step process, he or she was not considered for the study.

Using published articles in *NYT Science*, I employed a multi-step process to compile a list of scientists, who were then invited to participate in the study. Potential participants (scientists) were selected by searching articles published in *NYT Science* within a one-year timespan, June 2017 through June 2018, and identifying scientists who were cited in the article as subject matter experts. This timeframe was chosen because it was the most recent data set obtainable at the inception of this research. *The New York Times'* search bar enabled the ability to input the desired date range (June 2017 through June 2018) and keywords ("new study" and "science"). A preliminary search returned over 2,000 results. However, this initial number was misleading because very few of those results included a quoted source, and even fewer returned contact

information. Contact information was obtained by clicking the hyperlinked scientist, which would redirect to a homepage, school page, or other identifying webpage. This would typically contain contact information for the quoted scientist. If a scientist was not hyperlinked, but their study was, the article would redirect to their published study. Contact information was available for the quoted scientist if 1) they were an author or co-author on the study and 2) it was provided beneath their short biography beneath the heading of the article. If information was not obtainable directly through hyperlinks embedded within an article, no further research was conducted to locate it.

Out of 2,000 results, 73 fit the aforementioned requirements for participation. Many scientists were not included in the sample because their contact information could not be located. The 73 scientists who fit the criteria were emailed individually (Appendix F) and asked to participate in this survey. Of the 73 that received an email, 21 responded, resulting in a 29 percent response rate.

The scientists were asked to participate in the online survey (hosted on Google Forms), which was linked within the body of the email. The study was approved by the University of Missouri's Institutional Review Board (IRB) and informed consent was obtained from participants (Appendix A) before they began the survey.

Survey Design

The survey collected background information that included how surveyed participants consume and evaluate science news and their work experience, followed by three sections that prompted respondents to offer a yes or no answer and a written response. Lastly, the survey collected demographic information.

The first section of the survey, *Consuming Science News*, asked the following questions:

- *How often do you consume news on science topics (such as environmental issues, new research, or other stories that focus primarily on science)?*
 - Scale 1 to 5, Never to Every Day
- *How do you find science news?*
 - Search for it
 - Return to trusted outlet
 - Shows up in social media
 - Other
- *How do you consume science news? Check all that apply.*
 - Television (i.e. NBC, Fox, PBS, CNN)
 - General Interest Newspaper (i.e. The New York Times, The Washington Post, local paper)
 - General Interest Magazine (i.e. TIME, Newsweek, local magazine)
 - General Interest Online-only sources (i.e. Seattle post-Intelligencer, BuzzFeed, Huffington Post)
 - Social Media (i.e. Facebook newsfeed, Twitter, Instagram)
 - Science-Focused Publication (i.e. Scientific American, Science Magazine, Eos)
 - Academic Journals
 - Other
- *What outlets do you trust for science news?*
- *What makes a science story worth covering?*

The second section, titled ***Background***, asked the following questions:

- *How many years have you worked as a scientist, and in what field?*
- *Have you been used as a source in a news story (newspaper article, broadcast report, live interview, etc.)?*
 - Yes
 - No
- *If yes, how many times have you acted as a source for science news? Use numerals.*
- *What educational degree(s) have you completed? Please specify the degree and the field (i.e. Master's degree in geology, Ph.D in physics).*

The next three sections asked for “yes,” “no,” or “I don’t know” responses. Following that quantitative answer, participants were prompted to provide a written explanation for each question. The sections and related questions are listed below.

Opinions About the Role of the Media and Journalism

- *Journalists should assume a duty of care toward the public.*
- *Journalists should report on risks in a sober and matter-of-fact way.*
- *Journalists should avoid an emotional style in reporting on risks associated with science.*
- *Journalists should criticize scientists whose work may cause risks to the public.*

Opinions Concerning Journalist-Scientist Interactions

- *It is a journalists' task to translate science jargon into everyday language.*
- *Scientists should restrict themselves to statements about their field.*
- *Journalists should not accept the word of scientists at face value.*
- *Journalists should allow scientists they have interviewed to check copy before publication.*

Opinions About the Role of Scientists

- *Scientists have an important role in enhancing public understanding of science.*
- *Scientists need to be better trained in dealing with the media.*
- *Most scientists distrust journalists in reporting about scientific issues.*
- *Few scientists seem able to talk about science in everyday language.*

Lastly, the ***Closing Remarks*** section collected demographic information and any outstanding discussion:

- *What is your gender?*
- *What is your age?*
- *Please describe your race/ethnicity.*
- *In what country do you currently reside?*
- *Is there anything else you'd like to share about any aspect of your professional role or use of science news?*

These sections collected information about how participants view journalists, themselves, and their relationship with the media.

Google Forms automatically compiled all responses from participants, which was qualitatively coded and analyzed.

Research Design: Qualitative Coding Procedures

Saldaña (2016) states that the majority of qualitative researchers will code their data both during and after collection as an analytic tactic, as coding is analysis (p. 8). “I advocate that qualitative codes are essence-capturing and essential elements of the research story that, when clustered together according to similarity and regularity (i.e. a pattern), actively facilitate the development of categories and thus analysis of their connections,” (Saldaña, 2016, p. 9).

The raw data was recorded in a table (Appendix E) and repeatedly analyzed to establish codes, categories, and overarching themes. Each answer was read multiple times in search of repeating comments and themes. As laid out in Appendix E, the participants’ responses were picked through and recurring comments were highlighted. Each prompt that garnered written responses received its own dedicated table to sift through the data. The resulting tables within each section (*Opinions About the Role of the Media and Journalism, Opinions Concerning Journalist-Scientist Interactions, and Opinions About the Role of Scientists*) were combined and analyzed. This method of analysis helps confirm the “five Rs:” routines, rituals, rules, roles, and relationships (Saldaña, 2016, 5). Discerning these trends is a way to solidify observations into concrete instances of meaning (p. 6).

Analysis

I analyzed collected data using qualitative coding. Qualitative codes are essence-capturing and essential elements of the research story that, when clustered together according to similarity and regularity, actively facilitate the development of categories and thus analysis of

their connections. To codify is to arrange things in a systematic order, to make data part of a system or classification to categorize (Saldaña, 2016, 9).

In qualitative data analysis, a code is a researcher-generated construct that symbolizes or “translates” data (Vogt et. al, 2014, p. 13). As a qualitative researcher, Stenner (2013) states, we seek patterns as somewhat stable indicators of humans’ ways of living and working to render the world more comprehensible, predictable, and retractable (p. 143).

What are scientists’ opinions about the role of the media and journalism, including scientist-journalist interactions and the role of scientists in relation to science news? Each section included quantitative questions that allowed an initial overview of opinions. In addition, qualitative questions elicited a more in-depth understanding of the participants’ opinions regarding the role of the media and journalism, journalist-scientist interactions, and the role of scientists.

This research surveyed scientists quoted in *NYT Science* from June 2017 to June 2018 in order to examine their perception of journalists and science news as portrayed by journalists.

CHAPTER FOUR

Findings

Demographics and Background

Of the 21 participants, experience ranges from 9 to 60 years in their respective fields, with a mean of 32 years of experience. The fields in which participants practice include biology, chemistry, genomics, ecology, paleontology, genetics, psychology, and environmental science. In addition to their experience, 90.4 percent of participants have a Ph.D., while the remaining participants have a master’s degree. Participants ranged from ages 30 to 80 or older, were 90.4 percent male, and 76.2 percent currently reside in the U.S.

Consuming Science News

When searching for and finding science news, 76.2 percent of participants responded that they search for news on science topics every day. In order to access science news, 81 percent of participants responded that they return to a trusted outlet, 38.1 percent responded that they actively search for it, while 47.6 percent of participants responded that science news appears in their social media feed. Less than 5 percent of participants responded with a fill-in answer, stating the following methods in which they find science news: Google scholar alert, scientific journals, email notifications, auto-functions on research topics, and news alerts.

The top methods participants, in order from greatest to least, reported for consuming science news were academic journals (85.7 percent), science-focused publications (76.2 percent), general interest newspaper (57.1 percent), general interest online-only sources (42.9 percent), social media (42.9 percent), television (23.8 percent), general interest magazine (19 percent), and “Other” sources that participants could type in the open-ended field included blogs, books, and emailed newsletters. Participants overwhelmingly trust academic journals as their main source of science news.

When responding to the question “what makes a science story worth covering in the news,” common themes included information that was new, exciting, potentially popular, and of scientific significance.

RQ #1: What are scientists' opinions about the role of the media and journalism, including journalist-scientist interactions and the role of scientists in relation to science news?

Opinions About the Role of the Media and Journalism

One hundred percent of participants agreed that journalists should assume a duty of care toward the public (Q1) in the yes or no response. In the open-ended answers to these questions, coding determined that respondents find that journalists maintain a duty to:

- combat misinformation;
- ensure trustworthiness and factual reporting;
- avoid errors; and
- provide science news to the public.

According to participants, journalists' duty as outlined by the aforementioned themes include "avoid giving credence to dubious results" because "misinformation is catastrophic to social integrity and behavior.," according to two participants. Respondents said that "it is journalists and not scientists [the public] will turn to in order to understand the significance and consequences of scientific discoveries" because "people do not read academic papers." As such, journalists should "be using their resources to fact-check the statements or claims and report the issues of controversy" in order to "filter out fake news."

One hundred percent of participants agreed that journalists should report on risks in a sober and matter-of-fact way (Q2) in the yes or no response. Upon analysis, a common concern was about news stories that elicit a strong emotional response from the public. It appears that participants are wary about doomsday- or panic-inducing articles and sensationalism when it comes to reporting on scientific risks. Participants cited that these issues impair trustworthiness

in any given story, reporter, or outlet. Respondents believe that “reporting risks should be as dispassionate and factually complete as possible,” and “someone needs to give [the public] information in a calm way to avoid the modern tendency to hype up everything.” One respondent claimed that “apocalyptic or handwringing reportage is usually dishonest,” which was reflected by another’s response that “sensationalizing science leads to faulty conclusions.” Participants described that a trustworthy article or outlet is one that does not sensationalize risks in order to elicit a strong emotional response from readers.

The next question in this section—journalists should avoid an emotional style in reporting on risks associated with science (Q3)—returned mixed results. Nineteen percent of respondents disagreed, 61.9 percent agreed, and 19 percent did not know. The majority of participants believe that journalists should avoid an emotional style of reporting on risks associated with science. As demonstrated in the previous question (Q2), all participants agree that journalists should report on risks in a sober, matter-of-fact way. However, when asked if journalists should avoid an emotional style altogether, 40 percent either disagree or are unsure. Many participants said that the inclusion of any emotional style or tone is dependent on the story. In some cases, participants said emotion can be a helpful tool in conveying a science story. For example, one respondent said, “so long as the emotional style doesn’t obscure the facts, it is helpful to convey the importance in a more meaningful fashion,” while another said that “certain types of reporting allow a bit more personalization and editorializing.” However, many others starkly believed that emotions should remain solely in opinion or editorial pieces and that journalists should maintain strict, matter-of-fact reporting:

- “[Emotional style] badly compromises the core purpose of journalism to write articles that are supposed to be descriptions of objective fact;”

- “[Journalists] should not use the emotion to try to bias the audience;”
- “People are playing my emotions rather than engaging my intellect.”

Almost half of respondents agree that journalists should criticize scientists whose work may cause risks to the public (Q4). While 47.6 percent of participants agree to criticism, 23.8 percent disagree, and 28.6 percent were unsure. Many said that journalists can and should criticize scientists whose work may cause risks to the public, with the caveat that the journalist is 1) in an educated position to do so and/or 2) the article is an opinion piece. In the case of the first point, one respondent said, “journalists can criticize scientists if they have evidence and contrary opinions from other scientists,” and in the case of the second point, another respondent said “journalists, who are so moved, can and hopefully will write opinion essays, viewpoints, and outlooks through which they can share their personal opinions with the world.” The remaining responses reflected the opinion that journalists should stick to facts as provided by sources: “Report both sides of the issue and let the reader come to their own conclusion.”

Opinions Concerning Journalist-Scientist Interactions

A large majority of participants (76.2 percent) agreed that it is journalists’ task to translate science jargon into everyday language (Q1). A small percentage (4.8 percent) is unsure, while 19 percent of respondents disagreed that “translation” is a journalist’s job. While the minority of responses resulted in statements including “it’s the scientist’s role” and “leave it to the scientist,” the majority said that it’s in a journalist’s job description:

- “[‘Translating’ jargon] serves the public, and incidentally is a sign that the journalists themselves have done their work properly;”
- “It is a journalist’s task to convey an idea and a story;”

- “Literally their job: Making the concepts understandable to the readership.”

In many cases, although the respondents said that it is a journalist’s job to “translate,” they believe that scientists should lend aid in the matter, stating that it’s “a basic skill for any scientist to help disseminate and apply their work.”

Almost half (47.6 percent) of participants did not agree that scientists should restrict themselves to statements about their field of expertise (Q2). A smaller percentage (38.1 percent) agreed, and 14.3 percent did not know. Respondents claimed that “a scientist is most credible within their field of expertise” and “outside one’s expertise—even a Nobel Prize winner—is a layman.” One participant disagreed because it may pose a risk that “the public will interpret a statement coming from a scientist as expert opinion.” The remaining consensus offered that deductions and comments outside of a given field is okay in the context of an opinion piece, especially if it stems from critical consideration.

A large majority (76.2 percent) agreed that journalists should not accept the word of scientists at face value (Q3). Meanwhile, just 14.3 percent disagreed, and 9.5 percent responded that they do not know. Almost every participant agreed that journalists should do their own research, or “homework,” despite mixed results (i.e., the 23.8 percent of participants who did not agree) in the initial tally. A second common theme was the idea that not all scientists are good scientists:

- “Scientists are people too, there are good ones and bad ones;”
- “There are many scientists that do poor-quality work;”
- “Scientists are people that are subjected to their own biases.”

Simply put: One shouldn’t take a scientist’s word at face value due to title alone.

A large majority – 85.7 percent – of respondents agreed that journalists should allow scientists they have interviewed to check copy before publication (Q4). Participants claimed that fact-checking is “a MUST and good journalistic practice,” that forgoing a fact-check “often results in the journalist publishing misrepresentations,” and that “scientists should be able to point out where there is error of fact or interpretation.” This theme highlighting the importance of fact-checking persisted in almost every response, while some combined said theme with the idea that a scientist should not change the story tone or style in completing a copy review. A common issue that respondents cited was a journalist’s deadline and the resulting time crunch, which either severely decreases the time a scientist has to review copy or removes the option altogether.

Opinions About the Role of Scientists

One hundred percent of respondents agree that scientists have an important role in enhancing public understanding of science (Q1). Many responses highlighted the theme that enhancing the public’s understanding of science is not only an important role, but the duty of a scientist:

- “Part of our job. We are not merely technicians, but knowledge creators;”
- “Should scientists take time away from writing papers for scientific journals, or writing grants, or supervising students to enhance public understanding of science? The answer is yes, of course;”
- “It is the job of scientists to reach out for better public understanding of science;”
- “As the discoverers of knowledge (often at the public’s expense), we have a duty to share and explain it;”

- “Scientists themselves are the best teller of their own stories;”
- “To neglect trying to communicate their work means its intrinsic value is questionable.”

Participants overwhelmingly agree that scientists must communicate their research to the public, and in doing so, enhance the public’s understanding.

While 66.7 percent of respondents agree the scientists need to be better trained in dealing with the media (Q2), 23.8 percent are unsure and 9.5 percent disagree. Almost every respondent claimed that some kind of training is needed for scientists to communicate with journalists, but “training” is relative. A scientist should “be trained and be interested in public outreach” because “many scientists need to be better trained in explaining their work to people outside their field.” One participant claimed that “basic training should be there, but it shouldn’t be expected,” and another mentioned it’s “a useful skill, but it’s kind of a personal problem for the scientists to handle as part of their overall lives.” A few participants said that training should be shouldered by the journalists. Although most respondents agree that training should be undertaken—whether by the scientist or journalist—a common issue that arose was the lack of availability of said training.

Almost half of respondents (47.6 percent) do not agree that most scientists distrust journalists in reporting about scientific issues (Q3). While a much smaller 14.3 percent agree with the statement, a large percentage of 38.1 percent do not know. In this case, the response “I don’t know” would appear to signify a broader theme of being on the fence or having an answer that is dependent on any given situation:

- “Yes and no. Most scientists I know distrust major media outlets... However, most of us trust science journalists to get the basic facts right;”
- “It depends on the journalist;”

- “I think it depends on the outlet. Most science-focused journalists are trusted, but larger news outlets like NBC or CNN are often not trusted;”
- “We all have positive and negative experiences with journalists;”
- “Depends on the area and the reporter.”

Many participants said that, even though they might expect mistakes in science reporting, “distrust” was too strong a word.

The idea that few scientists seem able to talk about science in everyday language (Q4) returned an almost-evenly-divided response: While 9.5 percent replied they did not know, 47.6 percent disagreed, and 42.9 percent agreed with this statement. Although this prompt garnered a start difference in replies, there were common themes throughout the qualitative responses:

- “There is a strong tendency to over-use jargon;”
- “There is, in my view, zero effort made to teach good English prose composition to scientists;”
- “Some concepts are not explainable in “everyday” language;”
- “[Scientists are] not trained in communications;”

Some replies cited a need for training, while others said that “many can, many can’t. Scientists are people and people vary.” Much like Q3, many said the ability to use everyday language is dependent on the scientist.

RQ#2: What themes exist within scientists’ opinions on these topics?

The participants’ qualitative responses to *Opinions About the Role of the Media and Journalism, Opinions Concerning Journalist-Scientist Interactions, and Opinions About the Role*

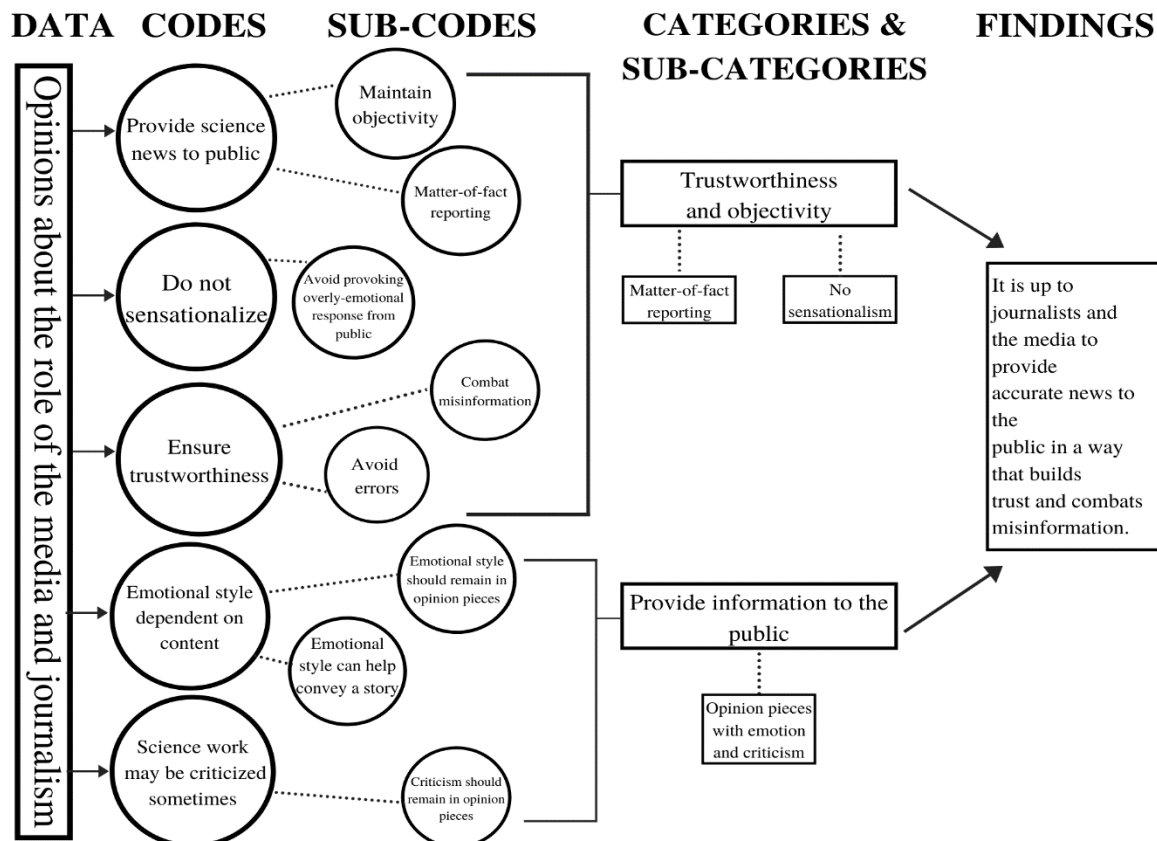
of Scientists were coded into categories and sub-categories in order to decipher the findings. In doing so, the common themes were revealed.

Figure 1: Opinions About the Role of the Media and Journalism

Findings: “It is up to journalists and the media to provide accurate news to the public in a way that builds trust and combats misinformation.”

After dissecting the raw, open-ended data as recorded in *Opinions About the Role of the Media and Journalism*, common codes were located and used to decipher common themes. The codes, sub-codes, categories, sub-categories, and theory are recorded in **Figure 1**. After many rounds of analysis via coding, the data showed the participants resoundingly agree that a journalist maintains a duty to tell the truth, refrain from sensationalism, remain trustworthy, and strive for

Figure 1: Coding analysis based on *Opinions About the Role of the Media and Journalism*



objectivity. Respondents said that journalists have a responsibility to provide accurate news to the public that builds trust and combats misinformation.

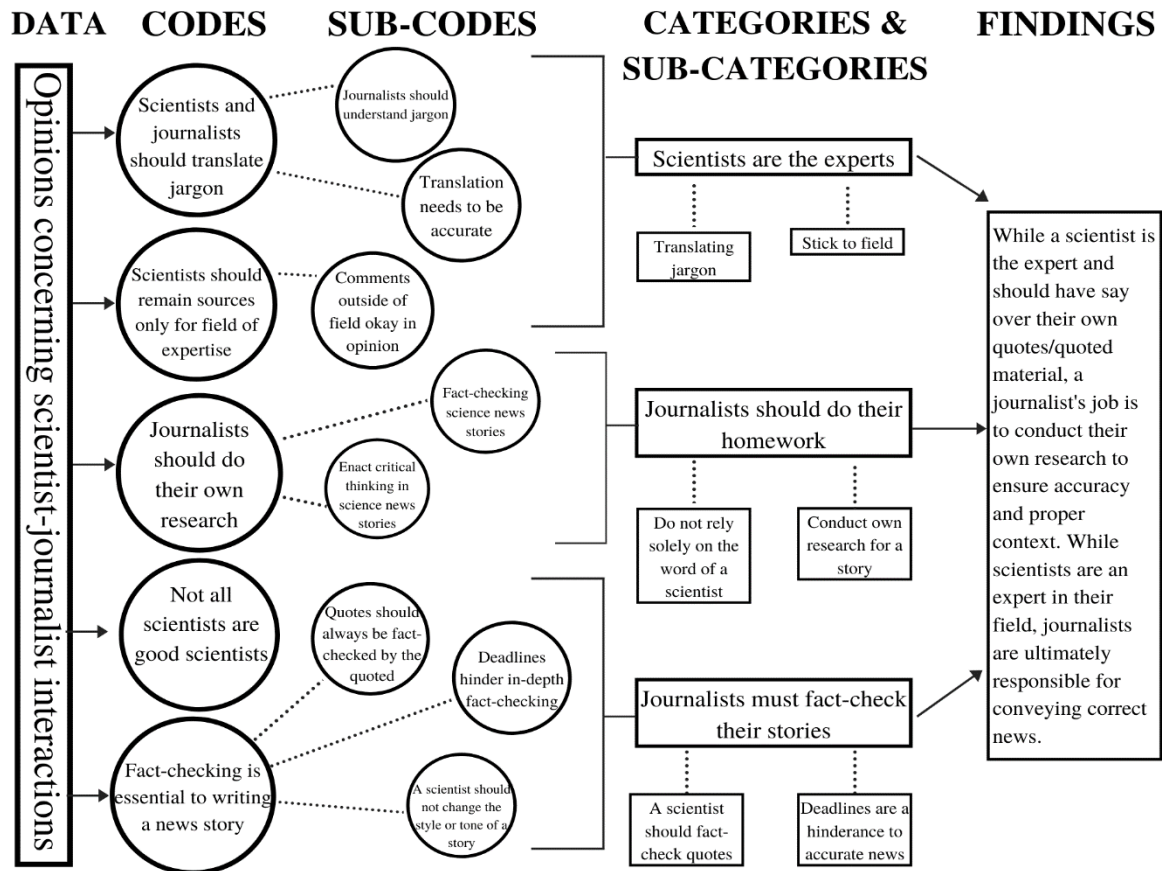
In response to *Opinions About the Role of the Media and Journalism*, scientists said they expect **trustworthiness and objectivity**, and for journalists to **provide information to the public**. Scientists stated that they prefer matter-of-fact reporting without any sensationalism. Journalists should maintain objectivity, avoid errors, combat misinformation, and avoid provoking an overly-emotional response from the public, results showed. However, emotional style may be helpful in conveying a story, as long as it remains in opinion pieces.

Figure 2: Opinions Concerning Scientist-Journalist Interactions

Findings: “While a scientist is the expert and should have say over their own quotes or quoted material, a journalist’s job is to conduct their own research to ensure accuracy and proper context, While scientists are an expert in their field, journalists are ultimately responsible for conveying correct news.”

In the survey section *Opinions Concerning Scientist-Journalist Interactions*, there are similar themes (**Figure 2**): It’s a journalist’s responsibility to conduct their own research to ensure accuracy and that fact-checking is essential in any news story. Participants responded that while scientists remain experts, journalists should conduct their own additional, background research and engage in critical thinking when disseminating science news. While a scientist should have editing power over their own quotes or quoted material, it is a journalist’s job to provide accurate reporting and proper context according to the participants. Additionally, respondents claimed that scientists are the experts in their field and should act as such in a news story, but journalists have ultimate control and responsibility over what is published.

Figure 2: Coding analysis based on *Opinions Concerning Scientist-Journalist Interactions*



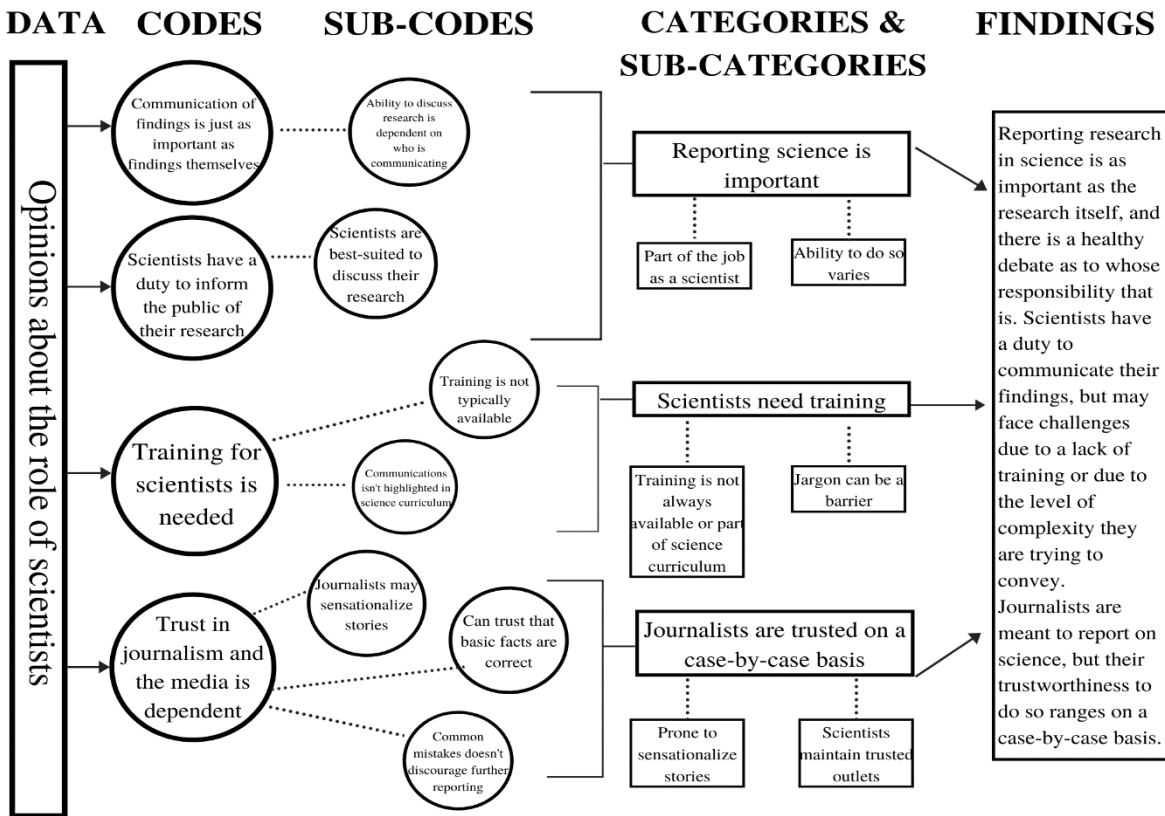
In response to *Opinions Concerning Scientist-Journalist Interactions*, participants responded that **scientists are the experts**, **journalists should do their homework**, and **journalists must fact-check their stories**. According to responses, scientists do have a responsibility to translate and “jargon,” or complex scientific terms, and to speak only on their expertise. That being said, a recurring theme was that journalists should understand jargon, conduct their own research on any given topic, and employ rigorous fact-checking. Scientists should be granted the opportunity to fact-check quotes and other relevant information within a story, but a journalist should know what is truly accurate despite looming deadlines that may cause a hindrance to the fact-checking process.

Figure 3: Opinions About the Role of Scientists

Findings: Reporting research in science is as important as the research itself, and there is a healthy debate as to whose responsibility that is. Scientists have a duty to communicate their findings, but may face challenges due to a lack of training or due to the level of complexity they are trying to convey. Journalists are meant to report on science, but their trustworthiness to do so ranges on a case-by-case basis.

When it comes to *Opinions About the Role of Scientists*, the results are much more varied and dependent on any given situation (**Figure 3**). Despite split in terms of agreement or disagreement with these prompts, there were many common themes throughout the qualitative responses. Participants said that reporting research in science is just as important as the research itself, but there are different opinions as to whose responsibility it is to conduct said reporting. While many

Figure 3: Coding analysis based on *Opinions About the Role of Scientists*



agree that reporting findings is part of one's duty as a scientist, others said insufficient training in science communications raises a barrier in doing so. Journalists are meant to report on science, but the trust a scientist places in a journalist to report varies on a case-by-case basis.

Participant responses to *Opinions About the Role of Scientists* showed that scientists believe their role is hindered in some ways. They generally said **reporting science is important**, but that **scientists need training** to make it consumable for the public. Despite a lack of training, **journalists are trusted on a case-by-case basis** due to a conception that journalists may sensationalize stories or get basic facts incorrect.

RQ#3: How have scientists' opinions on these topics changed over 20 years?

Agree to Disagree

Several of this study's questions replicated Gunter et al.'s 1999 study on the relationship between scientists and the media, allowing a comparison that spans twenty years. Due to the small sample size and difference in scope between these studies, I cannot definitively generalize the similarities and differences between all scientists' opinions over twenty years, but this gives a good first look into what has changed and what hasn't between 1999 and 2019.

When it comes to the *Opinions about the role of the media and journalism (Chart 1)*, the data shows that over twenty years, scientists still agree that journalists should assume a duty of care toward the public (Gunter et al.'s 97 percent v. Cawdrey's 100 percent) and that journalists should report on risks in a sober and matter-of-fact way (Gunter et al.'s 93 percent v. Cawdrey's 100 percent). The most variation in this question set was for question 4: Journalists should criticize scientists whose work may cause risks to the public. Only 47.6 percent of my study's

Opinions about the role of the media and journalism

Comparing the similarities and differences in scientists' opinions between 1999 and 2019

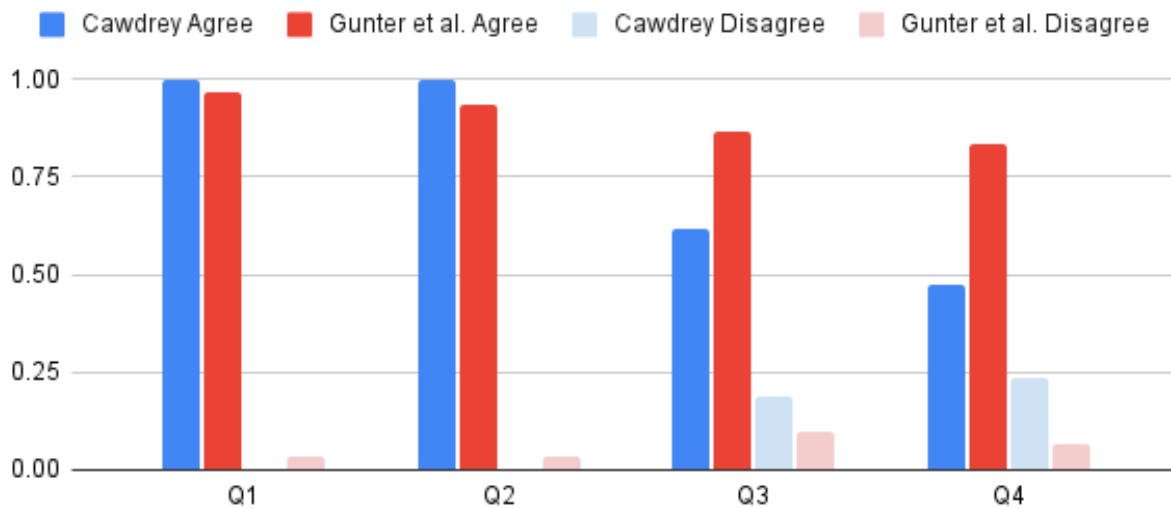


Chart 1: Cawdrey v. Gunter et al. findings

participants agreed with this statement, whereas an 83.3 percent majority of Gunter et al.'s study respondents agreed. In prompt four, "journalists should criticize scientists whose work may cause risks to the public," there is divergence between the 1999 study and this one. While 47.7 percent agreed with the statement in this study, a substantial 28.6 percent responded "I don't know." In Gunter et al.'s study, 83 percent agreed with this statement. In the qualitative responses, many scientists claimed that journalists "should absolutely criticize scientists whose work causes unnecessary or substantial risk," but only as long as "journalists can understand why there is a risk," according to two participants. Ultimately, the qualitative responses yielded the consensus that journalists may question scientists when they know well enough to do and/or confine such discussion to opinion pieces.

In the case of *Opinions concerning journalist-scientist interactions* (**Chart 2**), the data showed that while a scientist is the expert and should have say over their own quotes/quoted material, a journalist’s job is to conduct their own research to ensure accuracy and proper context. While scientists are an expert in their field, journalists are ultimately responsible for conveying correct news. The majority of scientists agreed that journalists should allow scientists they have interviewed to check copy before publication (85.6 percent v. Gunter et al.’s 93.3 percent), that journalists should not accept the word of scientists at face value (76.2 percent v. Gunter et al.’s 70 percent), and that it is the journalists’ task to translate science jargon into everyday language (76.2 percent v. Gunter et al.’s 80 percent). However, almost half of this study’s participants disagree that scientists should restrict themselves to statements about their field of expertise. While 73.3 percent of Gunter et al.’s participants agreed that scientists should restrict themselves, the majority of the surveyed scientists today think otherwise.

Opinions concerning journalist-scientist interactions

Comparing the similarities and differences in scientists' opinions between 1999 and 2019

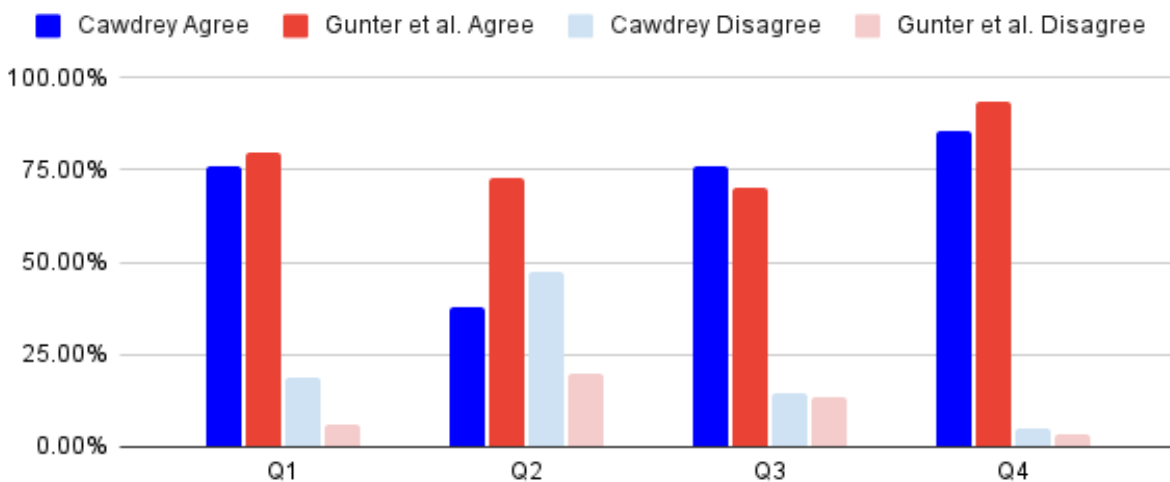


Chart 2: Cawdrey v. Gunter et al. findings

Lastly, in the findings as displayed in **Chart 3**, *Opinions about the role of scientists*, there is almost unanimous agreement in the following statement: It is a journalist’s task to translate science jargon into everyday language. In the second statement, “scientists should restrict themselves to statements about their field of expertise,” there is a slight difference in response. It is in the third prompt, “most scientists distrust journalists in reporting about scientific issues,” that there is a large divergence. In this study, 47.6 percent of respondents disagreed and only 14.3 agreed. This question yielded the most “I don’t know” responses at 38.1 percent. In Gunter et al.’s study, however, a large majority of 90 percent agreed. Respondents in my research appeared to trust journalists more now than those that participated in the 1999 study. However, many were unsure. The biggest critique as shown in the qualitative responses was the concern that “journalists tend to just parrot press releases and hype them up,” according to one respondent, and “sensationalize science stories,” according to another. A recurring theme,

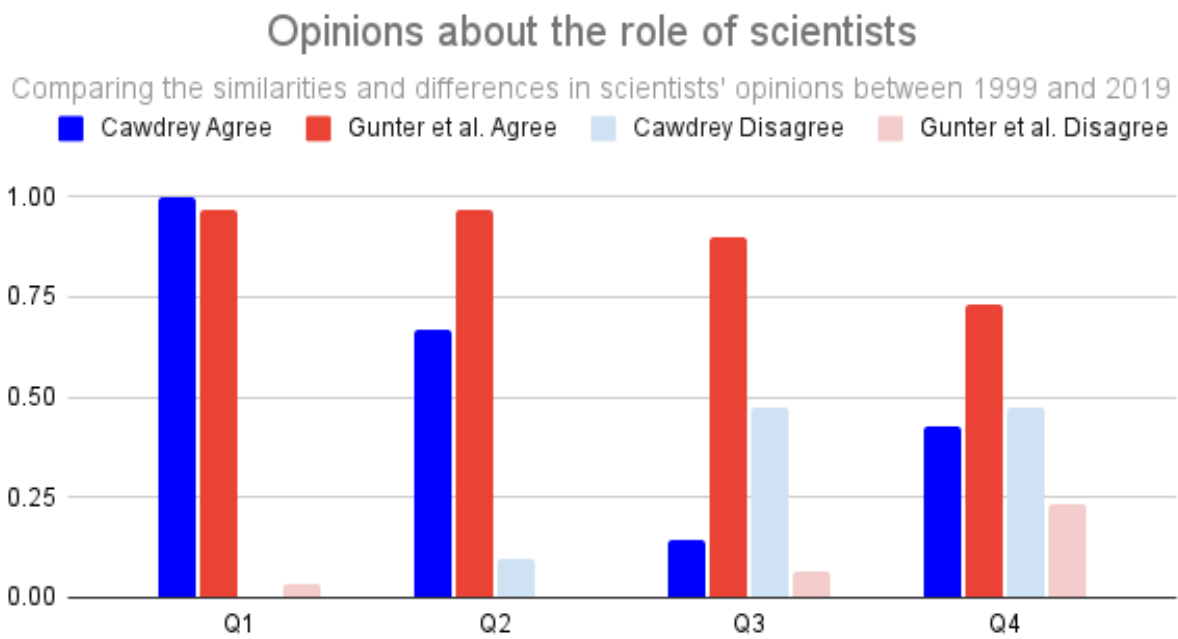


Chart 3: Cawdrey v. Gunter et al. findings

though, was that working with journalists “involves both risk and reward,” and many cited that their feelings on this statement varies on a case-by-case basis

CHAPTER FIVE

Discussion and Future Research

This survey paralleled a 1999 survey in order to better understand 1) the relationship of scientists and journalists, 2) the expected role of journalists, 3) the expected role of scientists, and 4) how these opinions may have changed over 20 years.

The Gunter et al. (1999) study surveyed both journalists and scientists, but for the sake of management, this study surveyed only scientists. The 1999 study recruited its sample of scientists from several professional and academic association or society lists, with memberships totaling more than 1,000 (p. 379). From an initial randomly selected contact sample of 150, a total of 30 scientists were interviewed. In this study, the sample was taken from within a one-year date range (June 1, 2017 to June 1, 2018) with a set of parameters (NYT quoted within the NYT Science section) that yielded 1,715 results. From there, the results were whittled down to 51 articles that offered 74 contacts. Out of that 74, 21 agreed to participate in the study.

While these sample sizes are small, I believe they were very comparable. The participation pool was roughly the same, however my parameters likely yielded more scientists who have had close, numerous interactions with journalists.

Twenty Years Later

Are journalists expected to do more research because data is more readily available with larger online resources? Do scientists need to take on additional responsibilities to better

communicate their research? According to this survey, participants generally agreed that scientists are the experts and can give insight into other fields, but journalists need to do their homework and fact-check their stories.

Gunter et. al (1999) found participants agreed that:

1. *Scientists have an important role to play in enhancing the public's understanding of science* (96.6 percent);
2. *Scientists need to be better trained in dealing with the media* (96.6 percent);
3. *Most scientists distrust journalists in reporting about scientific issues* (90 percent); and
4. *Few scientists seem able to talk about science in everyday language* (73.3 percent).

While statements 1 and 2 still say a majority of this study's participants agree, the latter statements returned much different results, displaying how opinions have changed over time – or at least between the two groups.

Twenty years after Gunter et al.'s study, this study was conducted to observe the relationship between scientists and journalists and to see how that relationship may have changed over time. Based on this research, the relationship and general opinions of scientists toward journalists, a journalist's role, and a scientist's role have largely remained the same. However, a few changes are reflected in the two studies, perhaps reflecting changes in how news is disseminated.

In twenty years, scientists still strongly agree that journalists should take a duty of care toward the public and should report on science in a sober and matter-of-fact way. Journalism is a vital tool for teaching the public about science, especially when a majority of both studies'

respondents agreed that scientists need to be better trained to work with the media and that few scientists seem to be able to discuss their work in everyday language. However, the biggest change I saw is the difference in opinion regarding how trustworthy journalists are. In the 1999 study, almost all participants distrusted journalists, whereas in 2019, the answers were much more skewed. I think that scientists realize the answer is more of a gray area, citing that they trust journalists of certain outlets and on a case-by-case basis. The group of surveyed scientists were also quoted in the *New York Times*, suggesting that they are more media friendly and have had good experiences with science journalists.

But why? Further research is needed to better understand these trends. Additionally, the worlds of both science and journalism have changed drastically due to years of technological development and how people consume science and news. Even so, there are many parts of journalist-scientist relationships that remain unchanged, according to this study.

Looking forward, this research could greatly benefit from a survey of the same questions administered to journalists to continue a comparison between Gunter et al.'s study and today's science news climate. The qualitative approach was very eye-opening in deciphering why scientists feel the way that they do about the difficult relationship between scientists and journalists in producing science news.

Limitations & Further Research

To cast a broader net (in terms of the number and location of participants), a survey was the chosen method over interviews. The data collected yielded long-form, written answers from each participant. While this collection strategy proved fruitful, it is limited in comparison to face-to-face interviews. A survey method also leaves room for confusion without a means to ask

questions conversationally. This research is a small step in gathering a better understanding of the relationship and expectations between scientists and journalists. An additional study could collect more information using methods such as in-depth and/or in-person interviews.

The proposed research methodology targeted 200 survey responses. However, after enacting the method for gathering suitable candidates, only 73 people fit the aforementioned criteria. In order to maintain the integrity of the proposed sample group, survey requests were sent only to those 73 candidates. Of those 73 people, 21 provided feedback. While this number is much smaller than anticipated, it offered insights into the perspectives of scientists who have experience with science media and journalism. The surveyed scientists—an elite group of people who were quoted in *NYT Science*—were predominantly male (90.4 percent) and white (76.2 percent). While the criteria laid out for the group itself greatly limits the sample size, it also appeared to reduce the diversity in respondents. Is this lack of representation only *NYT Science* and its sources, or does it provide insight into a larger issue regarding the lack of diversity in STEM? Further research is needed to answer this question.

The data that was received and analyzed for this research offered a tangible look into the relationship between scientists and journalists. However, a larger sample size is needed to confirm the themes that were discovered in this initial sample.

Some participants did not respond to each open-ended question in the survey, resulting in my questions with 18 to 20 responses out of the 21 people surveyed. Even so, the provided feedback offered a broad range of data as participants who did not respond to one answer would typically respond to another (i.e., it wasn't just one or two participants that did not answer any questions, but many participants would not answer every single question).

As aforementioned, this research is just a starting point for understanding the complex relationship between scientists and journalists. Further surveys or in-depth interviews should be conducted to better understand the intricacies of these important and multi-faceted relationships.

Personal Reflections

I first became interested in this research because of my own personal experiences as science journalism student, and later as a professional science communicator. During my undergraduate career, I reported for the *Columbia Missourian* and took on every science- or environment-related I could find. I began to notice a pattern with the scientists who acted as sources in my articles: they were short with me, they could be condescending, and they believed me incapable of properly discussing their research. They often asked to review my entire article before it was published, a practice that most journalists and newsrooms view as unacceptable because it infringes on editorial independence. In the 1999 study, 93 percent of respondents agreed the journalists should allow scientists they have interviewed to check copy before publication, and in my study, 85.7 still agree today. I was surprised to see this viewpoint sustained, especially since I was taught in journalism school that this was not a common, or good, practice. In my view, journalists need to maintain tone, style, and overall messaging of their piece; it is up to the sources to provide information and quotes. Scientists, however, are used to reviewing journal articles and press releases before publication and want to control how their work is presented. This issue is indicative of the sometimes-tumultuous relationship between scientists and journalists.

As I entered the workforce as a professional science communicator, I ran into the same patterns I experienced as a student. I was a science communicator at the National Aeronautics and Space Administration (NASA), where I was tasked to discuss robotics and other hardware my division created from scratch—what an exciting job! One instance in particular always comes to mind when I think about the relationship between scientists and journalists, and that was my experience with the “robot hotel.” Our division was sending a piece of hardware that they designed and built to the International Space Station (ISS) on a commercial resupply mission. This piece of hardware was incredibly important for the team. However, it was essentially a storage unit. So how do we get people excited about it? Well, it was a storage unit for two robotic devices that are regularly used on the ISS, so my team coined the term “robot hotel” for this little piece of equipment. Once we did that, it was picked up by the larger NASA communications teams, local news outlets, and many other outlets that repost science stories of interest. Our social channels were shared by NASA’s larger (2 million-plus followers) channels, and we reached a bigger audience than we ever could have hoped. Although this term was approved by the lead engineer, he was not quite as excited about the term “robot hotel” because he thought it was too cute—a point that did not occur to me and my colleague. Even though this piece of hardware had more coverage than anything else on that mission, the engineering team did not share our excitement because of the way their work was framed. The thought hit me hard because I was over the Moon (no pun intended) about the success of our campaign. I thought this exchange highlighted the differences between an engineer’s and a science communicator’s values.

There is absolutely room for improvement when it comes to the relationship between a scientist and a journalist. Both parties agree that disseminating science news is important, so why

is it so difficult to work together in some cases? I think it could largely be that difference in values. When I ask a source: “Why should the audience care about this?” I am looking for a hook that will snag the average person who has never heard of their subject before. I imagine the scientist hears something along the lines of “Why should anybody give a hoot that you’ve spent your entire career learning more about this?” Of course a scientist wants a say in how their research is presented to the world, especially in a world that can feel so anti-science. But it shouldn’t be one versus the other, it should be both versus the world. As clearly demonstrated in the U.S. these past years throughout an increasingly alarming climate crisis and anti-vaxxers, we have bigger fish to fry in science communication.

The Interloper

I began this thesis during the Administration that coined the term “fake news,” where Twitter was the main source of news directly from the president. I am finishing this project during (what is hopefully the end stages of) a global pandemic, where misinformation spread like wildfire on Facebook, and *The Washington Post* started a TikTok account.

What was once a platform to catch up on distant relatives’ lives or share photos of your food became this hodgepodge of news, misinformation, deepfake videos, and divisive comments. News outlets struggle to break the news first, but they can use only 180 characters. Journalists report live from wherever, but they have to manage the shares and comments that lead the readers away from the bigger picture. Academic institutions post an in-depth article about the latest research but receive comments based solely on the web preview because to click into the article is one click too many. Videos about war and chaos are limited to 15 seconds so people won’t lose interest and scroll away.

As discussed in my defense, social media has become an interloper in the news landscape, and it is especially challenging for science news, where nuance and context are so important. Future research on the scientist-journalist interface will need to account for this growing third rail of public communication.

Conclusion

Using coding as a method of dissecting qualitative data in search of recurring themes, I found commonalities in how scientists view journalists and science news. Data was collected by sampling scientists who acted as sources in *The New York Times* between June 2017 and June 2018, which yielded open-ended answers to questions pertaining to scientists' opinions about the role of the media and journalism, about journalist-scientist interactions, and about the role of scientists in relation to science news.

Coding this data revealed participants typically believe journalists are responsible for disseminating science news to the public. However, it is every scientists' duty to communicate their own findings, and in some cases, they are the best candidate to do so.

Surveyed scientists task journalists and the media with providing accurate news to the public. In order to build and maintain trustworthiness in a given journalist or outlet, said journalist or outlet must avoid sensationalism, stick to matter-of-fact reporting, and combat misinformation.

When it comes to scientist-journalist interactions, participants agree that a scientist is the expert and as such should have editing control over their own quotes or quoted material. A few responses claimed that a scientist should have more control over fact-checking, while the majority agreed that it is not up to the scientist to change tone, style, or structure of a story.

Although a scientist is the named expert, respondents typically agreed that journalists should do their own research and enact critical thinking to avoid mistakes and misinformation. While scientists are experts in their own field, journalists are ultimately responsible for conveying accurate science news.

Lastly, data shows diverging opinions when it comes to the role of scientists. Reporting research in science is as important as the research itself, many agreed. However, responsibility may fall onto either the journalist or scientist. Scientists have a duty to communicate their findings but may face challenges due to a lack of training or due to the level of complexity they are trying to convey. Journalists are meant to report on science, but their ability to do so ranges on a case-by-case basis according to the survey results.

The results of this research revealed many common trains of thought in the science community when it comes to journalists and science news. While all surveyed believe it is important to disseminate science news, there is debate as to who is best suited to do so as highlighted above. While journalists play an important role in reporting on science news, it is more important still that they do so accurately. Meanwhile, scientists have a duty to report on their research, but may be lacking in the training and ability to do so.

This research allowed an untarnished view through the looking-glass and into scientists' thoughts on the role journalists play in disseminating science news. I would be interested to gather journalists' thoughts on the same matter and compare the two. Although surveyed scientists weigh the pros and cons of journalists' science reporting, there are commonalities on which they all agree: It is critical for both journalists and scientists to accurately and effectively report on research in order to enhance the public understanding of science.

Appendices

Appendix A: Informed Consent Form

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

Title of Project: Understanding Science News

Principal Investigator: This study is being conducted by Master's of Arts in Environmental Reporting candidate Kathryn Cawdrey (knc7x9@mail.missouri.edu) under the direction of Thesis Committee Chair Sara Shipley Hiles (hiless@missouri.edu).

Purpose of Study: The current study aims to explore factors that contribute to barriers between scientists and journalists, each of whom play important roles in creating credible science news.

Procedures to be Followed: After participants read and understand this informed consent form, they can begin filling out the survey. The Science News Survey addresses perception, trust, newsworthiness, and consumption of science news. The survey is comprised of multiple choice, scale, and short-answer questions. Separate sections exist for self-identifying scientists, journalists, science communicators, and educators. Participants will then be asked to provide some demographic information.

Discomforts and Risks: There is minimal risk associated with your participation in this study and I do not anticipate any discomfort.

Benefits: Although there are no direct benefits to you for participating in our study, your participation will allow me to expand the knowledge on driving factors for scientists' and journalists' conceptions, and dissemination of science news.

Costs or Compensation: Your participation is strictly voluntary. There is no cost or compensation associated with your participation in this study.

Duration: Approximately 20 minutes.

Statement of Confidentiality: Your participation in this study will be kept completely confidential. I will not be collecting your name or any other identifying information in this study and your responses will be collected anonymously. No IP address will be collected and there will be no way for anyone to identify your responses. The original data sheets and the electronic file with your data will be stored in a secure location and only those individuals who are directly involved in the study will have access to your information. Finally, findings from this study will be presented in aggregate form with no identifying information to ensure confidentiality.

Right to ask Questions: You have the right to ask any questions during and after you participate in this study. Participants may contact Kathryn Cawdrey at knc7x9@mail.missouri.edu with any questions about the study.

Voluntary Participation and Right to Withdraw: You must be at least 18 years old to participate in this study. Participation in this study is completely voluntary. You have the right to refuse to participate. You also have the right to withdraw from the study at any time without penalty. You also have the right to refuse to answer any individual questions without withdrawing from the entire study; however, I strongly encourage you to answer all questions, since failing to do so could invalidate your results.

Clicking the "Next" button below and proceeding to the questions indicates that I have read the information above and that I agree to participate in this study. I can print out this web page for your records.

Appendix B: Survey

Section 2 of 7

Consuming Science News

Description (optional)

How often do you consume news on science topics (such as environmental issues, new research, or other stories that focus primarily on science)?

1 2 3 4 5

Never Every day

How do you find science news?

Search for it

Return to trusted outlet

Shows up in social media

Other.....

How do you consume science news? Check all that apply.

Television (i.e. NBC, Fox, PBS, CNN)

General Interest Newspaper (i.e. The New York Times, The Washington Post, local paper)

General Interest Magazine (i.e. TIME, Newsweek, local magazine)

General Interest Online-only sources (i.e. Seattle Post-Intelligencer, BuzzFeed, Huffington Post)

Social Media (i.e. Facebook newsfeed, Twitter, Instagram)

Science-Focused Publication (i.e. Scientific American, Science Magazine, Eos)

Academic Journals

Other.....

What outlets do you trust for science news?

Short answer text
.....

What makes a science story worth covering in the news?

Long answer text
.....

After section 2 Continue to next section

Section 3 of 7

Background

Description (optional)

How many years have you worked as a scientist, and in what field?

Short answer text
.....

Have you been used as a source in a news story (newspaper article, broadcast report, live interview, etc.)?

Yes

No

If yes, how many times have you acted as a source for science news? Use numerals.

Short answer text
.....

What educational degree(s) have you completed? Please specify the degree and the field (i.e. Master's degree in geology, Ph.D in physics).

Short answer text
.....

After section 3 Continue to next section

Opinions about the role of the media and journalism

There are 4 multiple choice questions in this section, each followed by a text-box so that you may explain the reasoning behind your answer.

Journalists should assume a duty of care toward the public.

- Agree
- Disagree
- I don't know

Why or why not?

Long answer text

.....

111

Journalists should report on risks in a sober and matter-of-fact way.

- Agree
- Disagree
- I don't know

Why or why not?

Long answer text

.....

Journalists should avoid an emotional style in reporting on risks associated with science.

- Agree
- Disagree
- I don't know

Why or why not?

Long answer text

.....

Journalists should criticize scientists whose work may cause risks to the public.

- Agree
- Disagree
- I don't know

Why or why not?

Long answer text

.....

Opinions concerning journalist-scientist interactions

There are 4 multiple choice questions in this section, each followed by a text-box so that you may explain the reasoning behind your answer.

It is journalists' task to translate science jargon into everyday language.

- Agree
- Disagree
- I don't know

Why or why not?

Long answer text

.....

111

Scientists should restrict themselves to statements about their field of expertise.

- Agree
- Disagree
- I don't know

Why or why not?

Long answer text

.....

Journalists should not accept the word of scientists at face value.

- Agree
- Disagree
- I don't know

Why or why not?

Long answer text

.....

Journalists should allow scientists they have interviewed to check copy before publication.

- Agree
- Disagree
- I don't know

Why or why not?

Long answer text

.....

Opinions about the role of scientists

There are 4 multiple choice questions in this section, each followed by a text-box so that you may explain the reasoning behind your answer.

Scientists have an important role in enhancing public understanding of science.

- Agree
- Disagree
- I don't know

Why or why not?

Long answer text

Scientists need to be better trained in dealing with the media.

- Agree
- Disagree
- I don't know

Why or why not?

Long answer text

Most scientists distrust journalists in reporting about scientific issues.

- Agree
- Disagree
- I don't know

Why or why not?

Long answer text

Few scientists seem able to talk about science in everyday language.

- Agree
- Disagree
- I don't know

Why or why not?

Long answer text

Closing Remarks

Description (optional)

What is your gender?

- Female
- Male
- Prefer not to say
- Other..

What is your age?

- 18 to 20
- 21 to 29
- 30 to 39
- 40 to 49
- 50 to 59
- 60 to 69
- 70 to 79
- 80 or older

Please describe your race/ethnicity:

Short answer text

In what country do you currently reside?

- United States
- Other..

Is there anything else you'd like to share about any aspect of your professional role or use of science news?

Long answer text

TABLE 6
Opinions about the Role of the Media and Journalism

	<i>Journalists (N = 31)</i>		<i>Scientists (N = 30)</i>	
	<i>Agree</i>	<i>Disagree</i>	<i>Agree</i>	<i>Disagree</i>
Journalists should assume a duty of care toward the public	29	2	29	1
Journalists should report on risks in a sober and matter-of-fact way	28	3	28	1
Journalists should avoid an emotional style in reporting on risks associated with science	24	4	26	3
Journalists should criticize scientists whose work may cause risks to the public	22	6	25	2
Journalists are more concerned to report events that do bad than those that do good	19	9	27	2
Journalists should support scientists in their efforts to popularize their findings	19	6	26	4
Journalists too often are concerned about circulation/audience figures in risk reporting	16	13	27	2
Journalists contribute in important ways to public acceptance of biotechnology	24	5	18	8
Journalists seldom weigh risks and benefits in a proper fashion	13	15	23	4
Journalists focus too much on the potential risks associated with biotechnology	13	17	20	9
Risk reporting should be interesting	14	12	14	15
Journalists seldom emphasize the benefits of scientific research	1	27	17	10

NOTE: "Don't know" responses were excluded.

TABLE 7
Opinions Concerning Journalist-Scientist Interactions

	<i>Journalists (N = 31)</i>		<i>Scientists (N = 30)</i>	
	<i>Agree</i>	<i>Disagree</i>	<i>Agree</i>	<i>Disagree</i>
Journalists should be technically well prepared before interviewing scientists	29	1	28	2
It is the journalists' task to translate science jargon into everyday language	30	1	24	6
Scientists should restrict themselves to statements about their field of expertise	18	12	22	6
Journalists should not accept the word of scientists at face value	18	11	21	4
Journalists should allow scientists they have interviewed to check copy before publication	4	23	28	1
In an interview, scientists should focus on the facts and should avoid giving opinions	6	19	14	13

NOTE: "Don't know" responses were excluded.

TABLE 8
Opinions about the Role of Scientists

	<i>Journalists (N = 31)</i>		<i>Scientists (N = 30)</i>	
	<i>Agree</i>	<i>Disagree</i>	<i>Agree</i>	<i>Disagree</i>
Scientists have an important role in enhancing public understanding of science	30	0	29	1
Scientists need to make more effort to report their research findings to the public	29	2	29	1
Scientists need to be better trained in dealing with the media	27	2	29	0
Scientists have a duty to let the public know of risks associated with their discoveries	29	2	28	0
Most scientists distrust journalists in reporting about scientific issues	22	3	27	2
Few scientists seem able to talk about science in everyday language	22	7	22	7
For most scientists, getting their research reported by the media is unimportant	11	15	20	9

NOTE: "Don't know" responses were excluded.

Appendix D: IRB Determination Letter

eCompliance

IRB Determination Letter: IRB #2012250 MU

Project number 2012250
 Review ID **IRB** Application: 240148
 Project title Through the looking glass: How scientists view journalists and science news
 Principal investigator Kathryn N. (MU-Student) Cawdrey
 Primary contact Kathryn N. (MU-Student) Cawdrey

Hello Investigators,

Please click on the following link to view the **IRB** determination for the review noted above.
https://ecompliance.missouri.edu/my/irb/projects/61343/attached_files/370445

This letter was also saved to document storage for this study.

Thank you,

MU **IRB**
 (573) 882-3181
irb@missouri.edu

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Appendix E: Qualitative Coding Example

Opinions Concerning Journalist-Scientist Interactions

Q1: It is journalists' task to translate science jargon into everyday language

Raw Data	Preliminary Codes	Final Codes
<p>Scientists need to do this too! Basic skill for any scientist, and helps disseminate + apply their work.</p>	<p>-scientists and journalists should translate jargon</p>	<p>In these responses, I see recurring themes including</p>
<p>This serves the public, and incidentally is a sign that the journalists themselves have done their work properly and understood their topic well. The physicist Rutherford once told his colleagues that, if they could not explain their work to 'a barmaid', they were frauds. Setting aside the possible disrespect to women tending bars, I think his point was entirely correct. Scientists and journalists should *both* be willing and able to write about science clearly, in language that is easily understood by non-scientists but that does not misrepresent the contents of science.</p>	<p>-scientists and journalists should translate jargon -journalists understanding of jargon is important</p>	<p>the following: -scientists and journalists should translate jargon -journalists understanding of jargon is important</p>
<p>only when the translation is accurate</p>	<p>-translation needs to be accurate</p>	<p>-translation needs to be accurate</p>
<p>the scientific terms must be clearly explained before their use</p>	<p>-translation needs to be accurate</p>	
<p>Scientists often lack the ability to effectively communicate with the layperson.</p>	<p>-journalists should translate jargon</p>	
<p>Why not!</p>		

<p>A journalist does not have the intellectual capacity for it, leave it to the scientist. if it is not possible, then society is not ripe to understand the concept anyway, because Micky Mouse explanations are not helpful</p>	<p>-scientists should translate jargon</p>	
<p>Understanding is not dependent on jargon. Plain English can in most cases express the truth or fact more effectively than complex language but this has to be carefully worded to avoided misinterpretation.</p>	<p>-journalists understanding of jargon is important</p>	
<p>yes but the scientists themselves should meet them halfway</p>	<p>-scientists and journalists should translate jargon</p>	
<p>It is a journalist's task to convey an idea and a story in an accurate and contextualized way. This distillation may require translating jargon into different words, or it may involve teaching the public about a new word they should know. Journalists should not dumb things down - that is not their job. But they should help make things accessible. This is a tough balance.</p>	<p>-journalists should translate jargon</p>	
<p>So long as they have expertise enough to understand it. Otherwise, scientists not involved in the study in question should be used to translate the jargon into plain English for them.</p>	<p>-scientists and journalists should translate jargon</p>	
<p>Its the scientist's role</p>	<p>-scientists should translate jargon</p>	
<p>Of course!</p>	<p>-journalists should translate jargon</p>	

That's their job.	-journalists should translate jargon	
Sure. I think "task" is appropriate, versus "It is journalists' duty .." or " ... responsibility ...". Task = work to be done, if possible, in the most accurate manner possible.	-journalists should translate jargon	
Jargon is usually an impediment to understanding.	-journalists understanding of jargon is important	
Literally their job: making the concepts understandable to the readership.	-journalists should translate jargon	
communication research policy gap	-journalists should translate jargon	

Appendix F: Survey Email to Participants (Example)

Dear Alex Gagnon

My name is Kathryn Cawdrey and I am working toward my master's degree at the [University of Missouri School of Journalism](#). I obtained your contact information via a New York Times article in the Science section.

Please consider completing my [survey](#), which consists of multiple choice, scale, and short answer questions. The [survey](#) should take 15 to 20 minutes to complete.

This study is being conducted by myself (kathryncawdrey@gmail.com) under the direction of Thesis Committee Chair Sara Shipley Hiles (shiles@missouri.edu). The study will use feedback from [surveys](#) administered to scientists to explore the factors that may influence their understanding and trust of journalists. Additionally, this research will provide further insight into communication barriers that stand between scientists and journalists.

Your name and contact information will not be collected when you begin the [survey](#), and your answers will remain completely anonymous.

[Take the survey here.](#)

Thank you for your time and consideration.
Sincerely,
[Kathryn Cawdrey](#)

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