Identifying opportunities for improved environmental health science communication in the popular press

Laura A. Gladson, Kevin R. Cromar
Marron Institute of Urban Management, New York University, 60 5th Avenue, 2nd Floor, New York, NY 10011
Corresponding author: Laura Gladson, laura.gladson@nyu.edu
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Mass media and the impact on science policy

Our understanding of the physical and natural world is constantly evolving. Yet no amount of scientific progress can improve public policy unless it is accurately communicated to both policymakers and the constituents who elect them. As a major source of science communication, mass media plays an important role in this translation of knowledge (Treise and Weigold 2002), ultimately impacting policy in at least two ways. First, the popular press both informs and shapes public perception of science-relevant topics, impacting which policies and candidates are favored. Second, news coverage can directly inform policymakers themselves on key scientific issues. Indeed, many legislators acknowledge their dependence on media to guide policy decisions, and past research has supported a connection between news coverage of an issue and the number of relevant bills introduced in state governments (Smith et al. 2016; Yanovitzky 2002).

While a variety of online media platforms have replaced print and television news in recent years, many individuals still use a mix of traditional and new media. Most newspapers now offer both on and offline material, and remain a major source of science information via links on social media (Su et al. 2015). Indeed, half of the population receives their news on science and technology from the internet, and nearly half of these rely primarily on online newspapers for this information. Subgroups that still follow traditional news sources, including print newspapers, have been shown to be less educated on scientific matters than their internet-using counterparts (Division of Behavioral and Social Sciences and Education and Committee on the Science of Science Communication: A Research Agenda 2017). And even among individuals with backgrounds in science, technology, engineering, and math (STEM), science news is often misunderstood and interpreted out of context. As such, efforts to ensure the accuracy and completeness of science information in the mass media remain a relevant issue today.

Given the importance of scientific progress and the presence of mass media outlets as a channel to communicate these findings, government policies should theoretically reflect the best available science and expert advice. However, advances in scientific understanding alone are not enough to guarantee beneficial, evidence-based policy. Several challenges contribute to this gap between science and public policy, including poor timing of research in relation to current policy debates, uncertainty of research results, and the difficulty in linking randomized findings to specific policy problems (Brownson et al. 2006). The media can potentially bridge this gap by providing a platform for reporting scientific research in lay terms, as well as opportunities for experts to provide policy interpretations. However, journalism has a mixed track record when it comes to quality science reporting and faces its own unique challenges in its honest attempts convey accurate information. Some common pitfalls are well documented: inaccurate or incomplete definitions of science terminology, lack of context and opinions from non-expert sources, and exaggeration of research significance (Amend and Secko 2012; Bubela et al. 2009; Dentzer 2009; Holtzman et al. 2005; Kua, Reder, and Grossel 2004; Pellechia 1997). Recognition of these challenges has fuelled an increase in research into the reasons for poor science communication in the popular press.

The rise of environmental health concerns to the public stage lends particular interest to the representation of this field in mass media. From food and product safety to air pollution and climate change, environmental health is gaining widespread media attention, yet reports on these issues are particularly prone to misrepresentation. Challenges to quality reporting, such as failing to provide sufficient context, presenting complex science as black and white issues, and focusing on extreme views, have created an inaccurate and unfair representation of environmental science (Boykoff 2009). Studies on environmental reporting have found that few news stories help to increase the public's understanding of the issues, and some may even go so far as to create greater confusion for the reader (Hargreaves, Spears, and Lewis 2003; Major and Atwood 2004). As environmental health scientists, we have explored some of these challenges, drawing recommendations for improved science communication from a small pilot study and the available literature.

Major challenges to science journalism

Science writing in the public press is particularly challenging: the reporter must not only comprehend science reports from various disciplines, but also convey this understanding to the layperson (Treise and Weigold 2002). As a result, journalists frequently turn to outside sources for explanations of science and find it most helpful when these individuals can translate complex ideas into everyday language (Amend and Secko 2012). The best sources for such information are professional scientific experts, those with special knowledge of their field gained through education, experience, or study. Yet despite their extensive understanding of scientific issues, scientists often struggle to convey this information in ways that are understandable to general audiences. In contrast, public relations representatives and opinion leaders are skilled in such clear communication, and are frequently cited by the media despite not having expertise in the topics covered. As such, there exists the potential for these organizations to take advantage of media outlets in order to forward their own interests (Ladle, Jepson, and Whittaker 2005). Without citing true scientific experts, news reports can suffer from exaggeration, lack of context, and other issues that arise when non-experts or interest groups seek to explain science. Expert availability and selection is thus a critical component of quality science journalism.

Science news reporting also suffers from a lack of investigative journalism, largely due to limited budgets and staff numbers at news outlets. Investigative journalism requires reporters to spend time fact-checking and considering the context of scientific news before publication, yet restrictions on time and resources lead most journalists to rely on press releases without critiquing the scientific information sent to them (Williams and Gajevic 2013; Cooper et al. 2012; Racine et al. 2006). Science journal editors understand this, and frequently issue press releases on their published studies (Granado 2011; Wilson and Petticrew 2008). However, press releases often fail to supply adequate detail and tend to over-promote findings (Ladle, Jepson, and Whittaker 2005). Brechman, Lee & Cappella (2009) found that when two news sources reported on the same genetics finding, information differed over 40% of the time. In their analysis, they suggested that press releases were causing scientific information to be distorted. Over-reliance on press releases and abandoning journalistic investigation has led to news stories that provide little context for scientific "breakthroughs" and have a tendency to avoid complete explanations of scientific studies (Hijmans, Pleijter, and Wester 2003; Kua, Reder, and Grossel 2004; Pellechia 1997). This presents an incomplete picture of scientific progress to citizens and policymakers alike, who receive only small fragments of a much larger, interconnected field of knowledge. In contrast, investigative journalism involves searching beyond single sources and consulting multiple, quality experts who can help reporters understand science news in the context of existing research.

News articles reporting individual peer-reviewed studies are common, yet communicating science in this way only adds to this fragmented world view. Bubela et al. (2009) argue that accuracy does not equate with completeness in scientific communication. A news report may avoid errors of commission while omitting background items such as funding information, methodology, and most importantly, how the discovery fits into the existing scientific framework (Bubela et al. 2009). As Granado (2011) observed, "readers are receiving a distorted image of science as a series of 'discoveries'…distant from the real daily world of scientists and the scientific process." Because of this, Wilson and Pettigrew (2008) argue that individual studies should be incorporated, tested, and built upon in their respective field before being applied to real-world problems. However, there has been little progress by scientists to present studies with adequate context (Wilson and Petticrew 2008). Instead, science journals and researchers often promote single studies in order to improve their image, set an agenda, or secure additional funding (Bubela et al. 2009; Elias 2008; Granado 2011; Williams and Gajevic 2013; Wilson and Petticrew 2008). Since media coverage has been shown to increase a scientific study's citations (Elias 2008), there is an obvious motivation for journals to promote their publications in order to increase their prestige in the academic world. For those researchers and academic groups compelled to share results with a wider community, prioritizing the promotion of meta-analysis instead of individual papers would ensure lay audiences receive information based in well-replicated, established science.

Evaluating environmental health science reporting in a local newspaper

We conducted a small pilot study to examine the quality of environmental health science reporting in a mid-sized U.S. city in order to determine which factors are most commonly associated with accurate scientific communication. News reports addressing environmental health topics from a major daily newspaper in Salt Lake City, Utah were evaluated based on the accuracy of scientific content included in the articles. Salt Lake City and the surrounding locales experience an array of environmental challenges, including recurring poor air quality, hazardous waste management, and debates over use of public lands (O'Donoghue 2015), making it an interesting sample region for this pilot study. We completed a comprehensive search of two years of news articles through LexisNexis using the search terms shown in Table 1. A total of 170 articles contained sufficient scientific content for analysis (in which explanations of science and scientific research were attempted) and were scored according to the accuracy and reliability of the science information presented. We defined accuracy as science news presenting true facts, clear explanations of scientific principles, and correct conclusions from reported studies. The reliability of news was determined by the sources of information, both in study and expert type. Reliable studies include, for example, systemic reviews or government reports, while reliable experts may be unaffiliated scientists or those representing national or international membership organizations.

We identified characteristics consistently observed in news articles containing accurate scientific information as positive factors. These characteristics included reporting findings from multiple peer-reviewed studies, using unaffiliated experts to provide scientific interpretations, evidence of investigative reporting on scientific topics, and the inclusion of all pertinent facts and conclusions from scientific studies. Similarly, negative factors were identified as those consistently found in news articles containing inaccurate reporting of scientific information, such as reporting findings from unpublished studies, having non-experts provide scientific explanations, giving equal weight to "both sides" of an established scientific finding, and providing little or no scientific background. Neutral factors were not consistently associated with either accurate or inaccurate scientific communication but rather had mixed results. We grouped these factors into four different categories: 1) the type of scientific study that was the basis of the reporting, 2) the source of expert interpretation, 3) the extent of investigative reporting, and 4) the presentation of scientific information. The percentage of news articles containing the specific factors identified through this study are shown in Table 2. Percentages in each category do not add up to 100% because not every news article contained one of the factors and in some cases more than one factor appeared in the same news story.

Approximately one quarter of news articles in the study contained expert interpretation from an unaffiliated expert, which was identified as a positive factor. We found the same percentage of articles had expert interpretations provided by an author involved in the study. Nearly a fifth of all articles in the sample contained expert interpretations from representatives from advocacy groups not accountable to a large membership body, suggesting that individuals with special interests, but not necessarily scientific backgrounds, are common sources for explaining environmental health science topics to the public.

The most commonly occurring negative factor was the reporting of information from scientific research in which the applicable study could not be identified due to a lack of reference information (34% of articles in the sample). A lower percentage of news articles referenced high quality studies included among the study's positive scoring factors, such as statistics from surveillance epidemiology (16%) and systemic reviews or government reports (14%).

News articles that focused on individual peer-reviewed studies (15%), a neutral factor, were associated with mixed results in regards to the accuracy of scientific communication. For these news articles in particular, the source of expert interpretation seemed to be the most critical factor in determining the accuracy of scientific content reported to the public. A comparison of articles stratified by type of scientific study (single peer-reviewed study vs. systematic reviews or government reports) shows that expert interpretation accompanying the reporting on individual peer-reviewed studies is more likely to come from an author involved with the study (p-value = 0.03), while articles reporting on systematic reviews or government reports are more likely to rely on unaffiliated experts for scientific interpretation (p-value = 0.09). Other factors evaluated in this study did not differ when comparing the two types of news articles (see Table 3).

Professional scientific societies filling the role of expert sources

Ultimately, this pilot study taught us that there are concrete ways to report accurate, reliable environmental health research to the public. The frequency of specific strengths and weaknesses in science reporting may vary locally due to socioeconomic and eco-political factors, but can ultimately be defined and addressed by communicators and scientists alike.

The accuracy of reporting on environmental health topics is heavily influenced by the quality of experts available to provide important context for scientific discoveries. Whether this is an advocate claiming a recent discovery supports their agenda or an outside researcher commenting on how findings fit in the field's broader scope of research, these comments can either mislead or provide clarity on the significance of scientific information. Advocacy groups and other non-experts have been described as "eager sources [who] eventually become regular ones, appearing in the news over and over again" (Gans 1979). Gaines (2014) notes that instead of relying on evidence-based information, such opinion spokespersons utilize rhetoric and current public opinion to promote scientific understanding that supports their purposes. As he warns, the media does not distinguish between a reliable source, such as a practicing scientist, and a biased source working for a corporation or political group, leading readers to see both sources as equal despite hidden motives.

While some responsibility for science communication skill development certainly falls on those in the journalism field, scientists themselves should ultimately take responsibility for the way their research is communicated to the public. Some have dubbed this the "issue advocate" role, a critical function scientific experts can play in the policy process (Ekayani, Nurrochmat, and Darusman 2016). While individual scientists are often capable of filling this role, more organized efforts are likely needed in order to make sustained improvements in the quality of scientific reporting.

Professional scientific societies are currently best positioned to assume a more prominent role in providing expert interpretations to the media in order to avoid having non-experts fill the void left when unbiased voices remain silent. In the context of climate change, but applicable to science topics generally, Boykoff (2007) admonishes that scientists should work towards continuous communication with mass media so that qualified experts are making themselves available in public discussions. While journalists should choose experts wisely, the need to hunt down scientists willing to explain scientific concepts can be extremely challenging, especially due to frequent deadlines and increasing workloads in the media industry. On the other hand, professional associations such as the International Society for Environmental Epidemiology (ISEE) or the American Thoracic Society (ATS) have access to the research and expertise necessary to provide accurate and complete explanations to media groups, and can play a bigger part in providing quality experts to ensure good science is not crowded out by non-expert and advocacy group agendas. Presently, these organizations focus on promoting articles found in their own journals; for instance, the ISEE frequency reaches out to the media regarding its affiliation to *Epidemiology,* while the ATS does the same for its publication, the *American Journal of Respiratory and Critical Care Medicine.* Others, such as the American Association for the Advancement of Science and the American Society for Biochemistry and Molecular Biology, have led efforts in recent years to offer science communication workshops and education to experts wishing to improve their media relations (AAAS 2017; ASBMB 2017). There is potential for such efforts to expand in their impact as science societies take the next step forward—by finding and making available trained experts in their field to explain science information to news media organizations.

The pipeline for communicating science to the pubic—the media—is already in place. It simply needs experts to make themselves available to explain and interpret science in educated, unbiased ways. Professional science organizations have the tools in place to make this a possibility. With their established reputations and access to subject experts across the nation, these groups can make positive changes in the way that science is communicated through the mass media. This will result in better informed citizens and policymakers alike, ultimately leading to more beneficial, evidence-based policies.

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Author Bio: Laura Gladson is a Research Scholar in the Air Quality Program at the Marron Institute of Urban Management at New York University. She holds an M.S. in Environmental Health Sciences from New York University and a B.S. in Public Health from Brigham Young University. Her research interests include environmental policy, epidemiology, and spatial analysis of the health effects of air pollution.

Dr. Kevin Cromar is the Director of the Air Quality Program at the Marron Institute of Urban Management at New York University and has secondary appointments in the departments of population health and environmental medicine at NYU School of Medicine. He holds a Ph.D. in Environmental Health Sciences from New York University, an M.S. in Environmental Health Sciences from New York University, and a B.S. in Neuroscience from Brigham Young University. He currently serves as a member of the American Thoracic Society Environmental and Occupational Health Policy Committee, and is a member of Utah's Air Quality Board.

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Table 1: Environmental Health Index Terms in LexisNexis

Air Pollutants	Lead Poisoning
Air Pollution	Lyme Disease
Air Quality	Malaria
Air Quality Instruments	Medical Waste & Biohazards
Air Quality Monitoring	Mosquito Borne Diseases
Air Quality Regulation	Nitrogen Oxides
Asbestos	Noise Pollution
Asthma	Nuclear Waste
Carbon Monoxide	Occupational Illness & Injury
Carcinogens	Ozone*
Climate Change	Particulate Matter
Emissions	Pollution Monitoring
Environmental Assessment	Radiation*
Environmental Illness	Radon
Environmental Testing	SARS
Food Borne Illness	Smog
Food Safety	Soil Contamination
Food Safety Regulation	Solid Waste Treatment & Disposal
Hazardous Air Pollutants	Sulfur Dioxide*
Heavy Metals & Toxic Minerals	Toxic & Hazardous Substances
Human Exposure Assessment	Vehicle Emissions
Indoor Air Quality	Volatile Organic Compounds
Industrial Pollution	Water Pollution
Lead	Water Quality Regulation
Lead Paint	West Nile Virus

Note. Asterisks (*) denote terms not indexed by LexisNexis but included in the search due to their relevance to environmental health. These terms were modified to reduce irrelevant search results, as follows: “ozone and health,” “radiation and environment and not treatment,” and “sulfur dioxide and health.”

Table 2: Percentage of Environmental Health News Articles Containing Positive, Neutral and Negative Factors Associated with Quality of Scientific Communication

TYPE OF SCIENTIFIC STUDY REPORTED		
Positive Factors	Reporting statistics from surveillance epidemiology.	16%
	Reporting a systematic review or government report.	14%
	Research report from reputable NGO.	6%
	Reporting on multiple peer-reviewed studies.	3%
Neutral Factors	Reporting results of a single peer-reviewed study.	15%
Negative Factors	Reporting findings from a study with no reference.	34%
	Reporting findings from an unpublished study.	1%
	Reporting expected findings from a study in progress.	1%
SOURCE OF EXPERT INTERPRETATIONS		
Positive Factors	Unaffiliated expert providing scientific interpretation.	24%
	Interpretation provided by expert speaking on behalf of national or international membership organization.	6%
Neutral Factors	Interpretation from author involved in the study.	24%
Negative Factors	Expert interpretation from an advocacy group that is not accountable to a membership body.	18%
	Non-expert providing expert interpretation.	7%
EXTENT OF INVESTIGATION		
Positive Factors	Evidence of investigative reporting on scientific topics.	8%
Negative Factors	Vaguely refers to scientific studies in providing declarative statements.	11%
	Gives equal weight to "both sides" of an established scientific finding.	1%
PRESENTATION OF SCIENTIFIC INFORMATION		
Positive Factors	Thorough, accurate explanations of scientific principles.	11%
	Includes all pertinent facts and conclusions from scientific studies.	11%
Negative Factors	Little or no scientific background provided.	13%
	Incomplete reporting on scientific information.	3%
	Suggestions of clinical relevance or behavior modification unsupported by the reported scientific findings.	1%

Table 3: Individual Studies vs. Systematic Reviews & Government Reports

Categories		Category Frequency: Individual Peer-Reviewed Studies (20 Articles)	Category Frequency: Systematic Reviews & Government Reports (20 Articles)	P-Value
SOURCE OF EXPERT INTERPRETATIONS				
Positive Factors	Unaffiliated expert; expert on behalf of national or international organization.	20%	45%	0.09
Neutral Factors	Expert involved in the scientific study.	65%	30%	0.03
Negative Factors	Non-expert; representative from advocacy organization.	20%	20%	1.00
EXTENT OF INVESTIGATION				
Positive Factors	Evidence of investigative reporting on scientific topics.	15%	15%	1.00
Negative Factors	Vague references to studies; gives equal weight to "both sides."	5%	5%	1.00
PRESENTATION OF SCIENTIFIC INFORMATION				
Positive Factors	Thorough, accurate explanations & coverage.	50%	40%	0.53
Negative Factors	Little background; incomplete science; scientifically unsupported suggestions.	5%	5%	1.00

Note. News articles citing only individual studies were compared with those citing only systematic reviews or government reports. P-values were determined using 2 sample t-tests, and reflect the significance of differences between factor frequencies in these two groups. P-values ≤ 0.05 were determined to be significant, while those between 0.05 and 0.10 were considered marginally significant. This table groups percentages by positive, neutral, and negative factors within each category.