# Insights on the Media's Practices and Representations of (Global Warming) Science: Confusing the public, educating school children?

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### Responses

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### Abstract

Global warming is perhaps the most significant issue that we face, yet it would appear to be poorly understood by the general public. Their knowledge of global warming science derives almost entirely from its coverage in news media. This article, using various case studies – comparing media publications to the original publications, the creation of a copy story or broadcast, talks given by journalists, and a journalist preparatory program – discusses practices inherent in the practice of journalism that contribute to the difficulties the general public has in understanding socioscientific issues such as global warming. In discussing the case studies the question is asked if news media should be trusted to convey those topics, if it should be used to teach subjects such as global warming to students, or even if they should be learning about those issues in science classes at all.

### Introduction

The phenomenon referred to as Global Warming or Climate Change is probably the most significant issue that will affect the rest of my life, probably yours too. It is, many would argue, the most significant environmental issue facing us. Yet, it is such a complex issue that it is difficult for many to understand in any detail, and as a consequence it is far too easy for others to undermine.

Most people learn little about global warming in school; in fact the majority of voters (looking at voting trends across age groups and the size of various age cohorts) were out of school for some years before it became an issue. Thus, their understanding of it has emerged almost entirely from media coverage. This, by the way, includes teachers, as just like the general public many of them have almost exclusively learned about global warming science by reading the newspaper or watching the news. Thus, the news media is a major influence on public thinking about global warming. Why might this be an issue?

### One Black Box is as Good as Another

To most people the practices of science are a "black box" into which they have few insights. What most people don't tend to recognize is that the media and its practices represent just a different type of "black box", yet they accept the practices media engage in to represent the practices of science to them almost uncritically. I believe that this is a major problem, one that undermines almost any attempt to sway public opinion on global warming issues through any form of activism.

One manner by which the media machine can be de-blackboxed is to understand what some of the mechanisms are in its current use and practices. This paper, using examples from news media reporting on science and global warming, and drawing on my personal experiences in a journalism school, provides numerous examples that contribute to the attempts to deconstruct media practices. It is first important to understand both how I became interested in global warming science and how I came to participate in a journalism program as they lay at the foundation of conclusions I have drawn.

I can clearly remember the first time I read something that made me think about the issue of global warming. I had completed a BSc in marine biology in '84, and after that was working on an MSc in behavioural toxicology; the sciences I was most interested in then and now are those of ecology and animal behaviour. At that time I subscribed to various nature and science magazines, read newspapers voraciously, and read journal articles both as part of my graduate work and my broader interests in science. I can recollect first reading about the issue of global warming in the later 1980's in an article in a magazine called "Seasons" published by the Federation of Ontario Naturalists. In that article it mentioned that, because of increasing temperatures, there was probably not going to be a commercially viable downhill ski industry in Southern Ontario by the mid 1990's. Although I wasn't much of a skier, this article caused a profound impact on my thinking and focus about the global climate, and I've paid attention to the research on global warming since then reading both secondary and primary source materials on the research.

In the intervening decades I became a teacher and then a professor of education where my interests moved from teaching kids about ecology to understanding issues in teaching teachers to even broader interests in the public understanding of science and what factors intrude on that understanding. My personal interest in global warming science and those issues ultimately meant that I became interested in understanding the role of the media in how the public understands global warming.

In the earlier, halcyon times of the 1980's global warming was not really on anyone's agenda. For instance, in a book entitled "The Earth Report: The Essential Guide to Global Ecological Issues" (Goldsmith & Hildyard, 1988) the chapters dealt with the politics of food aid, nuclear energy after Chernobyl, acid rain and forest decline, and the availability of potable water. One other chapter, written by James Lovelock, dealt with "Man and Gaia" but devoted only a single page to the issue of the greenhouse effect drawing the very tempered conclusion that

> Scientists estimate that such a rise may lead to an average of 2 to 3° C increase in surface air temperatures, with the effects becoming more exaggerated towards the Poles. The sea level will undoubtedly rise, threatening low-lying areas, but will it be followed by the melting of the ice caps? What will happen to cloud cover, will it increase and so offset some of the heating effects? Will some parts of the globe such as the semi-arid areas become drier still and other areas wetter? The climate will undoubtedly change, but perhaps in Gaian ways that will tend to reduce the impact (p. 62).

That was it, at least as far as concerns about global warming in a book devoted to global environmental issues. Almost twenty-five years later it's probably safe to say that Lovelock's optimism of that time – that there may be a Gaian regulation of the temperature increases associated with carbon dioxide increases – was probably unwarranted, although his comments about the amount of change and where it will be greatest is still accurate. Nowadays, amongst most scientists who do research on climate-change, there seems to be an ever-increasing sense of concern and stress over the changes they see coming in our future.

For this paper I'm first going to conduct a brief review of the literature on news media and global warming science. I'll then briefly discuss the implications as I see them of the "new media," what some refer to as Media 2.0, in relation to public understandings of science issues such as global warming. Finally, a few case studies and vignettes about science journalism and a journalism training program will be discussed.

## The Media and Presentations of Science

There is a substantial body of literature critiquing the media and how it constructs "news" for the public as well as a specific body of literature critiquing how the media portrays global warming science. For this review I will briefly summarize four main issues regarding the media and its portrayal of (global warming) science: influence of the media, manipulations of the media, commercial interests of the media, and the lack of knowledge/incompetence in journalism. I will readily accept the argument that these topics are not distinct and represent only four that are possible in discussing the literature about news media and global warming.

**Influence of Media**. For much of the public the news media (which these days would include the internet) is a significant source of information about science (Boyes & Stanisstreet, 1992; Dispensa & Brulle, 2003; Lewenstein, 2001; Schibeci, 1990) and plays a significant role in shaping the discourse on climate change (Boykoff, 2008). This is problematic however as the shortcomings of news media reports about global warming contribute to public misunderstanding about global warming science (Boykoff & Mansfield, 2008; Dispensa & Brulle, 2003). This affects more than adults as high school students often have a poor understanding of climate change science and have acquired most of their knowledge about global warming (Adams, 1999; Gowda et al, 1997) and other socioscientific issues (Reis and Galvao, 2004; Bencze et al, 2009) from the media.

In classrooms teachers use newspapers as part of their approach to teaching science (Jarman and McClune, 2002; Kachan, Guilbert and Bisanz, 2006) and some researchers suggest that media reports of science should be used to augment science textbooks, particularly to help students develop "critical reading skills needed to interpret argumentative text" (p. 432) and expose them to science meta-language (Penney et al, 2003) reflecting an overall trend in the increase of use of media in classrooms (Yore et al, 2003). Further, given various initiatives to provide students' active and ongoing internet access in classrooms (such as providing them netbooks or tablets), access to news media in classrooms is likely to increase. However, issues with how science is presented in the media, both in tone and accuracy, make this problematic.

**Manipulations of the Media**. In a book detailing the global warming issue and discussing the "deniers" in some detail George Monbiot described how a significant number of organizations central in spreading disinformation about global warming, including to reporters and others writing in newspapers, actually received their funding from Exxon (Monbiot, 2006; p. 27). Providing numerous examples, he concludes that "a total lack of scientific knowledge is no barrier to publication" (p.23) such that when checked with authorities one published claim was responded to with the statement "This is complete bullshit" (p. 24). Monbiot, in a chapter titled "The Denial Industry" provides considerable details of a campaign essentially orchestrated by "professional deniers" which manipulated media both directly and indirectly to influence public opinion. He concludes that that manipulation has considerably influenced public opinion. Through websites, the organizing of "fake" citizens groups, and media manipulation how society has dealt with climate change has been considerably slowed. Monbiot claims that "By dominating the media debate on climate change during seven or eight critical years…by constantly seeding doubt about the science…they have justified the money their sponsors spend on them many times over. I think it is fair to say that the professional denial industry has delayed effective global action on climate change by several years" (p. 39).

A book detailing how a "handful of scientists obscured the truth on issues from tobacco smoke to global warming" (Oreskes and Conway, 2010) argues that the mass media became "complicit" in undermining global warming science (p. 214) to such an extent that "reporting on climate in the United States became biased *toward* the sceptics and deniers" (ibid; italics in the original). They argue that the presentation of "balance" in the majority of media articles (drawn from 1988 to 2002; reporting on a study by Boykoff & Boykoff, 2004) despite consensus amongst scientists in climate science made it "easy for our

government to do nothing about global warming" (p. 215). In part this occurred because providing that balance lends credibility to the minority side (Dearing, 1995). Although these are clearly examples from the United States there are strong parallels between American and Canadian news, not to mention that Canadians watch American news and are therefore influenced by it. The bias in American news is even more significant when political leaders such as our Prime Minister state that they don't watch Canadian news – "I tend to watch mainly American news because I don't like to watch Canadian news" (MacCharles, 2009) – so any improved coverage in Canada would apparently have little influence on those in Canadian politics anyway. Anderson (2009), concluded that the negative influence of public relations activities "has played a highly significant role in the climate change debate and claims-makers are employing increasingly sophisticated strategies to target the media" (p. 171).

**Commercial Interests of the Media**. The phrase "Commercial interests" is used in the context of ways in which maximizing profit influences decisions made about how to conduct the business and practices of journalism. The influence of this factor can be profound – "commercial interests of the mass media can be incompatible with the social responsibility one should expect from journalists" (Roll-Hansen, 1994). These commercial interests drive reader/viewership and undoubtedly explains why there is a "focus on drama, aberration, and controversy in much reporting about science and technology [reflecting] the quest of journalists to make their articles more entertaining" (Nelkin, 1987, p. 119; also McBean and Hengeveld, 2000; Curtis, 2007). It is not difficult to see how this plays out in articles on global warming science, especially towards showing "balance" by journalists introducing a denier perspective into a majority of news articles (88% of newspaper articles between 1988 and 2002 had a "denier" perspective included (Boykoff & Boykoff, 2004); also see McBean and Hengeveld, 2000; Curtis, 2007). The commercial interest of media might also result in the downplaying of global warming issues, or perhaps that introduction of "balance", because of a fear of the loss of advertising from industries who contribute to global warming (Gelbspan, 2005; Monbiot, 2007). One could also argue that radio and television documentaries on global warming are designed to dramatically entertain as much as they are to inform (McBean and Hengeveld, 2000), and in fact I attended a talk given by one of Canada's most prominent science journalists at which he said that he saw his role as mainly one of entertainment, with informing the public about science being somewhat incidental rather than of necessity.

**The Competency and Practices of Journalists**. There is a broad literature discussing whether most journalists who report on science issues are equal to the task. However, science and scientists being misreported is not a recent phenomenon – "I merely wish the scientific public that still has the bad habit of reading and believing the newspaper to know that I was careful to deny that I made any such pretensions as were so generally attributed to me. More than one-half the interviews alleged to have been held with me were the fabrications of reporters who never saw me, and the other half omitted what I did say and published what I did not say" (Hyslop, 1899; p. 696). In the context of that comment the misreporting would be likely related to the sensationalism and drama which journalists imbue their work with to increase readership (Nelkin, 1987; Curis, 2007) whether or not the subject actually calls for it. But other misreporting of science is perhaps more serious, because it does not occur for reasons of style but rather because of insufficiency in the backgrounds of journalists. Recently, the results of the longitudinal "Interphone" study from the World Health Organization, which examined cell phone usage and cancer risk, was reported by some media as inconclusive, and by other media as finding that there is a link (Tyson, 2010). There are other instances where lack of journalist knowledge on environmental topics has led to inaccurate reporting (Roll-Hansen, 1994) with one research report suggesting that one story in six contained significant misreporting (Bell, 1994), although one could argue that the inclusion of "denier" perspectives in 88% of newspaper reports (Boykoff and Boykoff, 2004) means that the "significant misreporting" rate is much higher. In Canada the "vast majority" of journalists covering science have no science training, and the structure of Canadian daily newspapers is "not supportive of the style of reportage required for quality science writing, nor of the development of such writers" (Saari, Gibson & Osler, 1998; p. 61). One might well suggest that there is a serious shortage of science-dedicated reporters (McBean and Hengeveld, 2000), and that this leads

to inadvertent misreporting on science issues, such as failing to distinguish between scientific debate about small details and that about larger issues and by so doing presents the appearance of controversy where there really isn't any (McBean and Hengeveld, 2000).

In Canada the media also tends to focus on the focus on the controversial aspects of climate change science rather than the much greater areas in which there is agreement, leading to a "public perception of scientific uncertainty that significantly exceeds that perceived within the scientific community itself" (McBean and Hengeveld, 2000; p. 11). Their tendency to write articles on climate change science during unusually warm periods (Shanahan & Good, 2000) also likely misdirects the public on the consequences of global warming. One would be unsurprised that journalists who work the environmental beat full-time and who primarily use scientists as their sources have the most accurate knowledge about global warming (Wilson, 2000). Finally, in socio-scientific issues such as global warming, now the press deals with issues such as scientific uncertainty, and represents them to the public, may very well lead to inaction by the public (Zehr, 2000).

So, clearly the news media, whether through ineffective practices or manipulation by other agents, has a considerable effect on how the public perceives global warming and, consequentially on what public policy develops.

## Changes in How News Media Influences the Public

However, in the last few years media has changed in how it influences the public. Prior to news media being on the internet and Web 2.0 tools (such as discussion forums) individuals read articles and then perhaps discussed them with others that they knew. Now, however, many news media outlets have appended discussion forums to their news articles, so now the readership can discuss the articles with a much broader community and contribute to how a broader public makes sense of and understands global warming science.

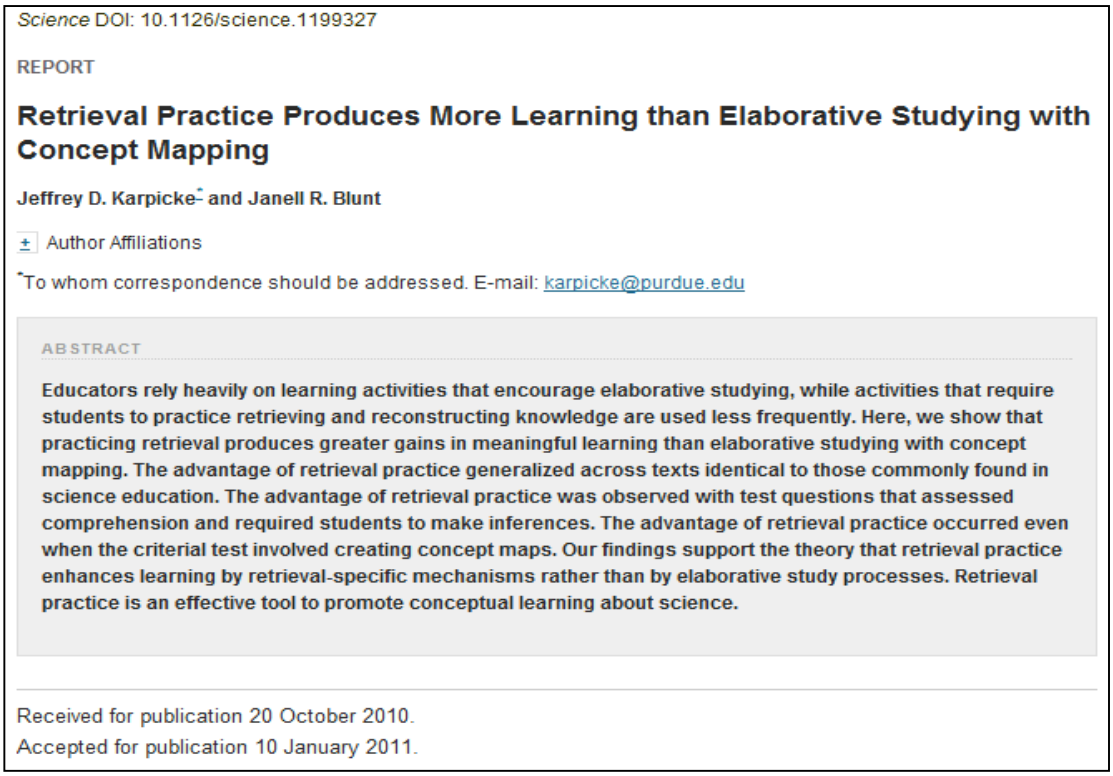
A few years ago I published a paper on discussions about global warming in the forums appended to newspaper articles, categorized strategies used by "deniers" (perhaps more correctly called "obfuscators"), and discussed how those might well have emerged from traditional approaches to teaching science (Bowen and Rodger, 2008). What is interesting to me is that four years after that data set was collected, when I look at current articles about global warming (such as the recent newspaper article by McCarthy, 2011) the forum discussions are often populated by many of the same individuals, with the "deniers" continuing to use the same strategies for arguing against global warming. Now that's not to say their arguments are the same arguments, often the points they were making four years ago have been negated through new research, but they continue to make ad hominem attacks (reduced somewhat by an improvement in moderation by the media outlet), raise straw dogs, deflect to other topics (such as air pollution) and so on. Throughout the years some of the previous "deniers" were outed as having significant investments in oil and gas production, or were working for the oil or gas industry and have "disappeared", although my reading of these forums over the years suggests that they have simply switched to another pseudonym and continue to argue against global warming or against its occurrence or against any mediating steps, etc.

So how does this relate to "media coverage" of global warming? Firstly, and this will be elaborated on in the discussion section, inaccuracies (either factual or in nuances of language) in reported stories often provides an access point for "deniers" to argue against global warming science (or policy). Secondly, I wish to propose that there has been a shift in what would be considered the "unit" of a media report. Prior to the internet, the readership only read and engaged with the content of the article in the media. The "unit" of media was merely that of the journalist's article itself. Now, however, I would suggest that the "unit" of media is constituted by both the article and the following discussion forum. This has implications for

journalists, because I believe that now journalists are not only responsible for "getting the story" right, they also have a responsibility to address how their story is engaged by others. If they have taken journalistic short cuts to portray information (such as some of those described below), and if these are then used by others to re-frame the meaning of the story, then the journalist (or the media outlet) has a responsibility to redress this in the discussion forum. I would argue that one cannot both claim a special role in society to inform the public, as journalists have, and then turn around and ignore their work then contributing to *mis*-informing the public through being redefined by others in text appended to their articles. Readers now form their perspectives on the topic through reading both the article and the comments, so if the intent of the article is to lead to a particular understanding in the average reader (who apparently reads the forums but does not post in them), I would argue that the responsibility of the media to be 'accurate" in what they report now also includes redressing misrepresentations of the story content in the discussion forums.

## The Media Making Sense of Science: A Case Study of Two Publications

Although the purpose of this article is to discuss the news media representing climate change science to the general public, climate change studies are often both quite long and quite complex so it is more difficult to summarize issues of news media representation of that research. Thus, to address this problem, I've chosen to discuss the media representation of a shorter research article (4 pages long) without the co-varying interval-ratio variables or mathematical models such as is often found in climate change research – in the chosen study there are four discrete treatments and a limited number of measured outcomes. This analysis will involve an examination of two "media" articles[1] written



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REPORT

**Retrieval Practice Produces More Learning than Elaborative Studying with Concept Mapping**

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ABSTRACT

**Educators rely heavily on learning activities that encourage elaborative studying, while activities that require students to practice retrieving and reconstructing knowledge are used less frequently. Here, we show that practicing retrieval produces greater gains in meaningful learning than elaborative studying with concept mapping. The advantage of retrieval practice generalized across texts identical to those commonly found in science education. The advantage of retrieval practice was observed with test questions that assessed comprehension and required students to make inferences. The advantage of retrieval practice occurred even when the criterial test involved creating concept maps. Our findings support the theory that retrieval practice enhances learning by retrieval-specific mechanisms rather than by elaborative study processes. Retrieval practice is an effective tool to promote conceptual learning about science.**

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**Figure 1: Screen Capture of an Article on the World Wide Web.**

[1] My thanks for a conversation with Don Duggan-Haas from which this topic arose. I had posted the "Wired" article on my Facebook wall and he copied it to his wall with the comment that it "has a different spin than an earlier" article he had read. Then a friend of his posted the New York Times article on the discussion thread; that was the article Don had read. I read both of the popular news media articles, then the original research article and supplementary materials. This analysis derives from those readings.

about a research article published in the journal "Science". Figure 1 provides a screen capture of the journal website depicting the article and summary information around it (captured 19 February 2011; located at http://www.sciencemag.org/content/early/2011/01/19/ science.1199327.abstract).

Although the print version of the journal publication (Karpicke and Blunt, 2011) is dated 11 February 2011, Volume 331 (p. 772 – 775), according to the publisher's website the article was available online prior to that on 20 January 2011. A news article about the research in the journal article appeared in the New York Times (online edition) on 20 January 2011 and in Wired Magazine (online edition) 21 January 2011. This apparent "rush" to publication, also described and discussed in later sections, is seemingly typical of news media reporting on science research – It is after all, as one instructor in the journalism program kept repeating, "The news, not the olds."

However one does wonder exactly why there is the rush to publish articles such as this in the popular press, because the science research itself is hardly time-sensitive. One might, however, infer that the publisher or the author was "pushing" the research into the media because the graphs used in the "Wired" article (Keim, 2011) were marked with the text "Embargoed until 2:00 PM US ET Thursday, 20 January 2011" suggesting that the news media had received advanced copies of the article. An advanced receipt may also explain the length of the New York Times article, as the more time a writer has to produce a story, the longer it is (Long, 1995).

This type of promotion of science articles used to be unusual, but scientists are now being encouraged to promote their science into the public sphere by people such as Nancy Baron (author of "A Guide To Making Your Science Matter: Escape From the Ivory Tower", 2010) who runs workshops and gives talks to scientists about promoting their research into the public news media. However, what this means for the public is that it is not the reporter determining what is relevant or significant research (a role the news media used to serve), that is now being determined by an outside agency or individual who provides "significant" research to the journalist. So, now a news media consumer must question the motives of those involved in determining what research ends up being promoted in the popular press. There is, for instance, a lot to gain for an assistant professor applying for tenure if their research is promoted in the popular press; any review committee would look on that favourably. But, does that warrant the research being written about for the general public? And why this piece and not others?[2] In many cases one should probably also ask whose political agendas are being forwarded by those research articles being written about.

The New York Times article (Belluck, 2011) was titled "To Really Learn, Quit Studying and Take a Test". It was 1133 words long (using the MS Word "word count" feature) and in addition to interviewing the lead author – Karpicke – also involved interviews with five other cognitive science researchers commenting on the findings of the research study. Despite frequent use of the word "test" throughout the article, the activity engaged in by the students does not reflect a "test" as most would think of it. Firstly, students didn't receive any mark, nor did the assessment by the researchers "count" for anything; for the students it was definitely a "low stakes" assessment. Secondly, there were no questions asked in that particular treatment – students spent 5 minutes reading a passage of text, and then had 10 minutes to write down what they could recall from it. They then repeated that sequence once more. In that context I would argue that calling that activity a "test" would be inappropriate and that then suggesting that "To Really Learn, Quit Studying and Take a Test" is a relevant summary of the research is a misleading representation of what was reported in the research. And although I'm not suggesting that the basic premise of the research would not provide insights useful to the researcher's broader agenda, as described it has little application to a classroom (despite content in the article both directly and indirectly suggesting it does) as it tests four completely discrete conditions which do not, in my view, represent realistic studying conditions. For instance, I've never heard a teacher or a researcher suggest that using a concept map as the only form of studying was sufficient. Or that just reading text was sufficient. None of this type of critique is apparent in

[2] A section below discusses this very issue with a case study of a public talk.

the NYT article, nor is the way in which the material was tested a week later critically examined at all (in the first "experiment" 84% of the calculated score on the final test derived from questions which were low-order memorization questions). I'd also suggest that the reporter did not adequately interrogate the reported results. For instance, suggesting that "students who read a passage, then took a test asking them to recall what they had read, retained about 50 percent more of the information a week later than students who used two other methods" ignores that the improvement is only around 30 percent for the higher-order inferential questions (only 2 inferential questions were asked; worth 2 marks each) and that this was masked through the researcher collapsing the question types together. Overall, my reading of the New York Times article suggests that what is being promoted by the author is a pro-testing agenda, which was not really the purpose of the "Science" research article and so the research is being mis-represented.

The "Wired" article (Keim, 2011) was titled "To learn best, write an essay" and is a much shorter article (221 words) relying entirely on material provided in the "Science" journal article. Yet, despite the length in some ways the "Wired" article more accurately represented the findings of the research stating, in its lede, "Trying to remember what you've just studied, then writing it down, may be a surprisingly good way to learn." Arguably this is a good one-sentence summation of the research article. However, the "Wired" article ignored presenting any statistical analysis of some of the data resorting to a comparison of the means: "Students who originally wrote essays performed best. Next came the crammers, then the concept mappers." This avoidance of statistical comparisons and focus on the comparison of means could lead to misunderstandings in the reader. For instance, the quoted sentence (i.e., "Students who originally…") suggests to the reader that the differences between treatments were unambiguous. Yet, despite the inference to the contrary in the statement, there was no statistically significant difference between the "crammers" and the "concept mappers" and both were significantly different (i.e., lower) than the "essay writers". In addition, the writer does not distinguish between the two different studies reported in the journal article, and by so doing conflates the findings of the two different studies. However, unlike the NYT article, the "Wired" article does include the graphs depicting the findings of the first study, so it is possible for the reader to understand the degree of some the differences and draw some of their own conclusions.

Although both news article were consistent with normative media practices of reporting only on a single research article, I would argue that neither news media article did a thorough job of either representing or critiquing the findings reported in that journal article. This is problematic because in the first case the general public doesn't have access to the journal article, and in the second case doesn't have the background to allow them to effectively understand the research article in the context of other research. Thus, in neither case would the public be able to accurately understand the findings of the article and what the implications of that research were. If issues like this arise reporting on such a small and simple study, where the news media distorts the original findings and don't place them in a critical framework, just what can we expect of them in representing more complex research, such as that of global warming, to the public? More importantly, why do these issues arise? The following sections deal with other case studies which will provide insight into how these problems in media representations of science arise.

## The J-School Experience: Insights into Media Practices Reporting Science

During my sabbatical year I was interested in exploring my familial roots (my father, who died when I was thirteen, was a journalist; my mother studied radio broadcasting) so I spent time participating as a student in a journalism school for the first half of the program. During those four months I participated in courses teaching the "basics" of print and broadcast journalism and then took a 6-week "radio workshop" which was responsible for providing (content, production and reading) the daily evening news for a local community radio station for the final five weeks.

My work as a professor in education involves engaging my students in a melding of conceptual insights, based on research in education, and practical approaches to science teaching that are consistent with that research. Given the similarities that journalism has to education (performing the role of conveying information to others in a manner they can understand it), I can say that I expected somewhat similar approaches to teaching journalism. In fact, I can say that given the rather extensive critique of the practice of journalism present in both the research literature and trade books, I particularly expected a rather thorough discussion of those critiques in a journalism program so that practices criticized in current journalistic practices were either not replicated or at least were in full knowledge of what was being done. However, much to my surprise this was not to be the case – in fact there were only a few circumstances where research on journalism was referred to either explicitly or implicitly – in general the journalism classes and workshop focused almost entirely on procedural methods with almost no conceptual content whatsoever. There was also almost a complete lack of meta-thinking/talk or reflection about journalism or the role it serves in society in either the "basics" part of the program or in the workshop – in point of fact, in several instances discussions with several of my faculty instructors made it abundantly clear that they themselves were unaware of the details of any critiques of journalistic practices. This probably explains why they often had us engage in actions/practices which were consistent with the practices identified in the literature as problematic.

As an example, in the workshop I participated in the instructor was fond of saying that a story had to "focus on one person, doing something, for a reason." This perspective tremendously affected the types of stories that were covered because, as he pointed out early on, "process stories are boring." In other words, stories about individuals and what they were doing were encouraged and stories about ideas or events were discouraged (unless seen through the eyes of an involved individual). Now, science stories are often about ideas, ideas that formed from the practices of collections of scientists, so this meant that unless an individual scientist could be interviewed about a particular story, then the story itself wasn't approved. As a consequence, a story proposed about the Atlantic launch of the Science Media Centre of Canada (an organization formed to improve the reporting of science stories in Canadian media) and the panel presentation/discussion with science journalists, with interviews proposed with several people (a science journalist, a science blogger, the SMCC director, etc) was supplanted by an interview with one of the science journalists participating in the panel discussion that evening which, unsurprisingly, mostly focused on that journalist (as opposed to the SMCC). As a consequence, science stories that did get permitted were most often not about broad issues, but about the actions or findings of an individual – in complete contrast to how science claims arise from the collective actions of (often many) individuals operating within a community of practitioners. This focus on "individual" scientists undermines and devalues the collective work that scientists do which result in scientific claims of fact which derive not from one individual, but from research which extends from the work of a community and thus leads to an inappropriate understanding of the practice of science in the public (Charney, 2003).

Apart from this issue there were others about course content, and what wasn't addressed in the courses…the courses designed to guide new journalists in what their practices were to be and how they were to think about those practices. For instance, I was surprised at how courses did not involved discussions about the nuances of using language or how to effectively use background sounds (and associated fade-in and fade-out and volume issues) in a radio news story to improve how a story sounded. However, as a non-English major (having studied science) it was the lack of discussion around the subtleties in the use of language I found most surprising. For example, consider the nuances of using language to convey what others are saying (Table 1):

| **Table 1: Changing the "Verbs of Saying"** |
| --- |
| • And she warns that if B.C. and Canada adopt a cap-and-trade system, domestic |

businesses will be out of step with the direction of U.S. regulation.*

- And she says that if B.C. and Canada adopt a cap-and-trade system, domestic businesses will be out of step with the direction of U.S. regulation.
- And she insists that if B.C. and Canada adopt a cap-and-trade system, domestic businesses will be out of step with the direction of U.S. regulation.
- And she believes that if B.C. and Canada adopt a cap-and-trade system, domestic businesses will be out of step with the direction of U.S. regulation.
- And she states that if B.C. and Canada adopt a cap-and-trade system, domestic businesses will be out of step with the direction of U.S. regulation.
- And she argues that if B.C. and Canada adopt a cap-and-trade system, domestic businesses will be out of step with the direction of U.S. regulation.
- And she claims that if B.C. and Canada adopt a cap-and-trade system, domestic businesses will be out of step with the direction of U.S. regulation.
- And she suggests that if B.C. and Canada adopt a cap-and-trade system, domestic businesses will be out of step with the direction of U.S. regulation.
- And she predicts that if B.C. and Canada adopt a cap-and-trade system, domestic businesses will be out of step with the direction of U.S. regulation.

* Original statement from the article "From carbon steam to cash flow: Companies implementing new technologies could see a profit in a cap-and-trade system" by Patrick Brethour posted in the Globe and Mail online edition 7:00 AM EDT ON 29/03/07.

In each bulleted point in Table 1 the third word, known as a "Verb of Saying"[3] was different. Reading each of those statements one by one the importance of which word is used in that third position becomes apparent, because each colours the interpretation of the subsequent statement somewhat and thus conveys a slightly different meaning. Consider, for instance, the difference when using "warns" as compared to "insists" – the first sounds helpful, the second somewhat desperate. Given the importance of choosing the appropriate term, one might expect that a journalism program would discuss that the accuracy of quotes and statements lies not just in the words being used, but also in the tone being set by the speaker and, just as importantly, what word is chosen to express that tone. However no such discussion occurred either in the "basics" courses or in the radio workshop. Based on my observations in the program, such a discussion was clearly warranted as I observed numerous instances where I felt that a stronger "verb of saying" was chosen than was appropriate; often in the aid of contributing to making a stronger statement than I felt the speaker intended. Do I think there was anything necessarily capricious in this? No, in fact I don't even think the journalism students consciously noticed what they were doing. But generating more drama (see Nelkin, 1987; Curtis, 2007), as media these days seems prone to do, to generate a greater emotional reaction in the reader/listener can distort the very issues that journalists are supposed to be objectively reporting on and is misleading – there is no objectivity if emotional "impact" for dramatic purposes takes precedence over accuracy in conveying the meaning of the text. Both the content of what was spoken (known as the "referential function"; Jakobson, 1960) and the emotional state of the speaker (known as the "emotive

[3] My thanks to Robert Lyon, former English Department Head of Fergus High School, for introducing me to this term and discussing the issue with me. This discussion helped clarify my thinking on the significance of this issue.

function"; ibid) are important components of effectively conveying the meaning of a statement. In fact, I would argue that conveying both (the textual meaning and the emotive meaning) accurately is requisite for the recipient to understand the meaning in the manner intended by the individual being quoted. Consequently, expecting that journalists have a conscious awareness of this issue and that journalism students should have their work examined to ensure they are accurately conveying the meaning and emotive tone of someone being quoted would not seem to be an unreasonable expectation. Such was not done.

Douglas McGill, an online commentator and writer on the media, argues:

> What journalists need to think about seriously right now is language itself – its essential nature, its cultural meanings, and most importantly its social uses and modes of action.

Language after all is the very medium of journalism, the substance that journalists sculpt and shape into journalism's many forms. That many if not most working journalists never spend a single hour seriously studying the manipulation of language by power – for example in its forms as rhetoric and propaganda or public relations – is a stunning, troubling fact. (2006)

Indeed, only a few of the fifty students I was in the program with came from academic backgrounds within which I suspect such subtleties would have had the opportunity to arise as part of the subject matter, so learning about them in the journalism program was probably necessary. One reason I participated in the journalism program was to learn to write to a different audience…as an academic one becomes skilled at writing to peers and professional audiences, but I had begun to believe that the only way to influence the public on these issues was to write to the general public. One reason for my not continuing through the latter half of the program (which would have comprised two more workshops and one course on media law) was that I concluded that I wasn't going to learn anything further about the subtleties of writing in the media for the general public, nor was I going to learn anything conceptual about the roles or practices of the media. The next section is a specific case analysis of a copy story proceeding from its initial drafting to its final broadcast in an evening radio news show, highlighting the changes the text undergoes through that trajectory.

## Copy Story Modification

This section describes the manner by which a copy story, a short news item, was created for radio broadcast. The copy story was written following a broadcast the previous day which had included a "live" phone interview with someone who was in Cancun for the upcoming 2010 Climate Change Conference.

It is common practice for "copy stories" to be written by someone delegated to the task. Nowadays that person or persons usually uses the internet (accessing newspapers) or "wire" stories (from various news agencies; e.g., Reuters, Canadian Press, etc.) to draft stories to be read by the news reader for the news broadcast. These copy stories are often around 20 seconds long, although they may be somewhat longer depending on station policy, the topic, or the wishes of the host (newsreader) and producer.

The particular story being described here was drawn from two separate articles in the Guardian Newspaper in England. The first article was "2010 on course to be joint hottest year since 1850" (Reuters, 2010a). The second article was "UN: Greenhouse gases at highest level since pre-industrial times" (Reuters, 2010b).

The Copy Story Writer's responsibility is to find the "nugget" that is central to the story, and summarize it so that it can be read out-loud by the news reader or host. However, between the copy story writer and broadcast lies the show producer (responsible for the content and management of the entire show) and the news reader (who reads the stories on-air, announces the time, etc). In some cases, or for some shows, one person may serve both roles. Each read of them read each copy story to make sure that the words flow in a

way that works for the reading style of the host and that the content "fits" with other items chosen for the news broadcast. The producer is responsible for the show length and tone (knowing all of the pieces that are going to be incorporated in the show), and so may have changes or suggestions that involve both content, length and "fit" with other news pieces.

The particular copy story being examined here is slightly longer than the norm, but that is because that copy story actually incorporated two news media stories. The Copy Story Writer drafted the story on the topic of climate change and then presented it to the Host/Producer who edited it, returned it. The Copy Story Writer then revised the story and again presented it to the Host/Producer. This iteration happened three times in total for this story. Another approach that can be taken is that the Copy Story Writer just passes the computer file to the host/producer and they edit it themselves, but that depends on the time available to the various participants and the circumstances around the production of other stories. In this instance editing was done by pen on hard copy and passed back to the Copy Story Writer.

In editing the first version of the story (Table 2, Column 1) the Host/Producer attended to the top half of the story (this is a consequence of other demands being made simultaneously) and, following an interruption, the Copy Story Writer took the edits on the top half and revised the text according to the provided feedback.

The text revisions on the initial draft are significant for two reasons. Firstly, in the second paragraph the replacement of the provided text with "it was the warmest October on record worldwide" significantly changes the meaning of the text. The original story (Table 2, Column 1) was explicit in mentioning "surface" temperature, and that was included by the Copy Story Writer because it has a specific significance in climate change science. In the segment below the Copy Story Writer discusses changes proposed by the Host/Producer for the climate change copy story:

> Host/Producer: {reading paragraph, saying some of the text out loud, and crossing text out while reading it} "October's surface temperatures", no no.
>
> Copy Story Writer: {interrupting} I was going to explain why it used "surface."
>
> Host/Producer: It's fine, I don't care.
>
> Copy Story Writer: This stuff is the stuff that's measured on the surface, as opposed to measured from satellites. That's the difference. That's why it's surface temperature; it's measured by stations around the globe that have been recording temperature for a long period of time.
>
> Host/Producer: ...we don't need to go into all of the background. If someone wants the background they can go into it. We're just trying to tell the story. We're not trying to tell the story about the difference between surface temperature and satellite temperature. (From notes made in workshop notebook)

In that first editing of the copy story the Host/Producer also significantly edited the second paragraph crossing out "highest average temperature for this point in a year" and changing it to "as the hottest year".

Again, the Copy Story Writer explained to the Host/Producer why that specific language had been used (it was only the first ten months of the year that were the "highest average temperature for this point in the year" compared to the first ten months of records from previous years). And again the Host/Producer indicated that the change to "the hottest year" was sufficient for the purposes of the news broadcast. The Copy Story Writer took the written edits, edited the file, and returned it to the Host/Producer.

Version 2 of the story (Table 2; Column 2) was presented to the Host/Producer and a colleague by the Copy Story Writer were further significant edits were made to the second half of the copy story.

The first paragraph was changed from "yet" to "on the ground" because the Host/Producer pointed out that a few weeks before there had been snowfall that had stayed on the ground for an evening, and thus "on the ground" was a more accurate description.

The first significant edit changed the reference to greenhouse gases' "highest recorded levels" to "their peak since they started recording them" (this was after the Copy Story Writer pointed out that the initial edit to just "highest levels" was misleading).

The second last paragraph removed the detailed description of "climate change conference did not result in an agreement between countries" and changed it to "was a bust" and "countries couldn't reach an agreement."

The final paragraph ("And expectations for success at the Cancun conference are mixed") was changed to "Hopefully Cancun can do better."

These edits were incorporated into Version 3 (Table 2; Column 3) and then submitted to the Host/Producer for feedback. Three significant changes were made:

- In the fourth paragraph the reference to "the industrial age" was removed.
- In the second last paragraph the generic reference to the conference not resulting in an agreement was removed and replaced by a specific reference to "Countries" not being able to agree.
- In the final paragraph the referent was changed from the conference to "Countries" doing better through the addition of "they".

The final copy (Table 2; Column 4) was what was read for the news broadcast.

**Analysis of Copy Story Modifications**

The changes made to this copy story as it progressed from the first submitted draft to the final broadcast are an interesting insight into media representations of global warming science and how it is portrayed to the public. In this particular case the modifications were made by those who were in journalism school, but notably someone who planned on focusing on science journalism suggesting that in the writing of their own future stories they would make the same sort of decisions for the same expedient reasons they did so here, but without the producer/editor knowing that they had been made.

It should probably first be mentioned why the articles from the Guardian were chosen for writing the copy story from. In choosing to write about this topic the Copy Story Writer was following up both on a previous day's story as well as his and the Host/Producer's interests (not to mention the interests of others in the newsroom). Despite one of these original news articles coming from a UN press release and the other from NASA (both of which are located on the eastern US seaboard), the main reason the articles were chosen from the Guardian paper in the United Kingdom was because on that day they had not yet been published in a Canadian or a major American news source. This may have been a consequence of the ~5h lead time that a British newspaper would have (because of time zones) and the slowness of the Google aggregator to show such an article, however when the articles were chosen from the Guardian in the early afternoon on the day of broadcast they were not yet on the Globe and Mail or the Toronto Star website or the Google news aggregator despite their origination from organizations in the local time zone. The Copy Story Writer was also aware that European media had been presenting a more complete picture on global warming issues than had North American news media (Dispensa and Brulle, 2003) and this also undoubtedly influenced the choice.

In the initial draft (Version 1) of the story there were eight paragraphs. In the first edit the fourth paragraph was eliminated, and in the second edit the original seventh paragraph was split into two statements resulting in the final copy having eight paragraphs. The original draft was 124 words (including the bridging words that tied together two related news items) and the final broadcast version was 106 words long. However, making it somewhat shorter changed some of the accuracy of the content of the science and also, through removing the bridging phrase "In a related story….", made it more of a longer single story than two related stories (copy stories are normally 18-20s; this one was almost double that). Overall five of the eight final paragraphs contained information about global warming that could be considered either inaccurate or misleading.

The above description of the various edits described what was changed in the various drafts; the following analysis will discuss the implications for each of those changes (comparing the broadcast version to the original version) for a listener with respect to what problems arise in relation to understanding climate change science or policy.

The changing of the phrase "surface temperature" to "temperature" means that the listener no longer knows where the temperature was measured. In global warming research the phrase "Surface Temperature" has specific meaning, and NASA's use of the term has even greater specific meaning for how they collected and analyzed the temperatures. Removing the specific reference to "surface" temperatures means that the listener may assume that the temperature was collected and determined in other ways. Clearly, based on the described discussion about the change wanted by the Host/Produer, the Copy Story Writer was aware of the distinction and wanted attention paid to that detail, but the Host/Producer thought that the difference was irrelevant. In fact, in examining the records of global warming "deniers" collected for the Bowen and Rodger (2008) paper one can see that it is this exact form of change in specifics that provides a foundation for "deniers" to criticize not just the work of the journalist but also allows them to raise doubt and uncertainty in the mind of the media consumer about the credibility of the original research itself. This highlights the importance for those producing news items to not just understand the specifics of the language used by the scientists, but also to understand how the media's practices end up influencing the public (this relates to my earlier argument about responsibilities of journalists in a Media 2.0 world where media consumers participate in constructing the broader publics interpretations of the news media provided information).

The third paragraph was altered so that the understanding that the temperature was warmest comparing the first ten months of the years for which temperature had been recorded was now lost. Instead, the listener would understand that the average temperature of the first ten months of 2010 was warmer than the twelve months of any previously measured year – not necessarily surprising might think a North American as the colder months of November and December in 2010 were not included in that average. Again, it is this very sort of poorly phrased statement that allows "deniers" to influence public understanding of what the journalists have reported.

The fourth and fifth paragraphs in the final version did not contain any misleading or inaccurate information.

The sixth paragraph in the final version, "Last year's conference at Copenhagen was a bust" is both a value judgment (particularly in comparison to the original paragraph which was accurately descriptive) and to understand it in isolation the listener would have to know what the outcome of that conference was. However, the following (seventh) paragraph somewhat provides that context.

The seventh paragraph in the final version stated that "Countries could not agree on how to deal with climate change." This phrasing implies that there was broad disagreement between countries, however only a few countries did not agree with the drafted agreement and as such it was not adopted. Additionally, it further implies that the "country" could not agree, whereas in some cases it was particular negotiators or government officials that did not, not necessarily the overall electorate. One might argue, for instance, that a

majority of Canadians were interested in dealing with climate change, but that their government at the time did not. However that is not the type of understanding that would emerge from that final version. Thus, there is a subtle difference between saying that "Countries could not agree…" and the original "…did not result in an agreement…"

The final paragraph in the final version again reflected a value statement (i.e., "hopeful") that might implicitly derive from either the broadcaster and/or the host (and notably might alienate audience members who do not support government making changes to address global warming; which the original statement would not have done) or might be taken to reflect the perspectives of either NASA or the UN weather agency. Although thinking that it reflects the host or broadcaster may not necessarily be inaccurate or

**Table 2: Editorial Revisions of Copy Story by Host/Producer**

| Version 1 | Version 2 | Version 3 | Broadcast Version |
|---|---|---|---|
| With no snow yet in XXX, you probably won't be surprised at this news. | With no snow ~~yet~~ ON THE GROUND in XXX, you probably won't be surprised at this news. | With no snow on the ground in XXX, you probably won't be surprised at this news. | With no snow on the ground in XXX, you probably won't be surprised at this news. |
| According to *NASA* scientists ~~October's surface temperatures set a new record high world-wide.~~ IT WAS THE WARMEST OCTOBER ON RECORD WORLDWIDE. | According to *NASA* scientists it was the warmest October on record [half-pause] world-wide. | According to *NASA* scientists it was the warmest October on record [half-pause] world-wide. | *NASA* scientists say it was the warmest October on record [half-pause] world-wide. |
| This means that 2010 is ~~still tied~~ NECK AND NECK with ~~1998 for having the highest average temperature for this point in a year~~ AS THE HOTTEST YEAR. | This means that 2010 is neck and neck with 1998 for having the highest average ~~yearly~~ temperature. | This means that 2010 is neck and neck with 1998 for ~~having~~ the highest average temperature. | This means that 2010 is neck and neck with 1998 for the highest average temperature. |
| ~~In a related story…~~ The ~~United Nations~~ UN'S weather agency ~~– the World Meteorological Organization –~~ also announced today that greenhouse gases have reached the highest recorded levels. | ACCORDING TO ~~T~~the UN weather agency ~~also announced today~~ that greenhouse gases have reached ~~the highest recorded levels~~ ~~THEIR HIGHEST LEVELS~~* THEIR PEAK SINCE THEY STARTED RECORDING THEM. | According to the UN weather agency greenhouse gases have reached their highest recorded levels ~~since the industrial age started~~. | According to the UN weather agency greenhouse gases have now reached their highest recorded levels. |
| These reports were both released just before the 2010 United Nations Climate Change Conference starts next week in Cancun, Mexico. | These reports were both released just before the 2010 UN Climate Change Conference[,] WHICH starts next week in Cancun, Mexico. | Both of these reports were released just before the 2010 UN Climate Change Conference which starts next week in Cancun, Mexico. | Both of these reports were released just before the 2010 UN Climate Change Conference which starts next week in Cancun, Mexico. |
| Last year's Copenhagen climate conference did not result in an agreement between countries on how to deal with | Last year's CONFERENCE IN Copenhagen ~~climate conference did not result in an agreement between countries~~ | Last year's conference in Copenhagen was a bust. | Last year's conference at Copenhagen was a bust. |
| **Legend:** strikethrough indicates removed, Upper Case is added text. | * reporter intervened and said they'd been at higher levels in the past, so host/producer inserted following text. | | |

problematic, to ascribe "hopefulness" to an outcome to either the UN or NASA scientists could lead to the perception that they have a bias in their science (as has occurred in many other such instances)

To summarize, clearly the changes that were made could very well lead to different understandings than would occur from the original press articles about either the global warming science itself or policy issues around those. More problematically, several of these inaccuracies or misrepresentations (particularly the third and fourth paragraph, and possibly the eighth) that if they appeared in print media are the type that provide a foundation, based on comments collected for research for the Bowen and Rodgers (2008) paper, for deniers to seed suspicion about the motives of the scientists and the accuracy of their science. This further suggests that journalists reporting on science issues, such as global warming, need to have both a firm grasp of the science and an understanding on how the work of journalists is being used by others, either directly or indirectly, to influence public debates.

## Demonstrating the Need for Science Journalist Experts

None of the issues I've described or in the literature are necessarily helped by trends in who becomes a journalist and what types of jobs they do when they become a journalist. In the recent class of fifty journalism students in the one-year program I attended there were three with a background in science (notably all in biology) and one with a background in health science (i.e., nursing qualifications). Although no historical data for this program was available, there is little doubt that the decline in full-time science journalism positions does not encourage people with science backgrounds to apply for journalism programs. Some maintain that this does not matter. At the Atlantic Canada launch for the Science Media Centre of Canada, an audience member asked the panellists (which had four current science journalists on it) about whether it made sense for someone who was interested in becoming a science journalist whether they should study science and then become a journalist, or whether they should become a journalist and then focus on learning to write about science. The panellists, in their collective response, essentially indicated that they didn't see that it mattered whether one had a science background and then became a journalist, or whether one's science literacy was developed on the job.

Although I'm not necessarily convinced of the equality of the routes discussed above, as I believe that many of the nuances of language and practice in science are less likely to emerge in the latter route, inadvertently one of the panellists in response to another question at this event highlighted an issue with regards to science journalism that effectively negates my concerns about the equality of those routes to becoming a science journalist.

The following segment is the presentation by a current national science reporter at the Atlantic SMCC launch. In the broadcast the need for the SMCC was first introduced by the radio announcer:

> "The need to understand the science behind everything from invasive species to the latest treatment for MS has never been greater. Yet, the ability of the media to tell complicated science stories is being compromised by the demands of the 24h news cycle, shrinking numbers of newsroom staff, and the fact that few media outlets have the luxury of allowing reporters to specialize in science reporting." [Originally broadcast 16 November 2010; transcribed from a streaming audio record at http://www.cbc.ca/ maritimenoon/2010/11/telling-science-stories-phone-in-pain-management.html on 14 February 2011]

In the introduction the host highlighted that science stories are becoming more and more important, and that it is getting harder and harder to report on them effectively, concluding that the Science Media Centre of Canada will therefore fill an important role (an argument also made by its executive director at the live event).

Following that introduction there was a panel of science journalists who were speaking to the audience. The second panellist (identified below as "Panellist A") spoke about the difficulties associated with being a medical reporter. The narrative is interesting because it highlights that even the voice of the "expert" on reporting science can be over-ruled by an "unknown" other (in this case probably the show producer).

> Panellist A: But first I want to tell you a little story. And that is something that happened at the end of last week. Two fairly big medical stories were breaking late in the afternoon one day. One was to do with a new drug called {drug x} which is something that everybody has been waiting for. It's an oral, a pill you can take as a blood thinner. As opposed to having to take warfarin that you need to have your blood tested. It's a big deal. So with only a few hours I was trying to figure out should we get something up on this, how could we do that. At the same time I got word about a study that showed the first evidence of ability to detect lung cancer at an early stage. And of course lung cancer is the deadliest cancer because it's undetectable when it's early and treatable. So, two stories, up the pipe they go to Toronto, "What do you like?" Well, I was disappointed. Toronto wasn't as excited about the lung cancer story as I was so they were just going to do a little copy. So then we turn our attention to the {drug x} story[4], which you know is an interesting story which will have impact for a lot of people. So then you've got to find your experts and say "What do you think about this? Is this, it feels big, is this really big?" and you know I talk to the author of the original research, talk to other experts that I know, some of whom may be here tonight. Uh, and, you know, the consensus was this is huge. People have been waiting for this. So this was more or less the story I did. And I have to say I think this was the first time in ten years of doing this that I did a "Ooh, there's a new drug on the market story". And I felt a little bit uncomfortable about that. And sure enough, the next day, I get an email from somebody who says, "We actually have some concerns about this research." And I thought "I knew there was going to be somebody out there." I just couldn't find them when I had three hours to mount a story. So I feel as though I didn't really get all the angles covered on that. And that is the worst feeling. You know, I hyped a drug. Uh, that now, somebody says "That could potentially harm someone. There's a signal that maybe there's an increased risk of myocardial infarction." That's a bad feeling as a health reporter. So, we do struggle to get it right, and there are a number of challenges that can impact our ability to do that.
>
> [text removed]
>
> "My story is a minute and a half long. Well, what can I tell you about a really complex story in a minute and a half?"
>
> [text removed]
>
> It's a tough job to do even when you do it every day. But there are 100's of general assignment reporters out there who are asked to do this at the drop of the hat. "Here's this great breaking medical news story. Go get it." Don't know where to begin, don't know the right questions to ask, don't understand what the potential biases of the research are. All of those things. So I guess that's where I see the Science Media Centre is a very valuable organization for people who are dropped into what could be complex kinds of stories to tell.

When the panellist finished the full narrative, another panellist, "B", proceeded to ask a question:

> Panellist B: …Panellist A said some really fascinating things I think. One is that someone in Toronto…made a decision that the blood thinner story was more to their taste….And, you know, one of the things I'd like to know is, what is driving those decisions?

[4] It is worth noting that three months later the Canadian Cardiovascular Society released new guidelines for treatment of atrial fibrillation, which affects 250,000 Canadians, and in those recommended that "drug x" be prescribed instead of warfarin to reduce stroke risk because it has fewer [known] side effects (Picard, 2011).

> Panellist A: Uh-hmm. Ya ya. Um, in terms of story selection, it would make my job a lot easier. Sometimes it's who's on the desk, sometimes it's that there may be some relation to a previous story that was of interest, or maybe they don't want it because there was a previous story somehow tangentially related "Oh we've heard that before" so you can't really predict. And sometimes it's maybe my pitching. Maybe I'd didn't pitch it right. Maybe I didn't say the right things that made somebody say "Oh, that'd be good."
> Panellist B: And it would depend who you were pitching it too.
>
> Panellist A: Absolutely, yeah.
>
> Panellist B: So see there's a lot of behind the scenes stuff that makes it kind of tricky.

This anecdote was particularly interesting coming from such a senior journalist voiced in a public forum as it describes several issues that are common in science journalism. However, this sort of story is not uncommon; other journalists have related similar stories to me about being pressured by those above them (such as editors or producers) to produce stories, or slants in stories, that will lead to the most drama in the piece and, supposedly, most interest amongst the consumers irrespective of whether what they were asked to focus on represented the most accurate version of the whole story or not.

The statements made by Panellist A are interesting for several reasons. The first reason is the way in which the concept of "big" in reference to the story, as the reference is presented as if the concept of what was an important story was separate from the interests and focus of the journalist-panellist and whatever resources they had to learn about stories. This de-personalized presentation of why it was chosen from any number of potential stories available on that day would thus decrease any critique a listener might have as to why it was chosen, as the statement was made unambiguously. Consider, for instance, if the journalist had said "There were two stories that I thought were really big that I learned about late in the afternoon one day." In that instance an observer might both question why that journalist thought they were big and how the journalist came to learn about them. By using the statement that was used any impact of public-relations mechanisms in how that information comes to the attention of the journalist is considerably downplayed and, I would argue, falls out of consideration by the listening public, as does any bias of the journalist in their interests or background and how something might be considered a "big" story.

The second feature of the statement that is worth discussing is the process by which decisions are made about "stories" which may not reflect the more involved understanding of the person who will be responsible for the story. Such a condition also existed in the "copy story" section where the more thorough understanding of the topics (through both having read both Guardian stories in detail and other background knowledge) were over-ruled by the host/producer. In this current example two stories were pitched by the specialist reporter to a seemingly unknown decision apparatus "up the pipe" in Toronto and the consequence was that one story was picked, the other (despite the interest of the reporter) was not for reasons unknown by the reporter. It is unlikely, given the rarity of journalists with science backgrounds, that whoever made the decision had a science or medical background so the reporter's background and interest was essentially meaningless in this context. In general then what this means is that the availability of science specialist reporters is more-or-less meaningless if their expertise is sidelined in choosing what stories are significant. Apart from that, one also must wonder what would have happened if those stories, rather than appearing on the same day, had appeared on sequential days. Would they have both run? There are not science stories broadcast each day on newscasts, so was it just bad timing? And even given that, if both are "big" stories (as the journalist stated) then what would the problem be with running both stories, but on different days? I questioned the aspect of "rushing" stories out earlier, and again in this particular instance I think of no reason that one or both stories could not run on different days. This "fast out the door" practice seems completely counter-productive for doing science stories well.

In point of fact, the journalist in this excerpt describes how the short timeline she had meant that she "missed" a critique of the product and thus hyped a drug that there may be actual problems with. One must ask why the story wasn't given 27 hours to come together rather than 3 hours so that the "big" news was done thoroughly and well by specialist reporters, not to mention the non-specialists who would have many fewer resources to draw on.

**Connections between the Anecdote and the Radio Workshop**

In the broadcast work of the radio workshop similar patterns of behaviour were evident in creating reports as were described by the senior science journalist. Although this suggests that the environment of the workshop paralleled that of a commercial broadcast station, this is not necessarily the best way to enculturate newcomers (Lave and Wenger, 1991), particularly in a situation where changes from the current culture of practice are perhaps necessary. The issue of "what is important" for broadcast (see Gans, 1979) was highlighted through other events in the radio workshop. For instance, if too many stories were prepared for broadcast some were dropped, yet I am aware of no instances where they were introduced in a later broadcast even when promoted by the journalist who conducted the interviews and did the story (basically representing a day of work, for which no academic credit was received either as only broadcast pieces were assessed). There is, for many stories, no reason for a later day broadcast not to occur that I can think of, and therefore such practices would appear to be more of habit than necessity. Unless a piece is "timely" (i.e, something happening today) I cannot think of a reason, particularly in a journalism school but also in real-life, that prepared science pieces should not be broadcast on a different day, given the time to be prepared thoroughly, and given the length to be effectively descriptive. In the radio workshop every story that was successfully pitched was given a length and a "type", but that did not mean that they necessarily got broadcast. Additionally, pieces were sometimes given much less time than necessary to do a thorough job of representing the topic so that all accepted stories could be fit in. This both created a rush-to-finish environment and contributed to errors (both editorially and factually) that were in the stories. When stories were successfully pitched it might make sense to have one or two fewer pieces each day (where some were scheduled for a subsequent day) which would then also provide sufficient time in the broadcast for the pieces on that day. However, in the journalism school students were not taught to consider what length they would need to do a good job on the piece, but instead settled for whatever they were given. Given these practices and others, I would argue that if the role of media is to inform then the practices being taught in the journalism school run against effective informing of the public and it is therefore not surprising for working journalists to just accept the times and topics afforded to them by producers who make decisions knowing few of the details about how "big" the story is. Consistent with this, as described by Panellist A, despite thinking that the cancer detection story was more significant, she did not describe going and arguing the decision with whoever made the decision.

**Being the "Instant Expert"**

The excerpt from "Panellist A" describes the issue of "generalist" reporters having to do stories outside of their areas of expertise. In the radio workshop, although we received feedback on every broadcast (not, note, every story) from the supervisor/instructor each week we also had feedback from someone (either a working reporter or producer) who listened to our show and critiqued each piece. One of these reviewers had just that week gone back to being a beat reporter after being a producer and host of their own show. His assignment as a reporter for later that day (90 minutes or so after providing us feedback) was to attend a

government press conference and then write a story on it for later that afternoon. In discussing this assignment he made the following comment (recorded in class notes):

> I'm going to have to go and learn about rural economic development. I don't know anything about rural economic development, but I'm supposed to go and listen to the Premier speak on it.

He also made other comments about this topic including how unprepared he felt to do this story and the responsibility he had for getting it "right." This theme of needing to be an "instant expert" within very constrained timelines was a constant refrain of the instructors throughout the "basics" courses taken in journalism school. Clearly, based on the comments of the above journalist, Panellist A and the constant emphasis on this in the school it is an acceptable part of journalism culture to consider oneself someone who is capable of being an "instant expert."

When participating in the radio workshop it was obvious that this "instant expertise" often played out in the most superficial manner you can imagine, and as a consequence science issues (not to mention others) were not necessarily represented accurately. In one case I happened to be overhearing the recorded script and interviews for a story that had been "pitched" a couple of days earlier. That pitch derived from a sign that the reporter had seen in a window about a product that a company wanted to test on people who had already been treated for cancer. His involvement in other activities meant that the reporter had longer than usual to prepare the story (the only instance I'm aware of this happening) and so, supposedly, had plenty of time to background research. For the story the reporter interviewed a senior company official about the "trial" of the product (Which had advertised for curiously low numbers compared to trials one normally read about in the media) and then interviewed a local medical researcher about what conditions were necessary to effectively test a medical product. However, while listening to bits of the interviews and recorded script as the story was being constructed I began to wonder, because the tone of the piece seemed to suggest that the product being tested was something which could contribute to treating cancer. Curious, I asked the journalist if the product was curative or palliative, and then had to explain the distinction between the terms. What became obvious, ninety minutes or so before deadline (for submitting the story for that evening's news broadcast), was that the reporter didn't actually know whether the product was curative or palliative and hadn't even considered that issue, so he phoned the company president and asked for a clarification discovering, consequentially, that the company's product was palliative – something intended to improve the quality of one's life as one recovered from the cancer treatment. In this instance this clearly was happening not because of the pressures of time for producing a piece but rather because of the journalist culture that *accepts* that being an instant expert, without necessarily doing any in-depth reading on the topic, is sufficient for being a reporter on a topic. This belief in the acceptability of being an instant expert, I believe, contributes to many of the errors about science which appear in the North American media and exposes an implicit arrogance that what they can do under pressure and with short timelines is sufficient for informing the public. Further, one could also speculate that the lack of expertise (and the lack of recognition that lacking that expertise is a big problem) also contributes to poor questioning when conducting interviews for stories. I will note that there was little evidence that pre-interviews were required in the workshop (we were told they were, but most students never conducted pre-interviews before their pitches and comments were never made about that) nor was there ever any apparent checking that stories were being checked factually, that copy stories accurately reflected original source material, that anyone had gathered sufficient background to write about the story authoritatively, or that interviews were accurately represented in the brief segments that were chosen for the story. In general, all of this suggests that the "instant expert" who is implicitly trusted is an accepted part of journalism culture as conveyed by the journalism school – which also means that the ethical standards of the journalists, even in journalism school, are assumed to be sufficient[5] and are taken at face value.

[5] I could, but will not, relate many instances which lead me to believe that such an assumption is unwarranted.

## The Reducibility of Complex Relationships

This lack of in-depth understanding of a topic is exacerbated by another "belief" that journalists appear to have: that any topic, no matter how complex, no matter how abstract, can be reduced to simple, concrete relationships that the general public can understand. This belief was voiced several times throughout the journalism "basics" courses, and even underlay some of the comments made by science journalists in the SMCC panel discussion. Although I won't go into great depths here critiquing that belief, the idea that complex systems can be fundamentally and effectively understood through reduction to a few simple ideas or relationships misrepresents the very complexity of our world, and can lead to great misunderstanding. In climate change comment threads it is quite common to see comments such as "How can there be global warming, it's only October and I'm seeing snow" which is of course, not at all inconsistent with the more irregular patterns in weather that global warming will result in.That there are a range of mixed outcomes in multivariate climate change models that portray complex systems seems to be seen as evidence by many that global warming is not happening, and the portrayal of simplistic systems in the media (including, for instance, the removal of qualifiers such as 'surface' and 'satellite' temperatures), one could argue, have contributed to this perspective.

## Conclusions and Implications about Science in the News Media

I'm going to discuss the implications of the cases discussed above under three sub-headings: science in the media, what j-school suggests about future journalism, and what the implications are for using media in the classroom with students to help them learn about socio-scientific issues such as global warming.

**What This Means for Understanding Science from the Media**. There are any numbers of issues which arise from the previously discussed cases, and none of them suggest that the public should take at face value any of the science research presented in the media. First there is the question of how it was chosen, or even if it was (given the influence of press releases and public relations activities), by the journalist. Their personal biases and interests remain unexplored despite the influence it might very well have on what science is portrayed in the media with much of the science in the news media being either medical or environmental (Einsiedel, 1992) apparently reflecting either the interests of the journalists or the editor/producer (who might be operating on some sense of "what the public wants" that from personal experience I suspect is a "seat of the pants" assessment for most of them). Additionally, the qualifications of journalists to write about certain topics is almost never critiqued, the assumption that they can be "instant experts" means that someone with a background in English can one day be and education reporter for several years and then be assigned to be a science reporter at the whim of an employer without any apparent expertise in either area. To pretend that the details can be understood with minor preparation by working on the stories reflects either an ignorance of what it takes to become an expert or an arrogance about their own abilities to become one. In concert with this is the naïve belief, perhaps coupled with arrogance, that complex relationships are always reducible (in a few column inches or a few minutes of broadcast) by *them* to simple relationships which nonetheless can accurately and effectively inform the public about the issues. This latter belief alone illustrates why it has been so difficult for the media to inform the public about socio-scientific issues in the last few decades as they have become more and more complex. Despite the fact that research suggests that if journalists had a better understanding of science and the work that scientists do it may result in a reduction in the negative perceptions of science and scientists contributed to by agents such as the media (Reis and Galvao, 2004), there is little evidence that news media organizations are interested in developing this (Saari, Gibson & Osler, 1998) or, seemingly, that journalism schools are either (at least the one I attended).

Apart from all of this, the apparent demands of commercial media, which reassigns (or constantly assigns) journalists at a whim whilst providing them little time or resources to develop insights, suggests that the news media organizations accept doing an inadequate job of conveying information accurately to the public as part of their business; apparently accuracy and depth can be sacrificed on the pyre for the sake of commercial interests. This means that however dissatisfied one might be with the state of science journalism, there's little chance that it's going to get better, at least in the traditional news media.

As briefly mentioned earlier, this has some considerable implications for the public with respect to socioscientific issues and public opinion. In my earlier paper (Bowen and Rodger, 2008) although I noted that "deniers" often picked up on and exploited language used by journalists (as opposed to that in the original science) as a way of arguing against global warming (including against policies that may address carbon production) the above cases provided fresh insight into that. Overall, I do not think I am making an egregious claim when I argue that in many cases it is the loose language used by journalists, for whatever media expediency they may believe in, that provides a foundation for those who wish to argue against the science of global warming. Consequentially, I agree with Oreskes and Conway (2010) that journalists are complicit in the negative public opinion that exists in North America regarding dealing with global warming. This, one would think, would seemingly have consequences for the preparation of new journalists.

**Looking at J-School Outcomes**. In my experience faculties of education take a determined look at what goes on in schools, and then ask what they should be doing with their students so that the problems that exist in current schools do not continue. I will readily admit that despite their best efforts it may be difficult to advance change in schools, including for reasons that are embedded within faculties of education, however in some way or another they take that task on as part of their role of preparing future education professionals. After progressing half-way through a journalism program I cannot say that I think that the program I attended, or other programs similar to it (and others were described to me both by professors and other students as being similar[6]), make any serious attempt to try and address issues in current journalism practices and the effectiveness (or lack thereof) by which the media informs the public. Few of the practices suggested, for instance, by Lave and Wenger (1991) for enculturating newcomers to a profession were present in the program I attended. Nor was there any evidence that work was being checked for accuracy of either content or in reflecting the content or emotive nature of interviews. In the end the problems I described in the j-school program in this paper paint a bleak picture for the future of science journalism, because if journalism schools are not going to prepare future journalists to address problems with media reporting on science issues, then who will? Saari et al (1998) make the argument that effective science writing is unlikely to emerge from media organizations themselves. What this suggests, again, is that the problems that exist in science journalism now are unlikely to be improved upon in the future. This leaves one asking where does this leave schools with regards to using news media in the classroom?

**Implications of Using News Media in the Classroom for Socio-scientific Issues**. Although many suggest that students should learn more actively about global warming using media in the classroom, teachers themselves probably do not have a background sufficient to help students address incorrect statements in the media about global warming science (see Fortner, 2001; Khalid, 2001; Norris et al, 2003). Given the above, this is problematic, and for reasons that go beyond media representation issues.

There is another way to look at this. Perhaps we are asking too much to ask students to engage critically in ideas, and particularly evidence, about global warming or other socio-scientific issues at all. Sadler et al

[6] That's not to say that there are not J-schools that take a more conceptual approach to teaching journalism so that its students are more reflective about their practices. For instance, Columbia Journalism Professor Judith Matloff (2011), commenting on her academic program, said "…generally you have to remember the curriculum of the school is a much more theoretical one and it's more craft oriented, safety training is not something which is usually incorporated in an academic program" suggesting that they deal with more conceptual and theoretical issues in the Columbia School of Journalism program than did the program I was in.

(2004) report that "just under one-half of students sampled were not able to accurately identify and describe data" (p. 402) and there is little reason to suspect that they have any experience with anything other than single dependent variable relationships from their experiences in schools (since that is the type of study that student teachers design when asked to design an investigation). Not only are there potential issues with students data literacy, there is also little evidence that teachers will have the requisite skills to address those data literacy issues (see Bowen and Bencze, 2008; Bowen et al., 2010; Millar and Wynne, 1988) suggesting that teachers are perhaps ill-prepared to scaffold students on the complexities and nuances of science, not to mention the multivariate complexities of global warming science.

Yet, clearly this is a defeatist attitude. Rather than viewing global warming science from a data literacy perspective, perhaps getting students to engage with global warming science through critical media literacy activities might be productive. For instance, using the Google news aggregator students could find multiple articles on the same topic and compare them for differences and then critically compare those to the original news release or publication (such as was done above with the New York Times and Wired article analysis). Using such an approach would actually help develop media literacy as well as data literacy because students would have to examine original source documents and define terms so that they could best understand the media representations.

However, it is still easy to see where problems could arise with this approach. The media, and critics of global warming science, rapidly grabbed onto a statement in emails which were (illegitimately) downloaded from the Climate Research Unit's email server in which Phil Jones, a climate scientist, wrote, "I've just completed Mike's Nature trick of adding in the real temps to each series for the last 20 years" taking the word "trick" to mean that something inappropriate was being done with the data and therefore that the claims emerging from the data were incorrect resulting in a "scandal" referred to as "Climategate."[7] Reading the offending email, and with my science background in analysis involving multivariate statistics, I found nothing offensive about the statement as it colloquially suggested some sort of transformation or use of a covariate – a completely normal practice in science analysis. Indeed, my assumption was consistent with the argument of others with a science background (see http://www.skepticalscience.com/ What-do-the-hacked-CRU-emails-tell-us.html; see the interview at http://voices.washingtonpost.com/capitalweathergang/2009/12/gerald_north _interview.html). However, that simple statement about a "trick" was used repeatedly in the media and blogosphere to suggest that there were the problems with claims emerging from the CRU about global warming. Given that my background in data analysis, as historical now as it may be, is uncommon for a teacher to have, one is left wondering just what a teacher would do with students who brought that quote of using a "trick" forward, how a teacher would explain it. Even doing media comparisons, or comparisons to source information, in this instance could leave a teacher in considerable quandary with a high likelihood of not being able to adequately explain or defend the context of how the word "trick" was used.

So where does that leave us? For me it means that perhaps we should re-think something like global warming being dealt with in a science classroom. School science curricula, in both the information portrayed in graphs and activities in which students are engaged, deals almost exclusively with single dependent-variable relationships. Nothing suggests to me that most teachers or students have a background sufficient to effectively engage with discussions around global warming science that incorporated the broad public perspectives that the topic has, nor that students or teachers could engage with available datasets in any effective manner. So, perhaps phenomena such as global warming need to be dealt with as a sociological construct by those who are more used to dealing with those; such as social studies teachers. Maybe this is where it would be useful to use news media to discuss the issue of global warming. I'm no longer as convinced as I used to be, particularly given the media commentary of the last few years, that teaching about

[7] Formal investigations by multiple authorities concluded there was nothing in the emails regarding inappropriate analysis or conclusions about global warming. Wikipedia has a full discussion for those interested

complex socioscientific topics should be done in science classrooms at all given the complexity of resources (such as misrepresentative statements in news media) that exist for students to access. The manner in which the public and the media engage socioscientific issues in contrast to the science (see Beacco et al., 2002) leaves me more and more convinced that sociological not scientific perspectives provide a better foundation for students to engage those issues.

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