SPINNING HEADS AND SPINNING NEWS: THE AMERICAN MEDIA'S GAP IN QUANTITATIVE REASONING SKILLS

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News increasingly depends on a careful dissection of numbers. Statistics are everywhere, from how many people are not covered by health insurance to whether Vitamin E is good for you or not. Yet for being so prevalent, statistics are badly understood by journalists and the general public. Misguided representations of science can actually shape public policy, legislation, and individual choices. We describe why it is so important that media writers understand basic concepts from statistics, epidemiology and even toxicology using examples in current media coverage. We also discuss the gulf between the scientific and media cultures, which can lead to bad science coverage. We finish with constructive suggestions for improvements in communication of scientific progress by media writers.

BACKGROUND

It may be a national pastime to deride the media. As we discuss below, scientists have little confidence that most media outlets can talk about issues involving statistics cogently. Statistics education has slowly started to be recognized as having central importance in a newly data-drive society. While much statistical education is school-based, there is without a doubt a need to improve the understanding of statistics by those who use it in a public forum, such as journalists. In this essay, we describe some of the perceptions that scientists have about media sources of information, and then continue to discuss some of challenges that journalists face in using statistics effectively in their work. Much, much more can be found at the website for Statistical Assessment Service (STATS) www.stats.org, where I am Director of Research. This role, in addition to my "main" appointment as a professor of mathematics at George Mason University, has led me on an unusual path toward non-institutional public education.

SURVEYING (SOME) EXPERTS ON RISK

Ideally we could quantify just how bad the situation is with the media's understanding of statistics. Unfortunately we haven't the resources to do a content-based examination of journalist's statistical strengths and weaknesses, but we were able to survey some scientists on their perception of journalistic know-how.

In recent work, Statistical Assessment Service (STATS) found that among one group of scientists, toxicologists, there is deep professional distrust of the media. We surveyed the Society of Toxicologists, emphasizing both evaluations of general risk of commonly found chemical exposure to humans, as well as an evaluation of media presentations and discussions of these risks. For information on how the actual risks stood up to professional scrutiny, see the full report at www.stats.org or http://www.stats.org/stories/2009/are_chemicals_killing_us.html.

The important point we note here is the impression that these professionals have of media discussions of risk. In our survey, the toxicologists overwhelmingly felt that the media do not do a good job in portraying actual risks of chemical exposure (as perceived by the toxicologists). Survey respondents expressed a large majority opinion that risks are *overstated* by local broadcast (81 percent), broadcast news (80 percent), cable news (76 percent), USA Today (66 percent), local papers (77 percent), news magazines (72 percent), national papers (71 percent) and PBS/NPR (56 percent). Of these, very few respondents felt that the corresponding news organizations were accurate or understating risks; most of the respondents who did not say that these organizations overstated risks declared that they did "not know" whether the risks were over, under, or accurately stated.

The contrast with web-driven information was stark. Only 23 percent felt that Wikipedia overstated risk (two percent felt they understated risk, and 21 percent felt Wiki was accurate -- the remaining respondents did not know). Similarly, 19 percent felt that WebMD overstated risk, three percent felt WebMD was understating risk, and 28 percent felt that WebMD was accurate.

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In addition to overstating risks, the media are accused of poor judgment in how to present the studies they cite. Nine out of ten toxicologists fault the media for an unbalanced picture of chemical risk without the presentation of diverse views. A full 95 percent of respondents rated the media's performance as "poor" in distinguishing good from bad studies, distinguishing correlation from causation, explaining the trade-off between risks and benefits, distinguishing absolute from relative risk, and explaining odds/ratios.

There are many reasons why toxicologists may lack confidence in media outlets. One may be the fact that the media often report scientific results before the results are published in a peer-reviewed journal (90 percent agree that peer review should occur before news coverage). Another may be the very nature of journalism; in order to generate the kind of hype that sells news, media outlets may naturally tend toward exaggerating risk.

This survey also illustrates the cultural divide between journalists and scientists. Mainly, a journalist sees an unusual outcome in a scientific study and thinks, "That makes for a great article!" while a scientist seems an unusual outcome and thinks, "What went wrong?" Journalists like conflict and disagreement, while scientists search for consensus. Journalists have to move quickly from one piece to the next, while scientists labor for years on the same topics. Journalists like clear messages, while science is typically messy and nuanced. Typically, journalists do not understand scientific culture and scientists do not understand the culture of journalism. This lack of common cultural ground unfortunately fosters miscommunication.

REGRESSION TOWARD THE MEAN: A SIMPLE PRINCIPAL THAT SCARES THE NON-STATISTICAL

There are many statistical concepts that journalists struggle with, or ignore entirely, and yet arise in new coverage. We take a moment to discuss one, mainly *regression toward the mean*. Regression toward the mean is a statistical phenomenon that eludes journalistic understanding, despite its very simple explanation.

The classic example of regression toward the mean is that tall people tend to have shorter children, and short people tend to have taller children. But this very example belies the problem (in explaining the concept to a non-statistician), as it hardly seems true that tall people have short children. Sure enough, tall people certainly tend to have tall*er* children than short people do. But they tend to have children shorter than themselves. Even this simple observation seems counterintuitive to most people.

The point is that some tall people (not the very tallest) have children taller than themselves, so that the new generation has the same average height. It's not that short people are suddenly having tall children.

To a journalist, the word "regression" is rather off-putting and the classic example using heights is difficult to understand. It would be a rare journalist indeed who notices the kind of bias that regularly occurs in news reporting due to regression toward the mean.

A recent example came up in media coverage of some interpretations of an American national math test, given by the National Assessment of Educational Progress. *CNN* reported the result that "School Math Scores Show Improvement" (December, 2009), whereas *The Christian Monitor* reported, "No improvement for fourth-graders on national math test" (October, 2009). They were speaking about the same test, and indeed the same grade level's test results. The difference between these two assessments is simply that *CNN* took a look at some urban centers, where improvement had been found (though not in all urban centers) and neglected that other students' performance had worsened.

Regression toward the mean can be expressed as simply a "statistical phenomenon" that occurs whenever one makes a measurement of data. If someone is measured to be average height, people can imagine that their children will be average height, but only *on average;* some will be a little taller than average and some will be a little shorter, in equal measures. The conceptual problem lies with considering the outliers. If someone is very tall, his or her children will also be tall, but *on average* not as tall. The new tall people of the next generation will come from the tallest people as well as some people who are not the tallest, but happen to have tall children. Similarly, retesting the worst test performers will (on average) produce better test results, even if no educational progress has been made.

ONE STUDY TRUMPS ALL

One of the principle ways that journalists use statistics is by writing about scientific studies, especially ones involving human health. Despite difficulty with many statistical ideas, big and small, the overwhelming mistake that journalists make in writing about health involves their addiction to the immediate, most recent study on any topic. For example, a recent study of Chinese men in Singapore (Mueller, 2010) came out pointing to increased risk of pancreatic cancer associated with soda consumption. The media described this result with little reference to the scientific literature around the topic and often with no qualifiers.

MSNBC, for example, entitled their article (Reuters, Feb. 9, 2010) on the topic, "Study links sugary soda to pancreas cancer" and added the teaser, "drinking just two or more sweetened soft drinks a week increases risk". The first sentence of the study continues, "WASHINGTON -- People who drink two or more sweetened soft drinks a week have a much higher risk of pancreatic cancer, an unusual but deadly cancer, researchers reported Monday." The rest of the study declined to mention any other research on the topic. Even worse, it indicated that the study based on data from the Singapore Chinese Health Study was the *only* study, quoting an author who believes the findings would apply elsewhere, as if "elsewhere" hadn't already been considered. The caveats were the disbelievers (as opposed to other scientific studies), such a board member of the publishing journal who works at the Yale Cancer Center stating that "Although this study found a risk, the finding was based on a relatively small number of cases and it remains unclear whether it is a causal association or not." She also noted that soft drink consumption in Singapore is associated with other adverse health factors, such as the consumption of red meat and smoking, "which we can't accurately control for."

Lacking in the *MSNBC* coverage is the fact that there have been numerous other studies on the topic, using data from American, Canadian, and European men and women. The largest of these studies was about ten times as large was published in 2008 in the *American Journal of Clinical Nutrition* (Bao, 2008), and included survey data of almost 600,000 people who are members of the American Association of Retired People (AARP). This study found no association between sugar soda (or other sugar consumption) and pancreatic cancer.

The analysis of the Singapore Chinese Health Study data (with about 60,000 people), however, agreed with some other small studies of about the same size. Some of them noted that the most marked risk seems to occur among overweight and sedentary people.

Other news organizations had slightly better coverage of the topic, though typically still declined to provide contextual information for the result. The *Los Angeles Times,* for example, began with the statement that "Sugar-sweetened sodas -- with their high-glycemic load eliciting natural suspicion -- have been linked with varying degrees of success to an increased risk of pancreatic cancer."(Dennis, Feb. 8, 2010) Again, this "varying degrees of success" suggests only that we do not know the magnitude of the link, rather than pointing to other, in one case much larger, studies that do not find a link at all.

This constant emphasis on the most recent scientific work hurts the presentation of risks, as it dismisses previous research that often provides an important contextual basis for readers to evaluate their own risk. If for example, the articles pointed to the large study with no link, several smaller studies that do find a link, and perhaps other studies finding a link with smoking and/or red meat, a typical reader would have a much fuller picture of how well we have identified (or not) which behaviors increase the risk of pancreatic cancer.

CAUSATION VERSUS CORRELATION

While it is a basic statistical tenet that causation (when one thing *causes* another) is not the same as correlation (when we observe two things *occurring at the same time*). However, it is a tried-and-true journalistic technique, and perhaps human nature, to look for causes whenever we see two things happen at the same time, without regard for coincidences.

There are many instances when the media turns correlation into cause without good reason or the evidene to back it up. Television, for example, is often blamed for an assortment of social ailments; in the past two years, we have seen it blamed for obesity, depression, violence, and early onset of sexual activity. Indeed, it could very easily be quite the opposite: depressed people may be more inclined to watch television, obese people to feeling sedentary and wanting to watch TV,

violent people to be attracted to violent television, and sexually active young people to watching soap operas (with sexually active adults). Yet the logic behind this difference is difficult for many to work through. Just last year, *The New York Times* (February, 2009) noted that adolescents who watched television for nine or more hours per day were subsequently more likely to develop depressive symptoms as young adults, compared to those who watched less than three hours per day. But any parent would ask, "Who is watching nine hours of television per day?" In other words, the context is highly suggestive that there may be other factors involved that may provide a causal explanation. Yet *The New York Times* did not even pose the question. It's only when the absurdity of the situation is pointed out that people stop to chuckle – and yet, we should be questioning these causal claims even when the possibility of a causal link does not seem absurd.

STEPS TOWARDS INCREASED NUMERACY IN PUBLIC DISCUSSIONS

It is a challenging task to increase statistical savvy in the public forum. At STATS, we work with journalists toward an increasingly accurate picture of risks or other statistically oriented reporting. We provide "STATS Simplified" http://www.stats.org/faq.htm, where we put into a writer's terms many of the basic statistical concepts that come up frequently. These include basic percentages, the difference between causation and correlation, the meaning of "statistically significant," the difference between absolute and relative risk, the difference between different types of studies (controlled, observational, case-control) and confounding factors. All of these issues come up time and time again as media writers consistently misunderstand these basic issues.

We also run workshops for journalists and give many public lectures. One of the techniques we use in these lectures is to bring up an emotionally hot topic to get people excited and opinionated. These have included in the past abortion, breastfeeding, chemical contamination, and the H1N1 flu vaccines. The more people are agitated and opinionated, the more they are invested in engaging in the discussion of what the data "really say" and why.

We also provide logistical and technical support to journalists as they work on pieces close to a deadline, and finally, we put do our own in-depth reporting on many of these topics which we hope serves as a model for good, statistically oriented journalism. We hope these efforts lead to a stronger conceptual grasp of these topics, which in turn leads to the kind of investigative reporting about statistics that we commonly have with political investigative reporting. Instead of simply repeating the abstracts from scientific journals, we could have reporting that truly touches people's lives through in-depth and careful investigation of topics of interest.

One of the themes we emphasize is that there are rules to good reporting on health findings. These include the following.

- Learn about the scientific consensus and put any new study in that context;
- Not all studies are equal. One should evaluate how good a study is and emphasize large, well-designed, careful studies more than smaller, sloppily done studies;
- Read more than the abstract of a new study. The discussion of the results and the limitations are often very helpful to understanding how strong a study is. The introduction often places the study itself into a historical context;
- Report sources. Link to the original article as well as any others that are used to give context;
- Include the opinion of disinterested experts;
- Investigate sources and standards for the research (for example, does the laboratory follow Good Laboratory Practice?). Check for financial *as well as ideological* motivations.

CONCLUSION

As statistics educators in an increasingly data-driven society, we need to be aware that our impact is far greater than it used to be, and far more important. Even if students of a "Stat 101" course end up with a clear understanding of the differences between cause and correlation and the meaning of a 95 percent confidence interval, we will have made great gains in promoting communication that uses–and uses clearly and correctly–quantitative reasoning. As the media today struggles through declining revenue to prove its relevance to society, it must adapt and provide readers with a synthesis that uses all their talents, including those statistical.

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