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The Dubious Credibility of Scientific Studies

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Abstract

The current process of undertaking, implementing, reviewing, and finally publishing a scientific study is riddled with flaws, as study results are subjected to many biases and interpretations at every level between inception and publication. As a result, when these studies finally reach the public, they are often depicted in ways that fail to reflect the genuine results and are at times utterly incorrect. Industries touting their products, scientists influenced by grants and prestige, reviewers adhering to personal political agendas, and journalists pressed to sell papers all in turn contribute to the inherently skewed depiction of scientific results to the public. These factors have allowed for a highly unpredictable credibility in scientific reporting, an observation that has been highly overlooked and disregarded. The dissemination and publicity of this incorrect or skewed information, which is believed to be scientifically accurate, can have a detrimental effect on the public in their everyday lives.

Introduction

When it comes to scientific studies, we have heard it all. Thousands of tips and suggestions pour in from the plethora of news and media resources we peruse daily, often leaving us questioning the validity or even the sanity of the "scientific" conclusions they represent. Can chocolate really cure cancer? Is alcohol actually healthy for you? Is eating egg yolks as bad for you as smoking? Claims such as these lend a glimpse into the imperfect processes that lead to the scientific reports you read about in the paper, stemming from biases and misconceptions that experimental data are exposed to prior to being revealed to the public. And while many of these conclusions are outrageous enough to sort the fact from the folly, many widely accepted experimental theories are also outcomes of this skewed process.

The inconsistent accuracy of scientific reports and studies shown in the media has been largely overlooked and disregarded. By the time many stories have reached the public, the experimental results have been subjected to several biases and interpretations that cause many reported conclusions to be either completely false or highly skewed to a particular end.

At the source, the motivation behind many experiments is industrial companies aiming to increase sales of their products. These experiments are often held to a much lower standard than professional experiments in a company's haste to endorse and find no fault in their products. With these same intentions, these industries might ignore or disregard crucial results that don't lend themselves to their economic agendas, leading to false advertising of the effectiveness or safety of a product.

Scientists themselves add another layer of potential biases to a topic prior to its release to the public, with the pressures to have their work published and to find conclusive, valuable results to attract attention and grant money. Additionally, on the side of the journalist reporting on scientific topics, media companies are more likely to seek topics and headlines that shock and draw in audiences, often at the expense of accuracy or true depictions of results. Furthermore, many relevant and important topics reported on in the media often prove too difficult to follow and form opinions on due to the complicated processes and considerations that scientists must undergo in experimentation before definitive results can be announced. In this way, topics are often misinterpreted or taken out of context, which can lead to conclusions that are completely off-line with the true interpretation of the data.

The accumulation of all these factors illustrates that there is a real and immediate problem in the reporting of scientific topics to the public that affects the credibility of information coverage, following the numerous biases it is subjected to.

The Middleman

An Eye for Advertising: The Lure of Associating Topics with Science

The authority and precision of science in the public eye offers an easy means of persuasive and nearly incontrovertible advertising for those who can exploit it. One such use of this advertising is in the endorsement of industrial products. Dorothy Nelkin, a Professor at NYU in the Department of Sociology, described how industries will often employ teams or "truth squads" of scientists to support company products and refute claims against them, using the influential nature of scientific-associated data and jargon (1987, p. 137). This has occurred with industries such as nuclear energy plants in salvaging the reputation of nuclear fuel after the infamous Chernobyl incident (1987, p. 137).

In the interest of maximizing product sales, companies will often integrate some form of scientific jargon or data, likely with statistics or graphs, in an attempt to associate their product and its efficiency with the air of truth and wisdom often accompanying scientific ideas. Unfortunately, "even trivial elements can increase public persuasion despite their not truly indicating scientific expertise or objective support" (Tal & Wansink, 2014, p. 117). In other words, the inclusion of graphs and statistics cannot confirm the use of sound scientific research behind data—in fact, it often doesn't. Yet this is what many readers' preconceived notions of scientific topics can lead them to believe. A study conducted by Aner Tal and Brian Wansink at Cornell University in 2014 set out to discover how much an association with science can affect the believability of a claim. They hypothesized: "Given the high standing of science in society, merely implying legitimate scientific standing can enhance persuasion due to the enhanced credibility of scientific sources" (2014, p. 117). The group then tested how believable participants found a claim to be, based on what information was associated with it. Based on their findings, they concluded that: "Even easily produced, trivial elements that are associated with science, such as graphs, can enhance persuasion. These findings demonstrate that companies can easily abuse the prestige with which science is held. Adding even trivial or peripheral elements that are associated with scientific objectivity can help persuade people of product efficacy" (2014, p. 124).

One paper in 2013 by Marisa Díez Arroyo from the Universidad de Oviedo on the advertising of cosmetics demonstrated the different forms that these integrations of science take in advertising, from charts and statistics to the inclusion of Latin and Greek-based rhetoric due to its association with scientific jargon. They explain how "advertisers seek to take advantage of the social consideration of science" by including such additions to their product advertisements, often without the implied scientific backing (2013, p. 203). The study describes how the terminology of these claims can persuade buyers to purchase their products, with statements such as "[created from] a team of dermatological scientists and cosmetic chemists" or "[following] five

years of research" (Díez Arroyo, 2013, p. 204). Otherwise, "Advertisers emphasize that the solution offered, i.e. the product, is the best possible one because their methods are backed by scientific proof" (Díez Arroyo, 2013, p. 204). This tactic becomes more troublesome, however, as it demonstrates how the mere inclusion of scientific terminology has the same or similar effects on the persuasion of a buyer. Without any sort of proof, either real or fabricated, these companies can imply almost the same credibility in their advertising through the use of scientific jargon.

In addition to these advertising tactics, other corporate influences can surround scientific claims. However, readers and viewers are often screened from the clear biases involved in research surrounding company products. The associations with commercial organizations is often hidden or buried so that the potential influences on the results are less obvious. An examination of a recent major study concerning the health effects of genetically modified crops found that the study, which had reported finding significant evidence of health detriments in consuming certain GM crops, was furtively funded by several organic crop companies and headed by a large opponent of the implementation of genetically modified crops. This raises some questions about the validity of the study, as it is almost entirely motivated by those with strong opinions on the subject (Lynas, 2014). These studies, along with other similar ones, demonstrate the ease with which companies can influence the information that is presented to the public for their own commercial means, which has allowed for a highly unpredictable credibility in scientific reporting.

The use of scientific teams, sometimes referred to as "truth squads," employed solely to create scientific data to support a company's product in advertising has become a common practice for industries (Nelkin, 1987, p. 137). Many public relations firms urge the use of this strategy in company advertising (1987, p. 137). Part of the problem with the current system lies in the legality of most of these occurrences. Rarely do industries deploy completely incorrect information to the public, though they might manipulate and skew wording and data. I interviewed Michelle Marvier, Ecologist and Professor at Santa Clara University, for her take on this topic. She spoke about her experience with science in industries and recalled that they "did the bare minimum as required by the government" in the configuration of the experiments, with minimal sample sizes and limited analysis. "Why would they be expected to work really hard to find problems with their products?" (Marvier, 2016). The reality of the situation is that there is no motivation for a company to report unbiasedly on their experiments.

Journalistic Agendas

Passed through the hands of scientists, experimental reports then step into the arena of the journalist, where they are subjected to further instances of bias and partiality. From the reporter's perspective, stories that are published must have a certain appeal to them to draw readers' attention,

which presents a situation in which the skewing of reports towards this ideal dramatization can significantly convolute its meaning and implications. Studies that show ambivalent results can quickly escalate to a "New Hope or No Hope" style of reporting. These headlines, which imply scientific truth from results that are not yet conclusive, shock readers into picking up a newspaper or magazine (Nelkin, 1987, p. 113).

In this dramatizing field, hesitance in drawing set-in-stone conclusions due to the potential effects of experimental error is scarce. An experiment that might have begun as a simple correlation can be transformed into superlatives and absolute truths to establish credibility and spark interest in stories. These black-and-white depictions of scientific research are intended to create "sensational headlines and programming...to advance their own and their advertisers' social and political agendas" rather than genuinely reporting on the facts of a study (Kornhauser, 2012).

Although journalists may not explicitly intend to misrepresent the details of a study, there is a very real chance that the draw of flashy headlines is incentive enough to skew the depictions of important studies' results. One specific journalistic strategy is to inflate the importance of a topic to invoke in readers a sense of urgency—describe life-changing facts and data that must be addressed as soon as possible and that readers feel are important enough to elicit action. Marvier describes, "There is definitely pressure to frame...results in a particular way. If you have a study that says something is actually recovering, or doing okay, that's not going to sell newspapers" (Marvier, 2016). This plays into an idea that she describes as the "fear appeal," which is that when a story or a study proclaims immediate, detrimental effects, readers are enticed to listen to what they have to report.

Interpretations and Context: Misusing and Misleading

Another prevalent factor contributing to the skewed perceptions of results from scientific experiments stems from barriers in communication, first between the scientist and the journalist and then between the journalist and the layperson. With the numerous and complicated processes that are often characteristic of scientific experimentation, implications and understanding can become lost amongst the scientific jargon in each of these two stages.

A study published in a standard scientific journal is intended for an audience of fellow scientists—not so much for the journalist, who is frequently ill-versed in scientific literature. Historically, the ambiguity of the wording in these reports has led to many misinterpretations of studies. One study by the National Academy of Sciences (NAS) Institute of Medicine described the uses of saccharin, an artificial sweetener, as "of moderate to high risk" yet did not suggest a ban; this seemingly ambivalent description led to several very different conclusions on the topic by some leading newspapers (Nelkin, 1987, p. 53). The *Times*

newspaper in Britain at first reported saccharin to be a "moderate cancer-causing agent," only to repeal its statement at the protest of the scientists involved in the experiment, and later reported an opposite, and still incorrect, interpretation (Nelkin, 1987, p. 53). Further, the *Washington Post* initially published that there was "no evidence" of cancer caused by the use of saccharin, only to report three days later a statement to the contrary from the NAS panel's chairman. Meanwhile, the *New York Times* simply focused on the "standoff" amongst the panel members itself, a dramatization that was based solely on the original ambiguous statement and not any details from the actual panel meeting. This disarray of information in reporting no doubt caused much confusion amongst the public as to the true effects of consuming this additive, prompting an encompassing question of credibility.

Part of the difficulty in deciphering these scientific reports stems from the fact that many news outlets are uninformed about the nuances of interpreting experimental results because it simply isn't their field. Furthermore, there is often a significant lack of reporters assigned to scientific topics, which makes it unreasonable to expect them to be able to build up a proficiency in scientific jargon. UT Southwestern professor Tom Wilkie wrote in his article in the Lancet that journalists must often cover many unrelated and significantly different topics and that "Such a small number of people face obvious logistical difficulties simply in covering news events as they happen, without the problems of trying to develop deeper expertise in any particular topic" (Wilkie, 1996). The distinction between *correlation* and *causation* in experimentation holds a key point of confusion in interpreting results. The graphical connection between two topics shown with statistical methods does not necessarily prove a real relationship between them. Writer Stephen Milloy stated ardently in one Consumer's Research magazine: "Statistics aren't science. Statistics don't explain observations or validate models. Sometimes, statistics aren't even statistics," the last of which refers to the tendency of statistics to over-simplify situations by pulling data from skewed sources (Milloy, 2001, p. 14). The confusion accumulated through this interpretative process of extracting a story from a scientific report therefore often skews the results, leading to a very different representation of scientific findings by the media.

Another important factor in interpreting the results of a study is how it factors into the results of other, similar studies or how it compares to identical studies' results. However, a largely neglected practice that is arguably essential to the scientific process is the repetition of these initial experiments to re-assert the results, as a subsequent "line of defense" against error. Yet this process is often forgotten by scientists due to its lack of appeal and incentive. An interviewee on John Oliver's satirical show *Last Week Tonight* described, "they don't get funded, no one wants to do them, there's no reward system in place…for being the second person to discover something in science" (Oliver, 2016). These instances

increase the likelihood of over-reliance on smaller segments of research of wavering credibility.

Faults at the Source

Publishing Pressures and Grant-Grasping: The Loophole-Ridden Review Process

In addition to the influences to scientific results on the commercial end, scientists themselves are often tempted to tweak their data or present them in a particular light in order to advance their studies, with the goal of getting published or receiving grants. The pressure to obtain certain results that are advantageous in some way creates a sizeable temptation to align experimental results with expected outcomes, whether consciously or unconsciously, creating another factor of potential bias in scientific reports.

Characteristic pressures on scientists regarding their findings are often due to their desires to obtain certain results or data to advance processes or confirm claims to ultimately continue experimentation, which is carried only by their popularity with the public or through grants. Experiments must be funded to continue, and funders aren't paying for dull results or for uninteresting headlines. This puts even more demand on scientists to discover breakthrough conclusions the first time around—a feat that is much less likely than it would appear to be. In John Oliver's recent satirical analysis titled "Scientific Studies" regarding the reporting of scientific topics, he presented an interview of one scientist verifying: "My success as a scientist depends on me publishing my findings. And I need to publish as frequently as possible in the most prestigious outlets that I can." An article in the Culvert Chronicles echoed this sentiment, stating: "Scientists usually use 'junk science' for academic advancement, to obtain funding for research or to achieve fame and fortune through other pathways" (Kornhauser, 2012).

Such mindsets can lead to temptations to conduct experiments in a sloppy or careless manner in the quest to obtain quick and useful results. And biases can lurk in the data whether they were induced consciously or not. A panel for the Institute of Medicine and the National Academy of Sciences found these types of experimentation that contain such biases to be "of greater concern" because they are much more common and harder to expose (Rubenstein and Chalk, 1991, p. 195). These biases can occur from subtle changes in the acquiring of data or the design of an experiment, among other things. An *Invisibilia* podcast episode touched on this idea, stating that scientists will often find from their experimentation conclusions that parallel what the expected outcomes are, even if those expected results are incorrect. They cited an example experiment in which identical groups of rats were given to scientists to study their intelligence, with the given pretense that one group was more intelligent than the other (even though this was not the case). These scientists confirmed these incorrect statements in their experiments. The

study described how the preconceived ideas about the test subjects affected how the scientists carried out their experimentation (Spiegel & Miller 2016). The results of this experiment suggest that this sort of bias could be occurring at a much larger scale in many studies. As a scientist herself, Marvier concurred: "I think that your preconceived ideas of what you're going to find is going to have a real big influence on what you find." Throughout her research, she has observed several instances of this induced skewing of data, as well as instances in which scientists neglect to report on their data correctly because it is inconsistent with their hypotheses. She explained, "At the end of the day, they would either not put forward all those data, or [would rather] frame the data a particular way and not show the whole picture…I think sometimes people have a hard time letting go of their preconceived notions instead of letting the data actually drive their conclusions" (Marvier, 2016).

In addition to scientist biases, one of the major drawbacks of the scientific process is the reviewing of experiments in that it is nearly impossible with the current review system to detect fabricated or skewed data, allowing these biases to leak through. The implied connotation of a peer-reviewed journal should be that the information enclosed has been highly controlled for quality and accuracy; however, given this tendency, it is perhaps unsafe to hold such assumptions. In this process, scientists regarded as experts in the field review these experimental reports prior to publication (Rubenstein & Chalk, 1991, p. 195). However, it is nearly impossible for these reviewers to identify such subtle nuances in the many experiments they are allocated to review. There are more hazardous implications of this trend as well: the presence of such skewed data can "erode the integrity of science and contribute to an overly-permissive research environment that fails to discourage more serious forms of misconduct" (Rubenstein & Chalk, 1991, p. 195).

In response to the question of whether the current scientific review processes are suitable for catching flaws in the experimental process, Marvier replied with a firm and resounding "No." She described that, "As a reviewer, you never have all of the data, you never see the full picture; so you're presented with already a slanted view of what this study found. But you can't tell that" (Marvier, 2016). Other influences she described included the political agendas of the reviewers themselves. Marvier referenced a study conducted by a colleague of hers regarding species biodiversity in local environments. She explained how the study had found that despite common grievances against the loss of biodiversity globally, that local biodiversity was increasing due to all the introduced species in an area. Marvier then explained that, even though the experiment had high quality data and a decently unbiased design, "the reviewers slammed [her]. They said that this was a dangerous message. 'We can't let this out, because people won't understand; they will think that there isn't a biodiversity crisis when there is'…just because it didn't align with their political message" (Marvier, 2016). The biases of reviewers and the

skewed review process therefore demonstrate that this system, which we are trusting to protect the public from faulty experimental results, is highly flawed.

The Effects on The Public

Misrepresented facts and skewed information presented to the public serve as more than simply an annoyance: they can lead to unhealthy behaviors and lifestyles for those that take these reports at face-value and affect how they perceive different topics and products, ultimately determining how they make decisions in their daily lives. While on a smaller scale this may seem trivial, the larger picture demonstrates that these falsely-based influences can have detrimental effects upon readers.

One area in which this impact is highly significant is in personal medical decisions since the media has become a very prominent source of health information for the public. These decisions, if made based on false or skewed information in reports, can have substantial consequences on individual health. One of the most well-known examples in this area is the falsehood that vaccinations can cause autism. In 1998, a British gastroenterologist published a paper suggesting a connection between the MMR vaccination and the early symptoms of autism in eight children that had received this vaccination (Gerber & Offit, 1998). While this study was riddled with flaws in the experimental process, the largest of which was the convenient lack of a control group, it still caused a backlash against vaccinations from the fearful public. The study was later debunked, but the fear remained, and there are still many parents who refuse to vaccinate their children based on these and other concerns that are based on faulty evidence. Thus, many children who would have otherwise been immune to these diseases are left exposed, creating a major detriment to the objective of herd immunity.

The MMR vaccine study is one of the more notorious of many such incidents. In another case, two people died after not taking their blood pressure medicine due to some reports of a scientific study "linking calcium channel blockers with increased risk of heart attack" (Milloy, 2001). In 1983, a morning sickness drug was taken off the market after suspicions that it caused birth defects, "an archetypal case of junk science scuttling a perfectly safe product" (Milloy, 2001). The cereal brand Kellogg's also widely sponsored the idea that high-fiber cereals will reduce the risk of colorectal cancer, an idea based on the "unscientific observations of a British medical missionary" (Milloy, 2001). These examples represent a small portion of the effects that false advertising, experimentation, and reporting can have on public health. The likelihood of bias or false representations in studies that we read and hear about in the news poses not only the risk that our opinions formed from that information will be skewed as a result, but also the risk that the importance of certain topics will become more or less inflated due to the extent to which it is covered by the press. This style of reporting can

create “unnecessary fears or promote false hopes” and can affect how individuals lead their daily lives (Milloy, 2001, p. 59).

The commonality of these problems can also cause an increased lack of trust in scientific reporting, consequently impacting the reputation of scientific experimentation itself. The results of experimentation can save and improve lives or create better environments, but only if it is heeded wisely; if it is difficult to distinguish which are the credible reports, the public is significantly less likely to even try, fueling a blanket disregard of many important topics. “When science and health research are dramatized through the highlighting of contradictions, individuals are more likely to devalue and disregard the research” and therefore lose what could be valuable facts that could aid in allowing individuals to make informed decisions (Seethaler, 2016).

Conclusion

The accumulation of biases leading to the final presentation of reports on scientific studies demonstrates how easily experimental results can be skewed or distorted at any given step of the process and the prevalence of these reports in what we read and watch from the media. These distortions stem from four major areas: individual scientists’ biases or influences, individual journalists’ biases, the interpretation of results between the scientist and the journalist, and the interpretation of information between the journalist and the public. Often there are accruing consequences resulting from such inadequate reporting of data on the public as well as on individual health. While personal biases are often inescapable, there are other ways to adjust this process to improve the credibility of reports for public knowledge: by improving the scientific review process and the means of communication between the three groups. Furthermore, the way in which information about studies is presented might require more background information to allow the reader to decide for him or herself how reliable the source is. The thorough examination of biases in scientific communication is an important step in encouraging caution amongst the public with regards to the believability of cursory scientific information and, ultimately, can be improved upon through further exposure of this problem.

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