Original Article

The ethics of science journalism in medicine: a science and technology studies approach

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Abstract

Reexamining science journalism through the constructivist lens of Science and Technology Studies (STS), the present paper argues that this perspective promotes a more responsible approach to reporting scientific discoveries in medicine. The dominant anti-constructivist, realist approach often results in what we term "dramatic modalization," which attributes greater facticity and universality to scientific findings than they actually possess at the time of publication, leading to significant moral consequences.

To illustrate this, we will first explore the STS perspective as a framework for understanding the construction of facts in practice. Next, through a discourse analysis of two historical cases in medical journalism—the MMR-autism link and the depression-serotonin connection—we will demonstrate that the realist media coverage of these cases engaged in dramatic modalization, resulting in tangible moral repercussions. We hereby propose an alternative STS model for science journalism in medicine, arguing that it offers a more morally responsible approach.

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Introduction

Broadly speaking, two types of science communication can be distinguished: communication by the scientists themselves (i.e., those who have participated in the scientific findings), and communication by others, including the media, brokers, and promoters, among others. In the first type, after scientists publish a scientific piece of work, they share their findings in simpler language and without technical details through press conferences, television and radio interviews, or newspaper articles. The purpose is to make the general public aware of their research results, particularly when the scientific finding in question has particular importance for the social system and people's well-being. This type of communication has been particularly noted since Robert Merton proposed the norms governing the scientific community (1). The second type of science communication, which is our focus here, is communication by non-specialists or non-scientists who usually act as intermediaries between the scientific community and the public. This type of communication encompasses a relatively new literature compared to the first type.

The main problem faced here is how to communicate a scientific finding in an ethical way. Several ethical principles governing the communication of scientific findings have been proposed in recent years for both scientists and non-scientists—particularly science journalists—including the principles of accuracy, utility, harm minimization/limitation, objectivity, accountability, and honesty (2-5).

While this principle-based approach to the ethics of communication is useful in its own right, it has two limitations. First, these principles are very general, and without more tangible and practical guidelines, they are not very useful in practice. Second, depending on individuals' theories and philosophies about the mechanism of scientific practice and facts, these principles may be interpreted differently, which in turn affects how they are understood and applied. For example, compare realism and constructivism as two general theoretical approaches toward science (6). Many people, usually in a realist atmosphere, think that scientific journals publish scientific

truths, facts or discoveries. Therefore, a published truth should be communicated transparently and accurately, especially if it can directly improve people's lives, such as in medical and social sciences. However, from a constructivist perspective, such as the approach of science and technology studies (STS), the process of constructing facts does not end with their publication in scientific journals, but begins there. This should influence how we understand the principles of science communication and how a scientific achievement must be comminunicated in practice.In the following, we will first discuss the construction of scientific facts within the framework of STS. We will then use insights from STS to analyse the discourse of two cases of the public communication of scientific achievements: the MMR-autism link and the depression-serotonin connection.

STS and construction of scientific facts

Constructivism stands in contrast to realism. Realism posits that science uncovers reality as it truly is, suggesting that scientific inquiry provides a largely accurate representation of the world (7). In contrast, constructivism argues that scientific facts emerge from complex and often costly and time-consuming negotiations and interactions between many actors including researchers, objects of studies, scientific community, and society in general. In this view, facts are not simply discovered; rather, they are constructed (8, 9).

Science and Technology Studies (STS) holds a completely constructivist view of the emergence of scientific facts and machines, in the sense that it believes various factors are at play in the formation of facts (8). There are two main approaches to the construction of scientific facts in STS: social constructivism and collective constructivism. The social construction of facts (as well as artifacts), represented by the sociology of scientific knowledge (SSK), suggests that scientific facts are not formed or detemined by the objects themselves (whether theoretical or observable), but are shaped by social factors as a context (7-10). In scientific controversies, what makes the difference is social factors, not the object itself (10).

On the other hand, the so called “observations” or “evidences” do not have the power to determine a particular scientific claim. For example, in the dispute between Pasteur and Pouchet about spontaneous generation, observations and experiments were not enough to defeat the rival as the latter could easily dispute the findings of experiments that apparently

showed results against their views. They had to design an experiment in which there was clean air and nutrients in a closed sterile container and then see whether or not the material inside the container would grow moldy; if it did, then the view of Pouchet who believed in spontaneous generation would be confirmed, otherwise Pasteur's theory would prove to be correct. However, none of these two results were binding for the parties because there are always ways to reconcile a series of contradictory observations with a particular theory. For example, if the material inside the container did not grow moldy, then Pouchet could claim that there was not enough air in the container, or that the nutrients were spoiled due to boiling or too much heat, and as a result, the conditions were not suitable for the emergence of a new organism. But if it got moldy, Pasteur could claim that the container or the air or the nutrients were not sterile enough, which would mean that living organisms had already been inside the container (11).

In the philosophy of science and STS literature the claim that observations alone cannot end scientific controversies is called "the under-determination of theory by data" (12). Other factors, such as social circumstances, are necessary to determine a fact. In the case of the Pasteur-Pouchet controversy, for instance, political and religious issues and bodies such as the French Academy of Sciences played a great role (13).

In contrast to social constructivism, actor-network theory is a celebrated doctrine in STS (15-20) that argues for the collective construction of scientific facts. In fact, collective constructivism is in a way an extension of social constructivism, because in addition to social factors, other factors that are usually considered non-social, including objects and tools, are also recognized as constructive elements.

How do constructivism and realism ethically relate to science journalism in medicine? The connection lies in how these approaches influence the reporting and communication of scientific findings in the media, which can result in either morally positive or negative outcomes. A realist journalist presents a newly published scientific finding as if it were an established truth, aiming to inform the public about this newly discovered truth in a straightforward manner. In contrast, a constructivist journalist approaches the coverage with greater sensitivity, recognizing that the process of constructing a fact takes time and that a newly published finding is merely the starting point. As we will examine

later by analyzing two historical cases in medical journalism, this practical difference has significant ethical consequences. However, before delving into these cases, we should first discuss the concept of modalization in the process of fact construction.

Modalization

Scientific controversies usually manifest themselves in scientific texts (mainly articles). When someone makes a claim in an article and publishes it, their claim may find opponents and proponents, and this means that the author is lucky since most articles are not read or referred to (14). The existence of opposition or proposition indicates the emergence of a scientific dispute. This opposition/proposition, as we mentioned before, can have many different causes. Opponents of spontaneous generation, including members of the French Academy of Sciences, may be influenced by religious and political values or beliefs, as Collins et al. pointed out (11). However, it is clear that scientists never appeal to these causes, at least not directly. This is not how the game of science works. Rather, they try to dispute their rival's assumptions, experiments, and experimental tools scientifically, and the under-determination of theory by data tells us that there is always a way to dispute and protest.

How do scientists show their disagreement or agreement in texts? Latour says that the mechanism of this game is modalization (14), a concept he took from semiotics. In semiotics, a modal is an expression that is added to a basic proposition and modifies it. For example, consider the basic proposition "There is a mountain of gold." By adding the modal "Jones thinks that" to this proposition, it is modified as "Jones thinks that there is a mountain of gold." The second proposition is modalized. Modals can be positive or negative. In Latour's discussions, a positive modal is one that takes the basic proposition (claim of the article) toward facticity, while a negative modal reduces the facticity of the proposition. For example, the facticity of "The structure of TRF is Pyro-Glu-His-Pro-NH2" is decreased by adding the negative modal "Guillemin thinks that ..." and increased by adding the positive modal "Recently Guillemin has proved that ..." (15). Any other scientific text that talks about or refers to an original claim defines its position toward it in some way by positive or negative modalizations.

The modalization process may continue for some time, even some years. At the end of this process,

there are no more than two states: In the first state, the original proposition becomes a fact, in which case there are no more modals, that is, the proposition is so universal and obvious that even the name of the author of the original article is gradually removed (who refers to Lavoisier's paper when writing the formula H2O for water?) (14). The second state is where the original claim will forever be mired in negative modals and join the fables, until it is no longer discussed except in the history of science or maybe the history of bad sciences (for example: *Laurier thought that* the planet Vulcan exists).

Accordingly, there is a process of modalization that begins with the publication of a claim in an article or book. At the beginning of this process, we are dealing with a statement that has only been approved by a few reviewers. We may witness controversies over this proposition and, as a result, fluctuation of positive and negative modals. Depending on how this process goes, this claim, probably after some modifications, will either be established as a scientific fact, or will be severely criticized and receive so many negative modals that it will be nothing more than a self-made artefact (Diagram 1).

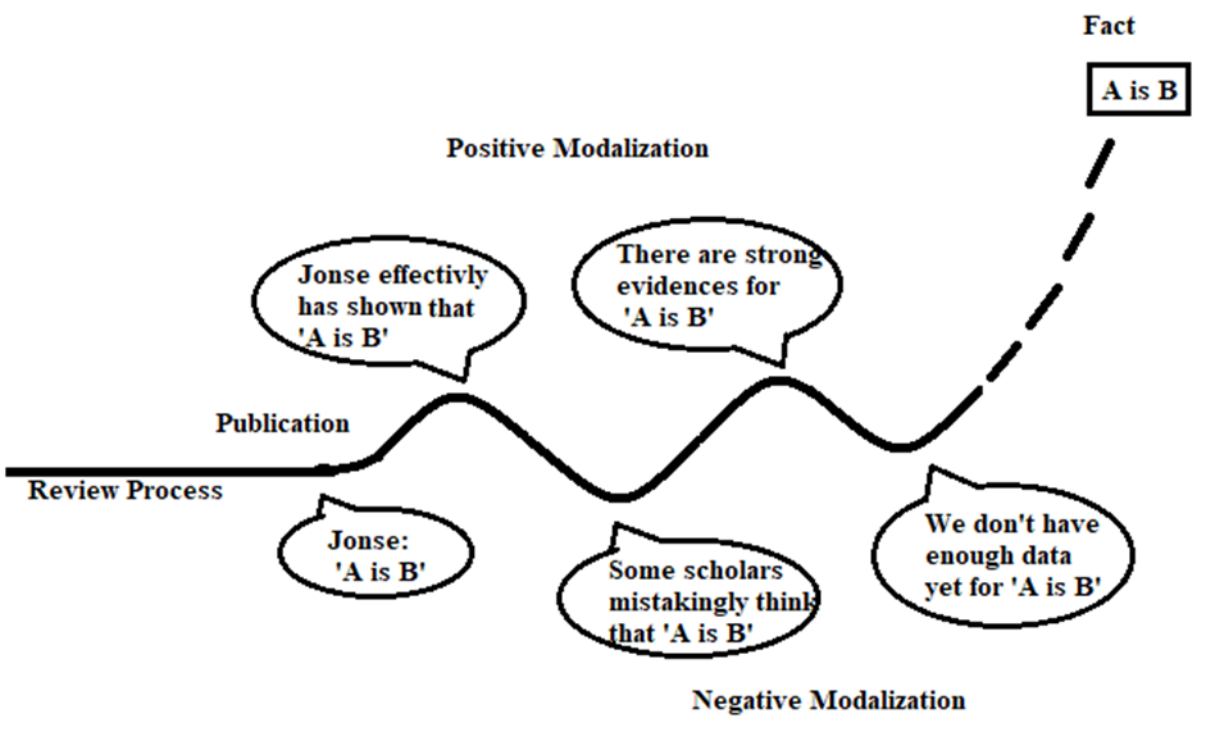

Diagram 1. The modalization and fact construction process

From publication to acceptance as a fact/artefact, modalization is usually a fluctuating, complex, costly, and time-consuming process. If an article is lucky (i.e., it is read, referenced, and not subjected by the negative modals of well-known scholars), it still has a long way to go before it becomes a fact. Here, the history of science can provide us with many evidences. Some of Newton's claims were more or less established and recognized as facts 50 years after their publication (21). Similarly, Einstein's theory of general relativity, which was published in 1915, lacked enough evidence to be established as a fact. The first strong evidence was provided four years later in 1919 by the renowned English scientist Eddington and his team in the famous solar eclipse observations, when they were able to measure the bending of a star's light as it passed by the sun. Interestingly enough, another 40 years or so was needed for it to be recognized as Newton's alternative theory, and that was only after scientists like Hawking were able to establish the existence of black holes (22).

As we have indicated before, there is an important point about the modalization process: propositions are not facts at the time of their publication. Rather, STS has shown that scientific truths are the result of a relatively long process of modalization.

This highlights an important ethical point for science journalists and generally to those who are interested in communicating scientific achievements: as science communicators, we should avoid what we term “dramatic modalization,” meaning we should not attribute more facticity to a newly published claim than it actually possesses. Dramatic modalization is contrasted with scientific modalization. As previously mentioned, modalization plays a crucial role in scientific discourse and practice; scientists actively seek to alter the facticity of a published claim by defending or rejecting it through provinding more evidence or scrutinizing the current evidence, presenting new experiments, or trying to replicate the orignal experimnts of the author(s) of the claim. Positive modalization advances a claim toward factness, while negative modalization pushes it toward being an artefact.

In contrast, dramatic modalization involves presenting or expressing a newly published scientific claim as if it had already undergone positive modalization. This form of modalization is typically carried out by interested individuals

outside the relevant scientific field, including journalists, science communicators, and the general public. Dramatic modalization has two significant moral consequences. Firstly, it may create overconfidence in a newly published claim among the public, even though it is not very reliable as most of the scientific community has not reacted to it yet. Secondly, it can lead to a loss of public trust in science, especially when the claim undergoes negative modalization sometime after its publication. Avoiding "dramatic modalization" is especially important in the case of sciences that directly deal with the well-being of people's lives, such as medicine. To make this point clearer, we will discuss two cases of science journalism in medicine, one old and the other more recent.

1. The case of the MMR vaccine-autism link

Andrew Wakefield, a British doctor, and his co-authors claimed in an article in 1998 that there is probably a connection between the MMR (measles, mumps and rubella) vaccine and autism (23). In this article, which was published in *The Lancet*, one of the most prestigious medical journals in the UK, 12 children between the ages of 3 and 10 with autism were examined, and it was claimed that 8 of these children showed signs of autism after being vaccinated with MMR. Upon publication of the paper, Wakefield said in a press conference that he did not claim there is necessarily a causal relationship between autism and MMR, but based on their findings, caution dictates that instead of this combined vaccine, three separate vaccines for measles, mumps, and rubella be injected. After the publication of the paper and its coverage by the media, people quickly took notice of this scientific finding and a public panic broke out, especially in the UK. Many parents did not allow the hygiene authorities to inject this vaccine to their child, fearing that their child might develop autism. As a result of this public fear and refusal to inject the vaccine, the number of kids suffering from the above diseases increased in the UK and other countries (24). In a study, Motta and Stecula (25) showed that Wakefield's article and its media coverage led to a significant increase in MMR cases in the months following its publication (Diagram 2).

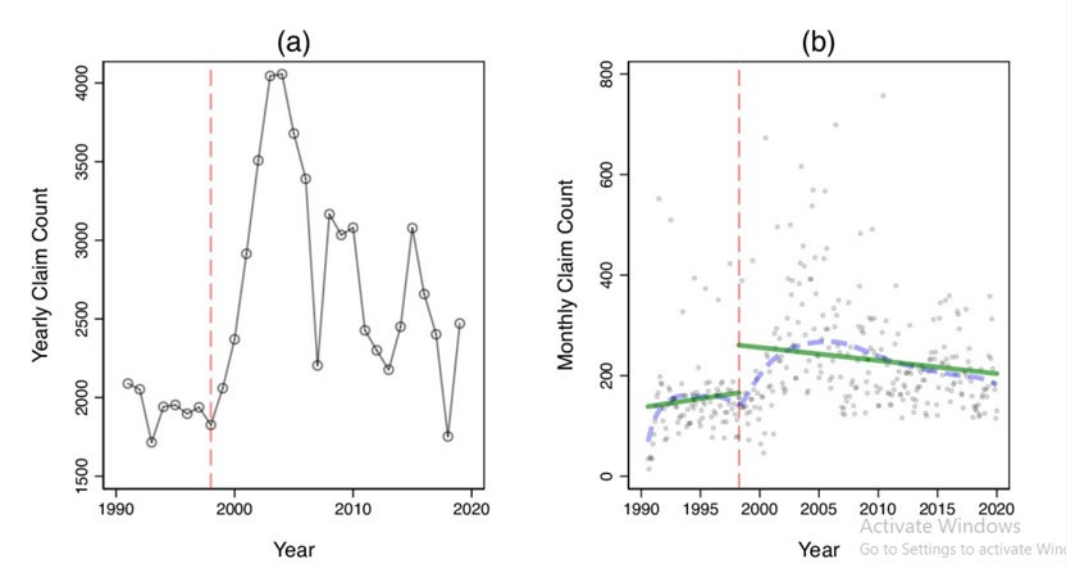

Diagram 2. According to reports from the Vaccine Adverse Event Reporting System (VAERS), a significant increase in MMR cases can be seen both annually and monthly following the publication of Wakefield's article. The dashed red line indicates the time of publication (the diagram was originally presented by Motta and Stecula (25)**.**

The modalization process of Wakefeld et al.'s claim moved in a negative direction. In the same year 1998 (26) and the following years, other articles showed that Wakefeld's data were too insufficient to establish a connection between autism and the MMR vaccine. There were even accusations of data fabrication and fraud, which eventually caused Wakefeld's article to be retracted by Lancet.

What is important here is not the refutation of Wakefeld's claims, as this is the fate of most claims that get a chance to be read. What is important is how the media have covered these claims. Consider, for example, how Wakefeld's claims were publicly announced by the BBC on February 27, 1998:

"A study by doctors at the Royal Free Hospital in London has suggested that a common childhood vaccine may be linked with autism and cause an intestinal disorder. The research has discovered a new inflammatory bowel disease which is associated with autistic children. The head of the research team, Dr. Andrew Wakefield, raised *alarms* because *children*'s behavior changed *drastically* shortly after they received the controversial single dose of the measles, mumps and rubella vaccin." [1](27).

[1] . All italics are mine

This news text is very dramatic and has a high persuasive power, even higher than Wakefeld's article, and can make any parent hesitate to allow the vaccine to be injected to their child. Let us analyze its discourse a little:

a) "A study by doctors at the Royal Free Hospital...": The text says that the researchers themselves are doctors and work in Royal Free Hospital. This is a true statement, but it is clear that the reference to Royal Free Hospital, an important and well-known institution, increases the persuasive power of the text among ordinary people. In addition, the text has used "doctors at..." instead of "some doctors at…" as if all or most of the doctors of this hospital were involved in the research.

b) "The research has discovered...": The text uses the word "discovery" which refers to scientific truths. As we discussed above, the discovery of facts itself is the product of a time-consuming process of modalization. When an article is published, nothing is discovered as only a local claim is made, approved by a few reviewers, but the majority of the scientific community is still unaware of it.

c) "The head of the research team, Dr. Andrew Wakefield, raised alarms because children's behavior changed drastically shortly after...": Firstly, the text of the article did not use the words *alarm* and *drastic*. These two words have made the news more dramatic due to their semantic network. Secondly, the writing style of the news implies that these drastic changes were observed in many children, while the entire research was limited to 12 children, but the news does not mention this limitation.

2. The case of the serotonin-depression link

In 2022, some researchers (28) conducted a systematic umbrella review of a number of published articles that were somehow related to "serotonin" and "depression" and published it in the Journal of Molecular Psychiatry. In this article, they concluded, "…there is no convincing evidence that depression is associated with, or caused by, lower serotonin concentrations or activity" (28).

This paper soon received significant negative modalization. Several studies accused Moncrieff 's article of misinterpretation and logical and methodological errors (29-32). One article even claimed that Moncrieff and the co-authors misunderstood the literature because no one has ever claimed that depression is directly caused by serotonin deficiency, rather it has been claimed that diagnosing the causes of depression is complex, and depression cannot be explained

based on the levels of one or more neurotransmitters (32).

This is part of a scientific controversy. Moncrieff et al.'s claim at the time of publication was not a truth discovery or a scientific fact because the scientific community had not examined it yet. It is a complex and time-consuming process of modalization that determines whether the claim is a fact or a fable. However, the media usually do not wait for the result of the modalization process. Due to its sensitive topic, this article received the attention of the media and then ordinary people from the very first day of its publication. Here we will briefly review and analyze two types of media coverage of Moncrieff et al.'s claim.

1) The Times (July 20, 2022):

"The widespread use of antidepressants *is 'not grounded in science*' because depression *is not caused* by a chemical imbalance, according to *a new study*. Researchers at University College London said they had *conclusively* disproved a controversial theory dating back to the 1960s that depression is caused by low levels of serotonin. After analyzing *decades of previous research, involving tens of thousands of patients with the condition,* the team found 'no convincing evidence' of a link with serotonin, a neurotransmitter in the brain." [2](33)

The writing style of this news is so rhetorical that it may even convince some people to stop their anti-depressant medications. This text uses words and phrases that increase its facticity and even goes beyond the boundaries of Moncrieff et al.'s article:

a) "Not grounded in science": An article is not equal to the whole of a branch of science. Just because an article disproves something does not mean that a scientific discipline has disproved that thing. Using "science" instead of "a research" has increased the persuasive power of the news.

b) "New study": In the strict sense of the word, a systematic review is not considered a new study. Moncrieff's paper itself did not undertake a new laboratory study.

c) "They had conclusively disproved…": Even Moncrieff and the co-authors have not claimed to have *conclusively* disproved the serotonin-depression link.

d) "After analyzing *decades of previous research, involving tens of thousands of*

[2] . italics are mine

patients...": By using "analysis" (instead of "review"), "decades," and "tens of thousands of patients," this sentence tries to raise the persuasive power of Moncrieff et al.'s claim significantly. The lay audience might assume that Moncrieff et al. analyzed all the clinical researches of the past few decades and concluded that there was no convincing evidence for a link between depression and serotonin in any single one of them. However, we know that each systematic review has its own limitations based on the protocols it defines. In this case, it has been shown that the paper was not careful enough in defining these criteria and consequently neglected some researches (31).

2) The Sun (July 21, 2022):

"Depression is not caused by a chemical imbalance in the brain, say experts – and pills 'not based on science': Depression is not caused by a chemical imbalance and pills may not work, say experts. People should be told of other treatment options given the side-effects of the pills, their rising widespread use and cost, said a team of researchers." (34).

Firstly, this news is stronger than the claim of Moncrieff et al.'s article. Secondly, it shifts from a descriptive to a somewhat prescriptive tone:

a) "Depression is not caused by a chemical imbalance": Moncrieff et al.'s paper does not say that depression is not caused by a chemical imbalance, only that after reviewing a number of past researches, they did not find "consistent" or "convincing" evidence for this causal connection. As a result, the only logical conclusion that can be drawn from Moncrieff et al.'s article is that depression may not be caused by chemical imbalance.

b) "Pills not based on science": First of all, a single research is considered equivalent to the whole science here to increase the facticity of the claim. Secondly, the claim that the pills are not effective or may not be effective is not mentioned at all in Moncrieff et al.'s article and does not follow from it. Assuming Moncrieff et al.'s claims are correct, the pills could still work even if we have not identified the mechanism.

c) "People should be told of other treatment options": One would expect that this prescriptive sentence would be announced by health authorities, not a general newspaper.

Dramatic modalization

It is understandable that the media is looking to dramatize the news simply because they want to attract more audience. Since ordinary people are less motivated by local and doubtful claims (the

state of most scientific claims when they are published), the media may use words and expressions that prematurely increase the universality and facticity of the claims. For example, instead of saying “a researcher has claimed that...,” they prefer to say “science has proven that...,” or “science has discovered that...,” and instead of “some researchers have shown that...,” they would like to say “researchers/scientists/experts have shown that....”. They also tend to use fewer words that indicate locality, hesitation, and uncertainty, such as “some,” “one,” “may,” “maybe,” and “probably.”

These linguistic tricks engage news in the positive modalization of a scientific claim, but a dramatic one for that matter, as we disscussed earlier. In this way, they attribute more power and facticity to newly published claims than they actually have in the time of publication.

Note that realists might not find the coverage of the two cases we reviewed problematic because, given their theoretical approach, they may not show much sensitivity to the words and how they are used in these coverages. However, to a constructivist, words themselves are actors and play a role in constructing facts. For a realist, the media serves as a mere tool to communicate a true message, but for a constructivist, the media itself is a part of the message (35) and can influence its construction.

This is why we believe that general ethical principles can be understood differently in light of our theoretical approach to science (and language) and thus have different applications. From a realist's perspective, saying “Science has discovered that...” instead of “Some scientists have shown that...” does not make a significant difference; therefore, principles like accuracy, precision, or transparency are not violated. But from a constructivist's perspective, the former carries a much stronger positive modalization than the latter.

Conclusion

Science journalism is grounded in specific philosophical theories or approaches to science. In this paper we disscussed two primary perspectives on the nature and mechanism of science: realism and constructivism, with realism being the traditional and prevailing approach in science journalism. By examining two historical cases in medicine, we found that the realist style of sceintifc news coverage often engages in dramatic modalization. This practice can lead to ethically concerning outcomes, such as fostering

public overconfidence in newly published findings that have not yet been established as facts, or a decline in public trust in findings that, after being dramatically modalized in media coverage, face negative modalization in scientific practice.

We finally argued that STS, as a constuctivist framework, can theoretically and practically enrich the science communication field. STS pays attention to various factors such as linguistic tricks, adverbs and descriptions, references to actors and institutions and how they are categorized, because all these details can modalize scientific claims, decrease or increase their facticity, and consequently make a significant change in action.

It seems that the coverage of newly published achievements should be done under more concrete guidelines than the moral principles we reviewed in the beginning of this paper to avoid dramatic modalizaion. Science journalists should be somewhat familiar with the mechanism of the development of scientific facts in practice, so as not to engage in intended or unintended dramatic modalization. In the case of covering sensitive scientific claims, especially medical ones, it is morally advisable to use an STS warning label. We know that some newspapers use warnings under the main headline and before the news description such as “Based on this text, do not change the way you take your medications.” An STS-oriented label would be psychologically more effective, meaning that it reduces the distress and anxiety a sensitive news topic can bring about: “This is just a newly published claim that may be rejected or modified by next researches.”

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The author declare no actual or potential conflicts of interests.

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