

Risk Definers and Media Coverage of GM Foods: A Comparative Analysis of the People's Daily and the New York Times*

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Abstract: Literature on GM foods reports often examined article tones in general, omitting the differences in various social actors' attitudes. To explore such differences, we conducted a comparative framing analysis of news reports on genetically modified (GM) foods in the United States and China, two large markets of GM foods, to examine (1) the use of frames on GM foods; (2) who has more power in defining the risks of GM foods and (3) the tones towards GM foods of the sources in each country. We used both article and source assertion as the unit of analysis. By content analyzing 267 news articles on GM foods from 2014–2023, including 126 from the People's Daily (PD) and 141 from the New York Times (NYT), we identified the frames, sources, and tones of each article. We also identified 1,496 source assertions to examine the tones of each source. Results showed PD used more treatment responsibility frame than NYT, while the latter used more conflict and causal responsibility frames than the former. While both publications primarily published neutral articles, NYT published more anti-GM food articles than PD. The NYT used a broader range of sources and more anti-GM food sources than PD, while PD cited more pro-GM food sources. The two newspapers both held neutral attitudes toward GM foods. By reporting both sides of the opinion on the issue, most news articles framed it as uncertain rather than having harm or benefit to human society, which may lead to public confusion about GM foods.

Keywords: GM foods; Framing; Tone; Source; Comparative study

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1. Introduction

Genetically modified foods (GM foods), which are those foods “produced from or using GM organisms”,¹ were first approved for commercial sale in 1994.² Today, more than two decades later-human societies still have not reached a consensus on the biosafety of those products. Indeed, people’s concerns about the risk of GM foods appeared with the birth and development of genetic engineering.³ Although the scientific risk assessments of some GM foods (e.g., soybeans, rice, maize, and wheat) show that they are as safe as their traditional (i.e., non-GM) counterparts,⁴ people’s concerns about GM foods remained unchanged.⁵ This indicates that GM foods are more than a scientific issue. It is also a social and political issue that was formed by different actors from different interest groups. Thus, to understand the debates about the risks and benefits of GM foods, and the power relations behind such debates, we need to review not only the scientific research but also the social arguments of relevant issues.

2. Literature review

2.1 GM Foods in China and the United States

In this research, we focused on the media coverage of GM foods in China and the United States (U.S.) to see how they were socially constructed and who was in charge of

¹ World Health Organisation. Food, genetically modified. Last modified May1,2014. <https://www.who.int/news-room/q-a-detail/FAQ-genetically-modified-foods>.

² Schauzu, M. “The concept of substantial equivalence in safety assessment of foods derived from genetically modified organisms.” *AgBiotechNet* 2.044 (2000): 1-4.

³ Frewer, L. J., Scholderer, J. & Bredahl, L. “Communicating about the risks and benefits of genetically modified foods: The mediating role of trust.” *Risk Analysis: An International Journal* 23.6 (2003): 1117-1133.

⁴ Domingo, J. L. “Safety assessment of GM plants: An updated review of the scientific literature.” *Food and Chemical Toxicology* 95 (2016): 12-18

⁵ Bawa, A. S. and Anilakumar, K. R. “Genetically modified foods: safety, risks and public concerns-a review.” *Journal of Food Science and Technology* 50.6 (2013): 1035-1046.

mediating them. These two countries differ culturally and politically, but they have similar interests in GM foods. We applied this comparative study based upon Mill's most different systems design (MDSD), which compares countries that do not share many features in common apart from the political outcome to be explained and a few explanatory factors that are important for the outcome. This comparative logic may help us uncover the major features that drove China and the U.S., the two different countries, to embrace GM foods regardless of their risk argument.⁶ According to the U.S. Food and Drug Administration (FDA), GM foods make up a very large percentage of the crops planted in the U.S. (e.g., soybeans, cotton, canola, corn). For instance, according to the FDA, genetically modified organisms (GMO) soybeans “made up 94% of all soybeans planted, and 92% of corn planted was GMO corn” in 2018.⁷ China, on the other hand, is more cautious with planting GM crops locally. The only two crops that China allowed for commercial production were cotton and papayas.⁸ The country, however, was not as cautious when importing GM foods, to the point that over 90% of maize and corn that China imported was genetically modified.⁹ Overall speaking, the U.S. seems to hold an open attitude toward GM food, while China is being cautiously optimistic toward GM foods.

Scholars have tried to understand the reasons why the two dissimilar countries both adopted GM foods and the public reactions to the adoption in the respective countries. The majority of the research focused on consumers' perceptions of GM foods in China and the U.S.,¹⁰ while some studies compared the laws and policies governing GM foods in the two

⁶ Mill, J. S. “A system of logic.” *In Arguing About Science*. Routledge (2012): 243-267.

⁷ U.S. Food and Drug Administration. GMO Crops, Animal Food, and Beyond. Last modified March5,2024. <https://www.fda.gov/food/agricultural-biotechnology/gmo-crops-animal-food-and-beyond>.

⁸ Ministry of Agriculture and Rural Affairs of China. China did not allow the commercial production of main crops. Last modified March5, 2014. http://www.moa.gov.cn/ztzl/2014lhjj/2014nian/201403/t20140305_3803881.htm.

⁹ Lucht, J. M. “Public acceptance of plant biotechnology and GM crops.” *Viruses* 7.8 (2015): 4254-4281.

¹⁰ Frewer, L. J., Miles, S., & Marsh, R. “The media and genetically modified foods: evidence in support of social amplification of risk.” *Risk Analysis: An International Journal* 22.4 (2002): 701-711;

countries.¹¹ Also, some researchers have studied scientists' perceptions of GM foods.¹² By examining these studies, we can find that different social actors' attitudes towards GM foods varied from time to time, struggling between the desire for commercial benefits and the concerns of health risks.

One limitation of those studies is that they examined the perceptions of GM foods from different social actors in a parallel way. Few studies have examined the power relations between policymakers, the public, the GMO industry, and scientists in supporting or questioning GM foods. The arguments from those actors were not expressed as isolated political speeches; rather, they formed social debates in China, the U.S., and other countries, competing for dominance in defining GM foods and their risks. To explore such debates and the power relations behind them, we examined the very embodiment of such debates, the media coverage of GM foods in China and the U.S.

Different arguments and thoughts were entangled, negotiated, and confronted in the news media, sharpening social perceptions of a controversial technology and its risk, and at the same time being influenced by the social atmosphere regarding the same topic.¹³ As a controversial technology, GM foods and the media coverage of them were not exceptional.¹⁴ We would like to compare and contrast the major concerns and focuses of different social actors and their attitudes toward GM foods in the media; Most importantly, we explored which stakeholders dominated the social construction of GM foods in China and the U.S., and we examined which stakeholders' voices were marginalized in the two countries' media. According to sociologists, whoever seizes the power of defining the risk of a technology like GM foods can take advantage of that domination by defining the

¹¹ Wong, A. Y. T. and Chan, A. W. K.. "Genetically modified foods in China and the United States: A primer of regulation and intellectual property protection." *Food Science and Human Wellness*, 5.3 (2016): 124-140.

¹² ilbeck, A., Binimelis, R., Defarge, N., Steinbrecher, R., Székács, A., Wickson, F. and Wynne, B. "No scientific consensus on GMO safety." *Environmental Sciences Europe* 27.1 (2015): 1-6.

¹³ Cottle, S. *TV news, lay voices and the visualisation of environmental risks*. (In *Environmental risks and the media*2013), 29-44.

¹⁴ Vilella-Vila, M., & Costa-Font, J. "Press media reporting effects on risk perceptions and attitudes towards genetically modified (GM) food." *The Journal of Socio-Economics* 37.5 (2008): 2095-2106.

technology to satisfy their own interests.¹⁵ By examining the media coverage of GM foods in the two countries and the salience of social actors in mediating the topic, we may understand the driving forces of the GM foods market and the obstacles against it. To reach this goal, we will apply framing analysis to approach the media coverage of GM foods in China and the U.S.

2.2 Media Framing of GM Foods: Angles, Sources, and Tones

According to Entman, journalists use different frames as devices to define problems, diagnose causes, suggest remedies, and make moral judgments.¹⁶ Through the usage of frames, media could shape public opinion on various social issues,¹⁷ including GM foods. Scholars have applied framing analysis to examine the social construction of GM foods in different countries.¹⁸ The literature shows that the media coverage of GM foods has varied in focused angles, tones, and sources. These three aspects can help us understand (a) the major concerns about GM foods presented by the media, (b) the media's attitudes toward GM foods, and (c) who did and did not dominate the media coverage of GM foods.

In this study, we apply Semetko and Valkenburg's research framework to examine how journalists framed GM foods in the U.S. and China. Semetko and Valkenburg found that journalists used different angles (i.e., frames) to highlight some specific angles of a social issue,¹⁹ including, but not limited to:

- *Economic consequences* (illustrating the economic impact of a certain issue),
- *Conflict* (portraying the conflicts between different interest groups),

¹⁵ Beck, U., Giddens, A. and Lash, S. *Reflexive Modernization: Politics, Tradition and Aesthetics in the Modern Social Order*. Stanford, Calif: Stanford University Press, 1994.

¹⁶ Entman, R. M. "Framing: Toward clarification of a fractured paradigm." *Journal of Communication* 43.4 (1993): 51-58.

¹⁷ Entman, R. M. "Framing bias: Media in the distribution of power." *Journal of Communication* 57.1 (2007): 163-173.

¹⁸ Dibden, J., Gibbs, D. and Cocklin, C. "Framing GM crops as a food security solution." *Journal of Rural Studies* 29 (2013): 59-70.

¹⁹ Semetko, H. A., & Valkenburg, P. M.. "Framing European politics: A content analysis of press and television news." *Journal of Communication*, 50.2 (2000): 93-109.

- *Attribution of responsibility* (discussing who shall take responsibility for fixing a problem),
- *Human interest* (using an emotional angle or bringing a human face to the discussion of an issue), and
- *Morality* (making moral judgments on institutions or individuals)

Scholars have used those frames in a flexible way to fit with the media data. For instance, some scholars used the frame of *human impact* (discussing the impact of certain social issues on human beings) instead of human interest as a core frame.²⁰ Some others divided the responsibility frame into the *causal responsibility* frame (blaming whom for causing the problem) and the *treatment responsibility* frame (how to solve the problems;).²¹ Despite the differences in naming, the frames that were originally identified by Semetko and Valkenburg are useful for examining the different focuses and angles journalists used to depict GM foods.²² Based upon such a framework, we may examine, for example, which aspects of GM foods the media were more likely to highlight, the impact of GM foods on human health, or the profits of the GMO industry. We can also analyze the conflicts among interest groups, moral judgments of GM foods, and the attribution of responsibility concerning the industry, which were illustrated in the newspapers. In addition, by comparing the frames used by journalists in China and the U.S., we can understand the differences and similarities between the two countries' media in shaping the social reality of GM foods. Some new frames may emerge from the data, and we will examine this in a pilot study. The first step of our research, therefore, is to identify the major frames that the journalists used to frame GM foods in China and the U.S. and to answer this question:

RQ1: How did the framing of GM foods differ between the media of China and the U.S.?

²⁰ Linstrom, M., and Marais, W. "Qualitative news frame analysis: A methodology." *Communitas*, 17 (2012): 21-38.

²¹ Wang, D. and Mao, Z. "From Risks to Catastrophes: How Chinese Newspapers Framed the Coronavirus Disease 2019 (COVID-19) in its Early Stage." *Health Risk and Society*. (2021) 1-19.

²² Semetko, H. A., & Valkenburg, P. M. "Framing European politics: A content analysis of press and television news." *Journal of Communication*, 50.2 (2000): 93-109.

2.3 Sources: Who Dominated the Communication of GM Foods, and Whose Voices Were Marginalized?

Previous studies have shown that consumers were exposed to conflicting information about food from multiple sources.²³ Similarly, in news articles, journalists may also cite multiple conflicting sources in their efforts to give a balanced report. In this study, therefore, we will examine the sources of information about GM foods under different frames to further understand the power relations between different social actors (e.g., scientists, policymakers, the public, journalists, and the GM food industry). We can systematically evaluate whose voices were louder under each topic of GM foods and, conversely, whose voices were marginalized. We will then further compare the sources that the media used in China and the U.S., examining the differences and similarities in constructing GM foods. Hence, we raise the second research question:

RQ2: How did the sources used by journalists differ between the media of China and the U.S. in the coverage of GM foods?

2.4 Tones: Attitudes Toward GM Foods

Scholars usually use surveys to evaluate public attitudes toward GM foods;²⁴ however, few studies have examined the media's attitudes toward GM foods. In this study, facilitated by framing analysis, we shall analyze the attitudes toward GM foods in three ways. First, we will take news articles as the unit of analysis and compare the tones of the media in China and the U.S. toward GM foods. After portraying a general picture of the media's attitudes, we will then treat sources as the second research unit by examining the attitudes of different social actors in China and the U.S. toward GM foods.

RQ3: How did the tone of the articles differ between China's and the U.S.'s media coverage of GM foods?

²³ Rendahl, J., Korp, P., Ekström, M. P. and Berg, C.. "Adolescents' trust in food messages and their sources." *British Food Journal*, 119.12 (2017): 2712-2723.

²⁴ Kajale, D. B. and Becker, T. C.. "Determinants of consumer support for mandatory labeling of genetically modified food in India." *British Food Journal*, 115.11 (2013): 1597-1611.

RQ4: How did the tone of the sources differ between China's and the U.S.'s media coverage of GM foods?

3. Method

3.1 Data

This study used content analysis to examine how news frames on GM foods were developed by different sources and what assertions different sources made on GM foods, focusing on newspaper coverage of GM foods in mainland China and the U.S. from 1 January 2014 to 31 December 2023. This study focused on the elite press in the two countries since it could reflect the serious opinions about GM foods in the countries. The People's Daily was chosen to represent the Chinese elite newspapers as it not only has the largest circulation in China but also is the mouthpiece of the central government of China. The New York Times was chosen to represent American elite newspapers as it has been recognized as an authoritative source of information on issues of public policy in the U.S.²⁵

A search was conducted in the official database of People's Daily using the keyword search string (“Zhuan Ji Yin (genetically modified)” OR “Zhuan Ji Yin Shi Wu (genetically modified foods)” OR “Ji Yin Bian Ji (gene editing)”) from January 1, 2014 to December 31, 2023. A total of 274 news articles were found. Similarly, a search was conducted with keywords “genetically modified”, “genetically modified foods”, “GM foods”, and “gene editing” on the official website of the New York Times after paying for its subscription from January 1, 2014, to December 31, 2023. A total of 460 news articles were found. After excluding non-GM foods, novels, and other unrelated articles, 126 articles from the People's Daily and 141 articles from the New York Times were selected. In total, 267 articles were examined, featuring 1496 source assertions.

²⁵ Friel, H., Falk, R. A., Falk, R. A. and Falk, R. “*The Record of the Paper: How the New York Times Misreports US Foreign Policy.*” London, New York: Verso. 2004.

3.2 Coding procedure

The full text of each article was examined for coding. Images and videos were not included in the analysis. We used a combination of deductive and inductive approaches to identify frames. Based on previous literature and a pilot examination of a sample of news articles, we identified six frames: conflict, human impact, causal responsibility, treatment responsibility, economic consequences, and information. We divided the attribution of responsibility frame into the causal responsibility frame and the treatment responsibility frame, which makes it easy to distinguish who is the cause and who should provide the treatment. The human interest frame was replaced with the human impact frame as more articles talked about the impact of GM foods on people's health and environment, rather than using an emotional angle to discuss GM foods. The morality frame was included in the coding book but as no articles used this frame, it was excluded from the coding book and the analysis. Based on the pilot coding, we also identified two more frames that are commonly used in the two newspapers, the human impact frame and the information frame.²⁶

Two coding books were revised multiple times during pilot coding before the final version was completed. One coding book used articles as a unit of analysis (Coding Book 1), while the other coding book used source assertion as a unit of analysis (Coding Book 2). For details, see Table 1. The first round of coding used a source assertion as the unit of analysis. A source was defined as a specific named person or organization. Source categories used for this study were domestic government officials, foreign government officials, domestic scientists and experts, foreign scientists and experts, the scientific community without mentioning nationality, non-governmental organizations (NGOs), GM foods manufacturers/research and development companies, media practitioners, community/ordinary citizens and farmers/distributors. Source assertions were coded as one sentence related to GM foods quoted from a specific source. The source tone referred to

²⁶ Neuman, W.R., Neuman, R.W., Just, M.R. and Crigler, A.N. *Common Knowledge: News and the Construction of Political Meaning*. (Chicago, IL: University of Chicago Press, 1992), 22-44.

sources' attitudes towards GM foods. The second round of coding used an article as the unit of analysis. Coders chose one core frame for each of the articles based on the major frame found in the article:

- *The conflict frame* refers to the conflict between traditional agriculture and GM technology; the conflict between biodiversity and transgenic technology and the conflict interests between farmers and GM crop-developing companies that control the patents of GM seeds.
- *The human impact frame* refers to the impact of GM foods on people's health as well as the risks of transgenic plants to the natural environment.
- *The causal responsibility frame* focuses on the parties that caused the problems of GM foods such as individuals' lack of understanding of transgenic technology, academic fraud of scientists and institutions, illegal GM foods production, false media reports, etc.
- *The treatment responsibility frame* focuses on how to solve the problems of GM foods such as individuals' learning knowledge of GM foods; scientific progress of GM foods; laws and regulations on GM technology; and supervision and management of illegal acts of GM foods.
- *The economic consequences frame* focused on the economic interests of the state and enterprises on GM foods.
- *The information frame* refers to the science popularization of transgenic technology.

We calculated inter-coder reliability by double-coding a random subsample ($n = 39$ or 17%) of the articles. Krippendorff's alpha ranged from .83 to 1.0 for all the variables, higher than the .80 alpha value suggested by Krippendorff.²⁷

²⁷ Krippendorff, K. *Content Analysis: An Introduction to its Methodology* (2nd ed.). (Thousand Oaks, CA: SAGE Publications 2004).

Table 1. Coding book.

Variables	Codes	Examples
Domestic government officials ^a	For the People's Daily, Chinese government officials=1 , else=0.	Liao Xiyuan said that the State Council approved the establishment of a major special project on genetically modified organisms in 2008, which has made great progress in the past eight years.
	For the New York Times, US government officials =1, else = 0.	A federal judge in Hawaii has struck down a local ordinance that would have restricted or regulated the use of pesticides and genetically modified crops on the island of Kauai, saying the measure was preempted by state law.
Foreign government officials ^a	For the People's Daily, government officials other than Chinese government officials = 1, else =0.	The drafter of the report on the law, Frederick Riyes, a member of the European Parliament from Belgium, stated that the law grants member states wishing to ban the cultivation of genetically modified crops autonomy, which is what many EU citizens hope for.
	For the New York Times, government officials other than US government officials =1, else = 0.	But genetically modified rice has been spreading illegally for years in China, officials have admitted.
Domestic scientists or experts ^a	For the People's Daily, Chinese scientists or experts =1 , else=0.	"With the support of major transgenic projects, China's overall research and development of transgenic breeding has reached the international advanced level." According to Wan Jianmin, academician of the CAE Member and chief technical engineer of the project.
	For the New York Times, U.S. scientists or experts =1, else = 0.	"Just as many on the political right discount the broad scientific consensus that human activities contribute to global warming, many progressive advocacy groups disregard, reject or ignore the decades of scientific studies demonstrating the safety and wide-reaching benefits" of genetically engineered crops, Pamela Ronald, a professor of plant pathology at the University of California, Davis, wrote on the blog of the nonprofit Biology Fortified.
Foreign scientists or experts ^a	For the People's Daily, scientists or experts other than Chinese scientists or experts = 1, else =0.	Belgian food and nutrition engineer Encore Snell told our reporter that there is still a large amount of animal feed containing genetically modified ingredients imported into the European Union, but in Belgium, the use of any genetically modified ingredient in animal feed is illegal.
	For the New York Times, scientists or experts other	Unapproved GM food can be found elsewhere in China's food supply, said Jiajun Dale Wen, an energy

	than US scientists or experts =1, else = 0.	and environment researcher at Renmin University.
Scientific community without mentioning nationality ^a	Mentioned=1 , not mentioned=0	Other scientists, including two Nobel Prize winners, wrote an opinion article for the journal Science last fall titled “Standing Up for G.M.O.s.”
NGOs ^a	Mentioned=1 , not mentioned=0	Cynthia Palmer of the American Bird Conservancy, which is a member of an E.P.A. pesticide advisory committee, said farmers who did not use the genetically modified soybean seeds were being hurt.
GM foods manufacturers/research and development companies ^a	Mentioned=1 , not mentioned=0	“G.M.O. acceptance is exceptionally low in Europe,” said Liam Condon, the head of Bayer’s crop science division, in an interview the day the Monsanto deal was announced.
Media practitioners ^a	Mentioned=1 , not mentioned=0	To the industry, shifting crucial crops like corn, soybeans, cotton, and rapeseed almost entirely to genetically modified varieties in many parts of the world fulfills a genuine need.
Community/ordinary citizens ^a	Mentioned=1 , not mentioned=0	Amy Harmon argues that scientific evidence shows that foods with genetically modified organisms are as safe as nonmodified products.
GM foods farmers/distributors ^a	Mentioned=1 , not mentioned=0	“I’m choosing on yield capabilities and plant characteristics more than I am on G.M.O. traits” like bug and poison resistance, he said, underscoring a crucial point: Yield is still driven by breeding plants to bring out desirable traits, as it has been for thousands of years.
Source tone of each assertion ^b	Positive=1	The European Union has authorized the import of 58 gene-altered varieties for food and feed from the rest of the world, including the United States.
	Negative=2	“We support Ecover’s determination to move away from using unsustainable palm oil, but would ask your company to reconsider the false solution of using ingredients derived from the new genetic engineering — synthetically modified organisms,” the groups wrote in a letter to the company.
	Neutral=3	But unlike the approval process required for new drugs and even many food additives like artificial sweeteners, the review process for new G.M.O. plant foods is voluntary.
Article tone ^c	Positive=1	We Need G.M.O. Wheat
	Negative=2	Genetically Modified Foods: Questions Remain
	Neutral=3	Opposed to G.M.O.s? How Much Do You Know About Them?
The core frame of the	Conflict=1	The fight between the competing academics is not focused on questions about the safety of genetically

article ^c		engineered seeds themselves. The sides are fighting mainly over the safety of herbicides used in so-called genetically modified organisms, or G.M.O., crops.
	Human impact=2	The Food and Drug Administration said on Friday that genetically engineered non-browning apples and bruise-resistant potatoes were as safe and nutritious as their conventional counterparts.
	Causal responsibility=3	However, a review of the pros and cons of G.M.O.s strongly suggests that the issue reflects a poor public understanding of the science behind them, along with a rebellion against the dominance of food and agricultural conglomerates.
	Treatment responsibility=4	G.M.O. labeling is already required in 64 countries, including those of the European Union; Russia; Japan; China; Australia; Brazil; and a number of countries in Africa, where despite rampant food scarcity and malnutrition, American exports that could save millions of lives have been rejected because the crops contained G.M.O.s.
	Economic consequences=5	The issue goes back to 2020, when President Andrés Manuel López Obrador of Mexico, in a likely bid to increase Mexican corn production and appeal to his working-class base, made a decree to phase out the import of genetically modified corn by 2024.
	Information=6	Plant scientists are using it to create new crops. Some researchers are even trying to use Crispr to bring species back from extinction.

Note: The examples in the People's Daily were translated from Chinese to English.

a. Used in Coding Book 1 and 2; b. Used in Coding Book 2; c. Used in Coding Book 3.

4. Results

We used “article” as the unit of analysis to answer RQ1-RQ3. In response to RQ1, Table 2 showed that in the People's Daily, the information frame (n = 47, 37.3%) was the most prevalent frame, followed by the treatment responsibility frame (n = 42, 33.3%), the human impact frame (n = 17, 13.5%), the economic consequences frame (n = 11, 8.7%), the causal responsibility frame (n = 6, 4.8%), and the conflict frame (n = 3, 2.4%). In the New York Times, the information frame (n = 44, 31.2%) was also the most prevalent frame, followed by the treatment responsibility (n = 30, 21.3%), the causal responsibility (n = 18, 12.8%), the conflict frame and the economic consequences (n = 17, 12.1%), and the human

impact frame (n =15, 10.6%). Chi-square tests and Fisher’s exact tests showed that the New York Times used significantly more conflict frame and causal responsibility than the People’s Daily while the latter used significantly more treatment responsibility frame than the former. Other frames were not used differently by the two newspapers.

Table 2. Percentage of News Articles Featuring Specific Frames in the People’s Daily and the New York Times-related “Genetically Modified Food” Coverage, 2014-2023.

Type of frame	The People's Daily (%; n=126)	The New York Times (%; n=141)	χ^2	Fisher's exact test ^a
Conflict	3 (2.4%)	17 (12.1%)	N/A	8.99**
Human impact	17 (13.5%)	15 (10.6%)	.51	N/A
Causal responsibility	6 (4.8%)	18 (12.8%)	5.21*	N/A
Treatment responsibility	42 (33.3%)	30 (21.3%)	4.91*	N/A
Economic consequences	11 (8.7%)	17 (12.1%)	.78	N/A
Information	47 (37.3%)	44 (31.2%)	1.10	N/A

Note: **: $p < 0.01$. N/A: not applicable. a: A Fisher’s exact test was performed where the value of the cell expected was lower than 5.

4.1 Differences in Sources between the People’s Daily and the New York Times

Table 3 outlines the sources used in each newspaper. The sources the People’s Daily cited most often when reporting GM foods were media practitioners (47.6%), followed by domestic government officials (38.1%), domestic scientists and experts (12.7%). Other sources were mentioned in less than 10% of the articles. The sources the New York Times cited most often when reporting GM foods were also media practitioners (80.1%), followed by domestic government officials (30.5%), community/ordinary citizens (26.4%), NGOs (24.8%), scientific community without mentioning nationality (19.9%), domestic scientists and experts (19.1%), GM foods manufacturers/research and development companies (15.7%), foreign scientists and experts (15.6%), and foreign government officials (11.3%). In response to RQ2, Chi-square tests, and Fisher’s exact tests showed that the New York

Times used significantly more sources such as foreign scientists and experts, the scientific community without mentioning nationality, NGOs, GM foods manufacturers/research and development companies, media practitioners, community/ordinary citizens, than the People's Daily.

Table 3. Percentage of GM Foods Related News Articles Featuring Specific Sources in the People's Daily and the New York Times, 2014-2023.

Types of sources	The People's Daily (%)	The New York Times (%)	χ^2	Fisher's exact test ^a
Domestic government officials	48(38.1%)	43 (30.5%)	1.71	N/A
Foreign government officials	7(5.6%)	16 (11.3%)	2.84	N/A
Domestic scientists and experts	16(12.7%)	27 (19.1%)	2.05	N/A
Foreign scientists and experts	5(4.0%)	22 (15.6%)	9.91**	N/A
Scientific community without mentioning nationality	6 (4.8%)	28 (19.9%)	13.65***	N/A
NGOs	4 (3.2%)	35 (24.8%)	25.00***	N/A
GM foods manufacturers/research and development companies	0(0)	22(15.7%)	N/A	21.43***
Media practitioners	60 (47.6%)	113 (80.1%)	30.85***	N/A
Community/ordinary citizens	7 (5.6%)	37 (26.4%)	20.93***	N/A
GM foods farmers/distributors	3 (2.4%)	26 (18.4%)	N/A	17.72***

Note: **: $p < 0.01$. ***: $p < 0.001$. N/A: not applicable. a: A Fisher's exact test was performed where the value of the cell expected was lower than 5. The percentages add up to more than 100% because the coders can choose more than one source for each article.

4.2 Differences in Article Tone

As shown in Table 4, neutral articles (50.8%) were most prevalent in the People's Daily, followed by pro-GM foods articles (30.2%) and anti-GM foods articles (19.0%). In the New York Times, neutral articles (45.4 %) were also the most prevalent, followed by anti-GM foods articles (34.0%) and pro-GM foods articles (20.6%). In response to RQ3, Chi-square tests showed that the New York Times (34.0%) were more likely to use an anti-GM foods tone than the People's Daily (19.0%; $\chi^2 = 13.04$, $p < .001$).

Table 4. Percentage of GM Foods Related News Articles Featuring Specific Source Tone in People's Daily and New York Times, 2014-2023.

Article tone	The People's Daily (%)	The New York Times (%)	χ^2
Pro-GM foods	38 (30.2%)	29 (20.6%)	3.26
Anti-GM foods	24 (19.0%)	48 (34.0%)	7.60**
Neutral	64 (50.8%)	64 (45.4%)	.78

Note: **: $p < 0.01$.

4.3 Differences in Source Tone

To answer RQ4, we used “source assertion” as the unit of analysis and we examined each source's tone in each newspaper. Table 5 shows the source tone in the People's Daily. Post hoc analysis following a significant Chi-square test showed that domestic government officials were significantly less likely to show an anti-GM foods attitude than expected (actual count = 12, expected count = 26.3) and more likely to show a neutral attitude (actual count = 106, expected count = 92.1); domestic scientists and experts were more likely to show a pro-GM foods attitude than expected (actual count = 18, expected count = 8.3); foreign scientists and experts were significantly more likely to show an anti-GM foods attitude than expected (actual count = 5, expected count = 1.2) and less likely to show a neutral attitude (actual count = 0, expected count = 4.0); scientific community without mentioning nationality more likely to show an anti-GM foods attitude than expected (actual count = 6, expected count = 1.2). Other sources' tones are distributed evenly among the three tones.

Table 5. Source Tone in the People's Daily, 2014-2023.

Types of sources	Pro-GM foods	Anti-GM foods	Neutral	χ^2	Fisher's Exact Test ^a
Domestic government officials	42 (42.9%)	12 (19.4%)	106 (48.8%)	17.18***	N/A
Foreign government officials	4 (4.1%)	3 (4.8%)	5 (2.3%)	1.35	N/A
Domestic scientists and experts	18 (18.4%)	1 (1.6%)	13 (6.0%)	17.83***	N/A
Foreign scientists and experts	2 (2.0%)	5 (8.1%)	0 (0)	17.24***	N/A
Scientific community without	0 (0)	6 (9.7%)	1 (0.5%)	N/A	15.44***

mentioning nationality					
NGOs	3 (3.1%)	1 (1.6%)	0 (0)	N/A	6.23*
GM foods manufacturers/research and development companies	0 (0)	0 (0)	0 (0)	N/A	N/A
Media practitioners	25 (25.5%)	25 (40.3%)	82 (37.8%)	5.39	N/A
Community/ordinary citizens	2 (2.0%)	4 (6.5%)	4 (1.8%)	N/A	N/A
GM foods farmers/distributors	1 (1.0%)	4 (6.5%)	3 (1.4%)	6.74*	N/A

Note: *: $p < 0.05$. The percentages add up to more than 100% because the coders can choose more than one source for each article. N/A: not applicable. a: A Fisher's exact test was performed where the value of the cell expected was lower than 5.

Table 6 shows the source tone in the New York Times. Post hoc analysis following a significant Chi-square test showed that foreign scientists and experts were significantly more likely to show a pro-GM foods attitude than expected (actual count = 45, expected count = 29.5); the scientific community without mentioning nationality were more likely to show a pro-GM foods attitude than expected (actual count = 27, expected count = 17.2); NGOs were more likely to anti-GM foods attitude than expected (actual count = 41, expected count = 27.9); GM foods manufacturers/research and development companies were more likely to show a pro-GM foods attitude than expected (actual count = 32, expected count = 20.2), and less likely to show an anti-GM foods attitude than expected (actual count = 9, expected count = 21.4); media practitioners were more likely to show a neutral attitude than expected (actual count = 181, expected count = 154.2); Community/ordinary citizens were less likely to show a positive attitude than expected (actual count = 13, expected count = 25.1) and more likely to show a negative attitude than expected (actual count = 44, expected count = 26.4). Other sources' tones are distributed evenly among the three tones.

Table 6. Source Tone in the New York Times, 2014-2023.

Types of sources	Pro-GM foods	Anti-GM foods	Neutral	χ^2	Fisher's Exact Test ^a
Domestic government officials	44 (11.5%)	54 (13.3%)	34 (10.3%)	1.67	N/A
Foreign government officials	3 (0.8%)	5 (1.2%)	5 (1.5%)	N/A	.93
Domestic scientists and experts	18 (4.7%)	19 (4.7%)	13 (3.9%)	.31	N/A
Foreign scientists and experts	45 (11.7%)	23 (5.7%)	18 (5.5%)	13.42**	N/A

Scientific community without mentioning nationality	27 (7.0%)	12 (3.0%)	11 (3.3%)	9.06*	N/A
NGOs	19 (4.9%)	41 (10.1%)	17 (5.2%)	10.43**	N/A
GM foods manufacturers/research and development companies	23 (8.3%)	9 (2.2%)	18 (5.5%)	14.77***	N/A
Media practitioners	168 (43.8%)	174 (43.0%)	181 (54.8%)	12.42**	N/A
Community/ordinary citizens	13 (3.4%)	44 (10.9%)	16 (4.8%)	20.23***	N/A
GM foods farmers/distributors	20 (5.2%)	29 (7.2%)	17 (5.2%)	1.82	N/A

Note: *: $p < 0.05$; **: $p < 0.01$; ***: $p < 0.001$. The percentages add up to more than 100% because the coders can choose more than one source for each article. N/A: not applicable. a: A Fisher's exact test was performed where the value of the cell expected was lower than 5.

5. Discussion

This study showed the differences in the frames, sources, and tones used in news coverage of GM foods in the People's Daily and the New York Times. By examining the different use of frames, sources, and tones, we found the different perspectives the two papers used to report GM foods, who has more power in defining the risks of GM foods, and the attitude of each newspaper towards GM foods.

5.1 Frames: Different perspectives on GM foods

In terms of the frames used by the two papers, we found while the treatment responsibility frame and the information frame were both the most frequently used frames by the two newspapers, the New York Times used the conflict frame and causal responsibility frame significantly more than the People's Daily, while the People's Daily used the treatment responsibility frame and information frame more than the New York Times.

The information frame was used most often by both papers. As GM foods are a scientific topic as well as a controversial topic, both papers published a substantial number of articles on the popularisation of transgenic technology and GM foods. Both papers used this frame to tell readers what GM foods are and the pros and cons of GM foods.

The treatment responsibility frame focused on the solutions to the problems of GM

foods. While both the People's Daily and the New York Times used this frame heavily, the former used it significantly more than the latter. The People's Daily used the treatment responsibility frame to describe relevant laws on GM technology formulated by the government and the punishment of illegal and criminal behaviors related to GM foods. For example, the Chinese Ministry of Agriculture claimed that they will strengthen supervision over the research, development, and production of GM agricultural products, including the disposal of illegally imported GM foods following the law. As China has passed laws on the mandatory labeling of GM foods in Article 28 of the *Regulations on the Safety Management of Agricultural Genetically Modified Organisms* as early as 2001,²⁸ labeling GM foods was not mentioned heavily in the treatment solution frame in our study period. In contrast to China, the U.S. did not enforce a mandatory regulation on labeling GM foods until 2020. In 2023, the U.S. *National Bioengineered Food Disclosure Standard* required food manufacturers, importers, and certain retailers to disclose information about whether foods are GM or contain GM ingredients. The implementation of this standard took several years: the standard was passed in 2016, implemented in 2021, and finally mandated in 2022.²⁹ Accordingly, in our study period, the New York Times often reported the success or failure to pass laws and regulations that would require the labeling of foods containing genetically engineered ingredients using the treatment responsibility frame. Other reports using this frame showed that some food companies labeled their products "G.M.O.-free" to appeal to consumers.

The New York Times used the conflict frame significantly more than the People's Daily. Using the conflict frame, the New York Times often pitted consumers and industry advocates against each other. For example, the New York Times reported that the Consumers Union believed that GM food developers were using a technical loophole so that some genetically engineered crops and organisms could escape regulation. The

²⁸ Zhu, R. Regulations on the Safety Management of Agricultural Genetically Modified Organisms. Last modified May23,2001.

http://www.gov.cn/gongbao/content/2001/content_60893.htm?ivk_sa=1024320u%20.

²⁹ U.S. Department of Agriculture. BE Frequently Asked Questions-General. Last modified March22,2022. <https://www.ams.usda.gov/rules-regulations/be/faq/general>.

People's Daily only had three articles using the conflict frame. One article entitled "Whether You Should Eat GM Foods", was about the questions of the public and the media raised to the scientists. In this article, science experts enumerated the many benefits of GM products and the safety thereof, while the public and the media seriously doubted it: they thought that GM products are unnatural and dangerous, even speculating that there are interest groups and conspiracies behind GM foods. The People's Daily held a neutral tone towards GM foods in this article.

In terms of the human impact frame, the two newspapers did not differ significantly. By using the human impact frame, the New York Times reported the impacts of GM technology on the natural environment and human health, as well as the risks of super antibody plants caused by GM crops. For example, the use of certain herbicides has no impact on GM crops but has a significant impact on conventional crops.

The causal responsibility frame focused on the parties that caused the problems of GM foods. The New York Times used the causal responsibility frame significantly more than the People's Daily. The New York Times used this frame to describe the illegal production by businessmen. For example, the New York Times reported that GM rice has been spreading illegally for years in China. One article also criticized 17 European countries' ban on the cultivation of genetically modified crops, claiming that scientists would not spend years developing GM crops knowing that there is a great chance that they will be outlawed by governments. Another article reported that the consumers who sought out the "all natural" label were misled by the label. In fact, "all natural" does not exclude GM organisms, hormones, pesticides, and artificial ingredients.

The economic consequences frame refers to articles that focus on the economic interests of the state and enterprises on GM foods. The two newspapers did not differ significantly in the use of this frame. Using an economic consequences frame, the New York Times discussed the interests of GM-crop developing companies such as the patenting of seeds. It also reported that nearly 20 million farmers around the world invested in GM seeds in the last two decades because farmers are seeing better harvests. Articles in the People's Daily using an economic consequences frame reported the trade agreement on GM

foods between different countries, such as Canada, China, the U.S., and those in the European Union. One article mentioned that GM soybean seeds are being controlled by multinational companies and that countries such as Argentina tried to independently develop their soybean seeds.

5.2 Diversity in Source and Source Tone: Who Has More Power in Defining the Risks Of GM Foods

News sources serve as the agenda builders of newspapers (Berkowitz, 1987). When journalists cite multiple sources in one news article, they may be engaging in cross-checking to include more divergent and balanced views. By doing so, they may also avoid the trap of relying on convenient sources, such as privileged parties or press releases.³⁰

In the People's Daily, fewer sources were cited, with media practitioners and government officials as the dominant sources. Wang *et al.* argued that the People's Daily, as the official party publication, is primarily concerned with interpreting the world from the perspective of the Communist Party of China.³¹ The reliance on government officials as dominant sources served this function. In comparison, the New York Times exhibited more diverse news sources. Even though media practitioners were also dominant sources, they cited many other sources. These included the scientific community without mentioning nationality, NGOs, GM foods manufacturers/research and development companies, community/ordinary citizens, and GM foods farmers/distributors. These sources may have provided more context, information, and expertise for the discussion of GM foods. They may also reflect the opinions of different interest groups. Those who manufacture and conduct research and development on GM foods may have more vested interests in supporting GM foods, whereas ordinary citizens may not support GM foods to avoid the risks. As in the previous findings, it is evident that the New York Times also

³⁰ Tiffen, R., Jones, P. K., Rowe, D., Aalberg, T., Coen, S., Curran, J., Hayashi, K., Iyengar, S., Mazzoleni, G., Papathanassopoulos, S., Rojas, H. and Soroka, S. "Sources In The News." *Journalism Studies* (2013): 1-18.

³¹ Wang, H., Sparks, C., and Huang, Y. "Measuring differences in the Chinese press: A study of People's Daily and Southern Metropolitan Daily." *Global Media and China* 3.3 (2018): 125-140.

avored government sources over other types. However, in comparison to the People's Daily, it had a greater range of source diversity.

Although citing diverse sources does not necessarily mean citing different views, in our study, this is the case. In comparing the two newspapers, we found that sources in the New York Times were not only divergent, but also their views were evenly distributed among three tones, including pro-GM foods, anti-GM foods, and neutral. In contrast, the sources in the People's Daily were not limited in diversity, but the views were also mainly leaning toward pro-GM foods. Though both the U.S. and Chinese governments made it legal to produce and distribute certain GM foods, the New York Times cited more anti-GM food sources than the People's Daily. Also, we discovered an interesting finding that different players served distinct roles at the two newspapers. In the People's Daily, the pro-GM foods parties were Chinese government officials, scientists, and experts. However, in the NYT, they were foreign scientists and experts. The anti-GM food parties in the New York Times were media practitioners, while no source was significantly more likely to show an anti-GM foods tone in the People's Daily. Sources that were significantly more likely to hold neutral tones toward GM foods in the New York Times were foreign government officials and GM foods farmers/distributors.

5.3 Article Tone: More Neutral Reports Than Pro- and Anti-GM Foods Reports

The risk of GM foods is different from other food safety issues which brought about only negative consequences. GM foods are a combination of risk and opportunity. They may have potential risks, but as biotechnology products, their emergence also offers benefits and opportunities. They are conducive to national science and technology development in solving grain production problems and reducing pesticide use.³² Therefore, when the media in China and the U.S. reported on GM foods, they preferred to hold neutral attitudes (about half of the articles in both the People's Daily and the New York Times used

³² Gurr, J. R. "Engineering plants with increased disease resistance: What are we going to express?". *Trends Biotechnol*, 23 (2005): 275-282.

a neutral tone), citing both sides of the opinion from news sources rather than showing clear support or opposition. By reporting both sides of the opinion on the issue, most news articles framed it as uncertain rather than having harm or benefit to human society. Corbett and Durfee's experiment showed that news stories that framed global warming as controversy increased readers' perceptions of its uncertainty.³³ Similarly, by reporting GM foods in a neutral tone and citing two-sided opinions, the two papers may lead to public confusion about GM foods.

6. Conclusion

Following the logic of Most Different System Design, we aimed to explain the similar “outcome”, or phenomenon, of the two very different societies in embracing GM foods by examining the few similarities in their media coverage of them. We found that, besides multiple differences, the absolute dominance of the two governments in defining GM foods and their risks or benefits might explain the adoption of these controversial technologies in the two societies. The Chinese government's open attitude was “cautiously optimistic”, with lots of neutral opinions and fewer supportive expressions. The U.S. is ambiguous, with a mixture of supports, oppositions, and neutral opinions of GM foods. Their voices were louder than the experts, the ordinary citizens, the farmers, and other interest groups of GM foods. Such dominance in discourse, we argue, is correspondingly reflecting the dominance of the two governments in the governance of GM foods. Indeed, both newspapers were not reluctant to report the negative opinions from different interest groups, yet the two countries still launched pro-GM food policies. This means the power relations behind the GM food policies were up-to-bottom instead of bottom-up—the two governments launched the policies based on their determinations and judgments, instead of responding to the public will. This is especially interesting given that the U.S. is a liberal government. Indeed, regarding GM foods policies, the U.S. government was acting as a

³³ Corbett, J. B., and Durfee, J. L. “Testing public (un) certainty of science: Media representations of global warming.” *Science Communication* 26.2 (2004): 129-151.

big government just as China is.

In general, the New York Times seemed to hold an open attitude toward the treatment of GM foods. The People's Daily, however, seemed cautiously optimistic. The media framing of GM foods in China was consistent with implemented policies. This finding was understandable since the Chinese media reflected the ideology of policymakers. Interestingly, we found a separation between the policies in the U.S. and the attitudes of social discourses over GM foods. U.S. society was far from reaching a social consensus on GM foods. The New York Times, as a newspaper in a liberal society, reflected the conflicts and questions of different social actors. The scientists and the manufacturers supported the development of GM foods, while the NGOs and ordinary citizens expressed their suspicions about the products. Overall, the American media maintained a neutral to negative position about GM foods. However, the policies and development of the GM foods industry in the U.S. indicated that the policymakers stood firmly with scientists and manufacturers, embracing GM foods regardless of potential controversies.

Apart from the above findings, another contribution of the current study is in the methodology part. The previous literature on media content analysis usually focused on articles as a unit analysis. Thus, previous researchers can only examine the tone of each article. As different sources may have divergent attitudes toward an issue, this method of coding cannot reveal the divergent opinions of sources. For analysis, this study used both articles as a unit and source assertions as a unit. By doing so, we can reveal each article's attitude and each source's attitude toward GM foods.

The limitation of our study is that we focused only on the social construction of GM foods through traditional media. Future studies could examine the social construction of GM foods related to social media. These studies may tell us, for example, whether government officials and scientists still play leading roles in constructing GM foods on social media. They may also reveal whether the tones and concerns about GM foods on social media are different from those found in traditional media. Another limitation is that we only examined the sources of press media, which can partly reflect the power dynamics regarding the social construction of GM foods, but not all of them. We did not include other

influential sources that did not appear in the media in our study, like the political talks in a congress hall, a scientific discussion in a laboratory, or the talks between two farmers about GM foods. Future studies could include more sources in different platforms to gain a comprehensive picture of the issue. Finally, by including articles in both Chinese and English, the potential language biases could be introduced.

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