Anti-GMO and Vaccine-Autism Public Policy Campaigns in the Court of Public Opinion

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Science skepticism is on the rise worldwide, and it has a pernicious influence on science and science-based public policy. This Article explores two of the most controversial science-based public policy issues: whether genetically modified foods are inherently unsafe and whether vaccines cause autism spectrum disorder. After evaluating the scientific credibility and discursive power of these claims, this Article analyzes how changes in public opinion can shift public policy away from anti-scientific practices. Legal scholarship can play a substantial role because, if accessibly written, it has the potential to be timely, persuasive, and comprehensible by a broad audience. Other stakeholders also play a meaningful role. Finally, this Article explores the possibility of what could happen if these movements are left unchecked. This Article concludes that a coordinated effort by a variety of stakeholders, and especially relevant experts in the legal field, can roll back the tide of anti-science in the court of public opinion.

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# Table of Contents

**Introduction** ........................................................................................................... 721

**I. The Safety of GMOs and Vaccines for Public Consumption** .............................. 724
   A. Are GMOs Safe to Consume? ........................................................................... 724
   B. Do Vaccines Cause Autism? ............................................................................. 727

**II. Why Are Anti-GMO and Vax-Autism Campaigns So Influential over Public Policy?** ............................................................ 729
   A. The Rise of the Anti-GMO Movement ............................................................... 729
   B. The Rise of the Vax-Autism Movement .............................................................. 734

**III. Engaging Public Opinion on GMO and Vaccine Public Policy** ........................... 737
   A. Can Changing Public Opinion Influence Science-Based Public Policy? ...... 737
   B. Towards Public Education of GMOs and Vaccines: What Works .............. 741
      1. Public Education about GMOs ................................................................. 742
      2. Public Education about Vaccines .............................................................. 745

**IV. The Role of the Legal Scholar in GMO and Vax-Autism Public Policy Debates** ................................................................................................................... 747
   A. Legal Scholarship Is Predisposed to Public Engagement ................................ 748
   B. Legal Scholarship Can Dispel Legal Myths That Encourage Pseudoscientific Beliefs .......................................................... 750
   C. Legal Knowledge Can Augment Evidence-Based Public Policy Research .................. 752
   D. Law Reviews Should Closely Scrutinize Manuscripts for Pseudoscience .......... 754

**V. Challenging Pseudoscience in the Information Supply Chain** ................. 757
   A. Scientists Must Proactively Deter the Spread of Pseudoscience .................. 757
   B. Legitimate Publishers Must Denounce Spurious Competitors ..................... 759
   C. Consumers Have a Responsibility to Self-Monitor for Misleading Scientific Claims 761

**VI. Modern Radicalism and the Possibility of a GMO-Vaccine Meta-Movement** ........................................... 767

**Conclusion** ............................................................................................................. 771
INTRODUCTION

Science skepticism is spreading at alarming rates. Globally, over one in three respondents surveyed are skeptical of science and nearly half prefer to accept science that aligns with their personal beliefs. In the United States, citizens are substantially more mistrustful than experts of the science behind climate change, use of pesticides, evolution, nuclear power, and other issues of public importance. At its extreme, scientific knowledge can be perceived as subjective and socially constructed, and science and scientists are depicted as fundamentally anti-human. Anti-science beliefs are becoming so powerful that they threaten the very functioning of both developed and developing democratic societies where scientific advancements materialize.

Activism in support of anti-science extracts a substantial human cost. Opponents of genetically modified organisms (GMOs) blocked the distribution of vitamin A enhanced white rice, resulting in millions of needless deaths to malnutrition and millions more to child blindness. Anti-vaccine activists are


5. See Miller, supra note 4, at 77.

promoting the idea that giving vaccines to children causes autism spectrum disorder.\textsuperscript{7} Their disinformation campaign has been so successful that over half of Americans surveyed either believed or were unsure that a link between child vaccines and autism exists.\textsuperscript{8} As a result, long dormant diseases are now reappearing in both the developed and developing world,\textsuperscript{9} potentially dismantling one of the greatest achievements of twentieth-century medicine.\textsuperscript{10}

Public policy has in some cases become an unwitting co-conspirator. In part driven by fears that vaccines cause autism,\textsuperscript{11} some European nations and at least fifteen U.S. states permit parents with philosophical and personal objections to opt out of vaccinating their children.\textsuperscript{12} Concerned parents have flooded vaccine courts with vaccine-autism claims.\textsuperscript{13} In the anti-GMO arena, advocates succeeded in convincing nineteen out of twenty-eight E.U. nations to impose partial or total bans on GMOs.\textsuperscript{14} Disruptions in trade from these bans


\textsuperscript{8} Does Europe Have the Right Idea on Vax Policy?, \textit{Hastings Law Journal} 72:719

and regulatory delays in introducing GMOs in African nations have cost an estimated hundreds of millions of dollars and thousands of human lives.\(^\text{15}\) Fear, and not science, is too often forcing public policy change.

This Article explores why these two powerful social movements, the movement against GMOs and the movement claiming that vaccines cause autism, have been so influential on public opinion and public policy and what can be done to respond. The first two Parts of this Article look closely at the scientific bases and historical narratives that underlie these social movements. Part I addresses the threshold question of whether the anti-GMO and vax-autism campaigns are scientifically credible. Part II investigates why the anti-GMO and vax-autism campaigns are so influential in modern discourse. This Part finds that the political and social framework for these campaigns have been building for decades, laying the groundwork for the modern activism experienced today.

This Article then examines how stakeholders can respond to these campaigns. Part III examines whether changing public opinion about GMOs and vaccines will necessarily have an impact on public policy. Not all public policy matters are susceptible to public opinion. However, the very salience, simplicity, and emotion-laden nature of these issues that helped anti-GMO and vax-autism activists can also be leveraged to educate the American public with evidence-based knowledge. Further, this Article argues that any efforts at education must carefully tailor messages toward particular audiences, leverage storytelling of successes related to GMOs and vaccines, and avoid alienation of stakeholders that could cause policy backfire.

Part IV explores how legal scholars can play an important role in the public discourse, and not only through standard legal analyses suggesting regulatory reform. Compared to some other academic disciplines, legal scholarship is distinct for its relative accessibility, persuasiveness, and timeliness. Those very traits can be leveraged to participate in the court of public opinion, while also ensuring that legal scholarship does not facilitate the further spread of pseudoscientific ideas.

Coordinated anti-science campaigns require coordinated responses, and Part V of this Article examines how stakeholders throughout the information supply chain,\(^\text{16}\) including scientists, publishers, and consumers, can also respond

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16. For purpose of this Article, an information supply chain is the pipeline of evidence-based scientific knowledge from the creator of original scientific knowledge through various information intermediaries to the final consumer of that scientific information. *Cf.* Holly Doremus, *Data Gaps in Natural Resource Management: Sniffing for Leaks Along the Information Pipeline*, 83 IND. L.J. 407, 417–43 (2008) (detailing the scientific information supply chain in the natural resources context).
to the anti-GMO and vax-autism movements. Part VI addresses the disturbing possibility that the anti-GMO and vax-autism campaigns could merge into a combined “health liberty” social movement that leverages its synergies to even more forcefully erode the credibility of evidence-based practices. This Article concludes that a holistic effort from a variety of stakeholders, not the least those who write and publish in law reviews, can help change the outlook of GMOs and vaccines in the court of public opinion and help resist the tide of dangerous pseudoscience infecting modern public policy.

I. THE SAFETY OF GMOs AND VACCINES FOR PUBLIC CONSUMPTION

Before arguing for responses to the anti-GMO and vax-autism movements, it is important to address the threshold question of whether GMOs and vaccines are sufficiently safe that a response to these social movements is necessary. This Part first reviews the prevailing science regarding the safety of GMOs for human and animal consumption. This Part then examines the scientific evidence regarding the safety of vaccines, specifically in reference to autism, for human and animal consumption.

A. ARE GMOs SAFE TO CONSUME?

Stated simply, a GMO is “any organism that possesses any novel combination or expression as a trait of genetic material obtained through the use of modern biotechnology.” Genetic modification has been practiced by humans for over 30,000 years. Corn began its life as a genetic modification of...
wild grass.\textsuperscript{21} Broccoli, bananas, and apples with desirable traits that we consume today are the product of long-ago genetic selection.\textsuperscript{22} Modern genetically modified crops help reduce food spoilage, increase food security, empower disadvantaged groups, and generate $100 billion in economic gains that improve agriculture in both developed and developing nations.\textsuperscript{23}

Crops planted with biotechnology have also improved agricultural efficiency, saving an estimated 123 million hectares of land from agriculture consumption over a sixteen-year period.\textsuperscript{24} Such crops have also helped alleviate poverty for over 16.5 million small farmers and their families.\textsuperscript{25} With an estimated need to increase the global food supply by 60–70\% by 2050, genetically modified crops present one of the most effective ways to expand food production and meet this growing demand.\textsuperscript{26}

GMOs are not only economically beneficial but are also generally safe to grow and consume. A meta-analysis reviewing 6,006 publications over a twenty-one-year period, carefully selected for scientific rigor, found that GMO maize showed clear benefits to grain quality and yield and no substantial effect on the diversity of non-targeted insects.\textsuperscript{27} Scholars reviewing a ten-year literature on GMO crop safety concluded that “the scientific research conducted so far has not detected any significant hazard directly connected with the use of GM crops” and that “genetic engineering and GE crops should be considered important options in the efforts toward sustainable agricultural production.”\textsuperscript{28} A variety of scholarship, including one of the most detailed and far-reaching
reports produced by scientists which examined hundreds of scientific studies, found “no substantiated evidence that foods from GE crops were less safe than foods from non-GE crops.”

Furthermore, the weight of the scientific community behind GMOs is strong. One hundred twenty-nine Nobel Laureates joined an effort to convince the public and anti-GMO advocates that GMOs are not only safe but beneficial to the developing world. A letter signed by these laureates urges GMO opponents to reconsider their resistance to genetically modified agriculture.

Nobel Laureate Richard Roberts writes that,

[all] serious scientific studies; i.e., those published in prestigious journals, show that the plant varieties prepared by GM methods are not more dangerous than those available by traditional breeding techniques. If anything, the GMO varieties are likely to be safer than traditionally bred varieties because they are subject to many more controls.

Billions of animals are raised on GMO food each year with no evidence of harm to animals or humans.
Experts affirming GMO safety are not limited to Nobel Laureates. Eighty-eight percent of surveyed American Association for the Advancement of Science (AAAS) scientists responded that genetically modified foods are generally safe.\textsuperscript{34} The National Academy of Sciences released a thorough report concluding that little evidence connects GMO crops to adverse environmental or agronomic problems and “[o]verall, the committee found no evidence of cause-and-effect relationships between GE crops and environmental problems.”\textsuperscript{35} Entities ranging from the World Health Organization\textsuperscript{36} and the American Medical Association\textsuperscript{37} to the Pontifical Academy of Sciences\textsuperscript{38} have made official statements in support of GMOs. The evidence supports the conclusion that GMOs are safe, legitimate, and generate positive value to a variety of sectors in society.

B. DO VACCINES CAUSE AUTISM?

A vaccine is a product that protects individuals against serious and potentially deadly disease.\textsuperscript{39} Introducing germs into the human body that are killed or weakened so that an individual does not get sick, vaccines encourage an individual’s immune system to produce antibodies against that particular germ.\textsuperscript{40} In the United States, vaccines have prevented an estimated 21 million or more hospitalizations and 732,000 deaths of children over a twenty-year period.\textsuperscript{41} Vaccines have also saved $295 billion in direct costs and $1.38 trillion in total costs to society.\textsuperscript{42} Vaccines are one of the greatest medical advances in the modern era.\textsuperscript{43}

\begin{footnotesize}
\begin{enumerate}
\item[] 34. Funk et al., supra note 2, at 37.
\item[] 35. Nat’l Acads., Sci., Eng. & Med., supra note 29, at 154. The authors also called for further research and noted a lack of consensus on selected issues, but not for genetically engineered crops overall. Id. at 154–55.
\item[] 36. Food, Genetically Modified, World Health Org. (May 1, 2014), http://www.who.int/foodsafety/areas_work/food-technology/faq-genetically-modified-food/en/ (“GM foods currently available on the international market have passed safety assessments and are not likely to present risks for human health. In addition, no effects on human health have been shown as a result of the consumption of such foods by the general population in the countries where they have been approved.”).
\item[] 37. Bioengineered (Genetically Engineered) Crops and Foods H-480.958, Am. Med. Ass’n (2012), https://policysearch.ama-assn.org/policyfinder/detail/bioengineered%20foods?uri=%2FAMADo%2FHOD.xml%0=4359.xml (concluding in part that the “AMA recognizes the many potential benefits offered by bioengineered crops and foods, does not support a moratorium on planting bioengineered crops, and encourages ongoing research developments in food biotechnology”).
\item[] 42. Id
\item[] 43. See, e.g., Flavia Bustreo & Marie-Paule Kieny, Vaccines: A Global Health Success Story That Keeps Us on Our Toes, World Health Org. (Apr. 25, 2016), https://www.who.int/mediacentre/commentaries/vaccines/en/ (“It’s no secret that vaccines are considered 1 of the greatest global health achievements. Every
Vaccines are also highly safe, and the “current U.S. vaccine supply is the safest in history.”

Substantial research has been conducted on the safety of a wide variety of vaccines ranging from chickenpox (varicella) vaccines to vaccines that prevent the onset of measles, mumps, and rubella. A review of numerous studies examining the safety of vaccines found that adverse effects were “extremely rare” and that “absolute risk is low.” For example, estimated adverse effects for a vaccine against rotavirus were as low as 1.1 to 1.5 cases per 100,000 doses. This extremely small risk is roughly similar to the U.S. plane accident fatality rate per 100,000 flight hours or the risk of death from playing soccer. Vaccines avert an estimated two to three million deaths per year worldwide.

Vaccines do not cause autism. In the largest study of its kind, researchers found that receiving the measles-mumps-rubella (MMR) vaccine is not associated with an increased risk of autism spectrum disorder, even among children who were at a higher risk of autism due to a sibling already having autism. Numerous methodologically sound studies have been conducted on the issue and have consistently shown no association between vaccines and autism spectrum disorder.

A nationwide cohort study of 657,461 children tracked from 1999 through 2010 concluded that, “our study does not support that MMR

...
vaccination increases the risk for autism, triggers autism in susceptible children, or is associated with clustering of autism cases after vaccination. There also appears to be no reliable scientific evidence that vaccines are causally related to autism in dogs. Overall, there is currently no credible scientific evidence showing that vaccines cause autism.

II. WHY ARE ANTI-GMO AND VAX-AUTISM CAMPAIGNS SO INFLUENTIAL OVER PUBLIC POLICY?

Today, anti-GMO and vax-autism movements are widely known and well-funded. However, no amount of funding or publicity can mobilize an anti-science movement without exploiting some lingering discontent, uncertainty, or fear. This Part shows that the anti-GMO and vax-autism movements did not appear spontaneously. Instead, they emerged from a decades-long history of mismanagement of scientific research, concurrent social and political forces, and a public carefully primed to distrust the very experts who have dedicated their careers to solving some of the world’s most pressing problems. The result is that both movements today have the power to influence how GMOs and vaccines are regulated.

A. THE RISE OF THE ANTI-GMO MOVEMENT

How did genetic modification become so vilified? In 1973, two scientists discovered how to create the first successful genetically engineered organism. An early conference of scientists, lawyers, and government officials agreed that genetic engineering projects were viable within guidelines. Genetic engineering quietly continued with scientific innovations and regulatory approvals for the next twenty years.

The problem for proponents of genetic engineering, however, was that during this developmental period a series of loosely science-related calamities

56. See Rangel, supra note 20 (citing Stanley N. Cohen, Annie C.Y. Chang, Herbert W. Boyer & Robert B. Helling, Construction of Biologically Functional Bacterial Plasmids In Vitro, 70 PNAS 3240, 3240 (1973) (reporting transfer of DNA involving Escherichia coli cells)). The scientists transferred a gene encoding resistance to antibiotics from one strain of bacteria to another. Id. The result was the second strain of bacteria displaying resistance to antibiotics. Id.
57. Id.
58. Id.
entered the public consciousness. In the 1980s, the use of recombinant bovine somatotropin (rBST) as a growth hormone to lengthen the lactation cycle of cows triggered a major controversy.\textsuperscript{59} Fallout from the 1986 Chernobyl nuclear disaster contaminated European agricultural fields, making Europeans more suspicious of scientific assurances that agricultural technology is safe.\textsuperscript{60} During the early 1990s news of the spread of bovine spongiform encephalopathy, also known as mad cow disease, appalled European and American consumers.\textsuperscript{61} The media was awash with shocking footage of convulsing cows and reports of live cows fed remains of diseased cows as a price-motivated feed practice on factory farms.\textsuperscript{62} The furor over mad cow disease, and public mistrust of governments’ response, is credited as a major turning point in consumer attitudes toward the modern food supply.\textsuperscript{63} It was during and shortly thereafter this pivotal period that Jeremy Rifkin,\textsuperscript{64} or perhaps others,\textsuperscript{65} sparked the modern anti-GMO movement, and questioned the health of GMO foods for consumption in humans. The popular 1990 white paper \textit{Biotechnology’s Bitter Harvest} criticized the introduction of genetically modified crops that better tolerated herbicide.\textsuperscript{66} During the early 1990s, the Keystone Center, a nonprofit organization, hosted a series of “national conversations” on the ethical use of genetic technologies.\textsuperscript{67}

Thus, the mad cow crisis and other calamities happened just as resistance against GMOs was building and the European Union was considering supranational regulation of genetically modified products.\textsuperscript{68} As one author recalled, the debate about GMOs was “woven into a field of discourse that included intra-European disputes over the ‘mad cow’ crisis, transatlantic trade wars over products such as hormone-treated beef, and ongoing state-society


\textsuperscript{60} Id.


\textsuperscript{62} Id. at 394.

\textsuperscript{63} LISA H. WEASEL, \textit{FOOD FRAY: INSIDE THE CONTROVERSY OF GENETICALLY MODIFIED FOOD} 31 (2009).


\textsuperscript{67} Thompson, supra note 59.

conflicts over environmental issues."69 Policymakers were coaxed into framing public health issues as debates over values rather than science.70 These values were “the meaning of nature and the natural, the protection of local customs in food and agriculture, and the preference for precaution over risk-taking."71 Viewing genetic modification through such a lens was to set the stage for skepticism and ultimately opposition toward GMOs and their products.

The first modern GMO crop product to be commercialized was the apparently innocuous Flavr Savr tomato in 1994.72 The GMOs were used to identify and block a gene that promotes the tomato ripening process.73 The manufacturer voluntarily submitted the new tomato to the Food and Drug Administration (FDA) for an advisory opinion.74 The FDA replied that the tomato would be treated as any other because of lack of any difference in safety.75 Despite the clear labeling that the product was derived from genetically engineered tomatoes, demand for the tomato paste product was robust.76 Initial sales outstripped traditional tomato paste product at many locations.77 The product was not profitable, however, because of high production and distribution costs.78

Meanwhile, in the United Kingdom, Zeneca introduced genetically engineered tomato paste that lowered processing costs, resulting in a 20% lower price for the product.79 Initial sales were brisk but then declined dramatically in the fall of 1998.80 A select committee report of the U.K. House of Commons credited the decline to a broadcast featuring Dr. Arpad Pusztai, who announced

70. Id.
71. Id. This viewpoint also helped create the divide between U.S. and E.U. policy. While U.S. scientists set the scientific agenda, which was endorsed by the state, in Europe the state fixed the terms of the debate and only subsequently turned to science. Id. at 63. This different treatment of scientists and scientific information in the development of policy may help explain why current U.S. and E.U. GMO policies have diverged so widely. See Firestone, supra note 68, at 36–37.
73. Bruening & Lyons, supra note 72, at 6.
74. Id. at 6–7; see also JORDAN FRABONI, Note, A Federal GMO Labeling Law: How It Creates Uniformity and Protects Consumers, 32 BERKELEY TECH. L.J. 563, 565 (2017) (citing U.S. FOOD & DRUG ADMIN., AGENCY SUMMARY MEMORANDUM RE: CONSULTATION WITH CALGENE, INC. CONCERNING FLAVR SAVR™ TOMATOES (1994)).
76. Bruening & Lyons, supra note 72, at 7.
77. Id.
78. Id.; see also ANTON WOHLENS, REGULATING GENETICALLY MODIFIED FOOD: POLICY TRAJECTORIES, POLITICAL CULTURE, AND RISK PERCEPTIONS IN THE U.S., CANADA, AND EU, 29 POL. & LIFE SCI. 17, 23 (2010) ("[T]he genetically modified tomato was eventually taken off the market in 1997 due to poor yield in the unsuitable sandy soil and humid climate of Florida . . . ").
79. Bruening & Lyons, supra note 72, at 7.
80. Id.
that his study of rats fed genetically modified potatoes resulted in biological impacts that “could” be attributed to genetic engineering.\textsuperscript{81} Pusztai’s study proved hotly controversial, with disputed accounts lingering for years afterward.\textsuperscript{82}

In spite of these controversies, opinions in favor of GMOs had remained strong in the United States. In the 1990s, 70\% of the surveyed American public supported genetically modified foods.\textsuperscript{83} This illustrated both substantial and remarkable stability regarding support of biotechnology.\textsuperscript{84} GMOs were generally associated with improved quality of life and low threats to human health.\textsuperscript{85} However, campaigns by interest groups in the late 1990s helped change public opinion.\textsuperscript{86} Unequivocal public support for GMOs declined. Surveys in the 2000s revealed that only a minority held outright support for GMOs, with a substantial part of the public still uncertain about the biotechnology and its applications.\textsuperscript{87} Today, Americans are narrowly divided on the question of whether GMOs are harmful to human health.\textsuperscript{88}

By contrast, European and other consumers are deeply skeptical about the safety of GMOs.\textsuperscript{89} With the exception of South Africa, no country in sub-Saharan Africa permits crops with GMOs.\textsuperscript{90} Then-President Robert Mugabe of Zimbabwe linked sexual impotence in the United States to consumption of foods with GMOs.\textsuperscript{91} A farmer in Tanzania told one reporter that he refused to grow GMO crops for fear they would turn his children into homosexuals.\textsuperscript{92} Surveys conducted in India offer mixed results and a significant lack of knowledge about

\textsuperscript{81} Id.

\textsuperscript{82} For different interpretations of Pusztai’s study, compare Sarah Lively, Note, The ABCs and NTBs of GMOs: The Great European Union-United States Trade Debate—Do European Restrictions on the Trade of Genetically Modified Organisms Violate International Trade Law?, 23 NW. J. INT’L L. & BUS. 239, 253 (2002) (”[W]e do know that GMOs potentially pose real threats. For example, a study conducted by Dr. Arnpad [sic] Pusztai, formerly of the Towett Research Institute, found that rats who were fed genetically modified potatoes suffered weight loss, internal organ damage, and suppression of their immune systems after a certain period of consumption.”), with Johannes S.A. Claas II, Comment, The European Union’s Efforts to Sidestep the WTO Through Its Ban on GMOs: A Response to Sarah Lively’s Paper, “The ABCs and NTBs of GMOs”; 24 NW. J. INT’L L. & BUS. 173, 193–95 (2003) (responding to this claim).

\textsuperscript{83} Wohlers, supra note 78, at 22.

\textsuperscript{84} Id.

\textsuperscript{85} Id. at 23.

\textsuperscript{86} Id.

\textsuperscript{87} Id.


\textsuperscript{89} Eurobarometer—More Europeans Opposed to GM Food, GMWATCH (Nov. 12, 2010), https://www.gmwatch.org/en/latest-listing/1-news-items/12660-eurobarometer-more-europeans-opposed-to-gm-food; Lively, supra note 82, at 244.


\textsuperscript{91} Id.

\textsuperscript{92} Id.
the implications of GMOs. Although earlier surveys reported general support, approval of GMOs in China has become increasingly controversial. While the Chinese government and press are supportive of GMOs, the public remains widely skeptical.

Fundamentally, the dispute over GMOs is a clash between worldviews. Attitudes toward GMOs have been influenced by the evolution of a countercultural awareness that is suspicious of big business. Interviews with anti-biotech advocates stated that the suspicion arose from a lack of control and ownership over that technology. The fact that a single company such as Monsanto could have such a dominant role in agricultural production was an example of a shocking development that motivated anti-GMO activists and others to act. GMOs have even been perceived as a violation of a sacred trust between humankind and its creator. Although the three major western religions do not have unified stances for or against GMOs, there is the underlying concern that humans should not interfere with the fundamental instructions from the divine. “Playing God” and pushing nature beyond its intended limits, the argument goes, could boomerang back on society in the form of divine consequences that punish us all.

93. Satish Deodhar, Are Indian Consumers Concerned About GMO Food?, PARIS INNOVATION REV. (May 26, 2016), http://parisinnovationreview.com/articles-en/are-indian-consumers-concerned-about-gm-food; Aaron M. Shew, Lawton L. Nalley, Diana M. Danforth, Bruce L. Dixon, Rodolfo M. Nayga Jr., Anne-Cecile Delwaide & Barbara Valent, Are All GMOs the Same? Consumer Acceptance of Cisgenic Rise in India, 14 PLANT BIOTECHNOLOGY J. 4, 6 (2016) (“Our study results generally imply that (i) Indian consumers are willing to eat both cisgenic and ‘GM’ rice, albeit at a discount; (ii) from a consumer perspective, cisgenic and GM products should not be regulated as distinct from one another in India; (iii) cisgenic and GM foods should be labelled as such; and (iv) labelling GM and cisgenic foods as ‘no fungicide’ may enhance the marketability of GM rice in India.”).


96. RACHEL SCHURMAN & WILLIAM A. MUNRO, FIGHTING FOR THE FUTURE OF FOOD: ACTIVISTS VERSUS AGribusiness in the Struggle Over BIOTECHNOLOGY, at xvi–xvi (2010).

97. Id. at xvi.


99. See Emmanuel B. Omobowale, Peter A. Singer & Abdallah S. Daar, The Three Main Monothetic Religions and GM Food Technology: An Overview of Perspectives, 9 BMC INT’L HEALTH & HUM. RTS. 18, 23 (2009) (“[T]here is no consensus on whether GM food technology should be banned or accepted by [Judaism, Islam, and Christianity].”)

100. See BRIAN WYNNE, Creating Public Alienation: Expert Cultures of Risk and Ethics on GMOs, 10 SCI. AS CULTURE 445, 469–70 (2001).
B. THE RISE OF THE VAX-AUTISM MOVEMENT

While the anti-GMO movement is only a few decades old, the modern crusade against vaccines has a longer history.\textsuperscript{101} Co-discoverer of natural selection and famous explorer Alfred Russel Wallace argued in the 1880s that the smallpox vaccine was unsafe and that compulsory vaccination was an unethical practice.\textsuperscript{102} Wallace believed that the vaccine upset the balance of human nature and would cause disastrous harm.\textsuperscript{103} Responding to a statement made in The Lancet, a leading medical journal, that vaccines are safe and effective, Wallace scornfully declared that, “[s]urely, never before was misstatement so ignorantly promulgated, or so completely refuted!”\textsuperscript{104}

During the twentieth century, a time of great successes for vaccines,\textsuperscript{105} a parallel controversy emerged over a frustratingly complex disability now known as autism spectrum disorder. Although similar symptoms have been described by writers for centuries,\textsuperscript{106} the modern understanding upon which autism is based originates from Leo Kanner, a psychiatrist and physician at Johns Hopkins Hospital.\textsuperscript{107} Kanner described a syndrome characterized by an obsession with repetition, an impaired ability to relate socially to others, limited speech and language, unusual responses to objects and events, and a robust rote memory.\textsuperscript{108}

The combination of a new diagnosis, with symptoms easily mistaken for bad behavior, and a field dominated by a few researchers may have contributed


\textsuperscript{103} Greydanus & Toledo-Pereyra, supra note 101, at 3.

\textsuperscript{104} ALFRED RUSSEL WALLACE, \textit{VACCINATION A DELUSION: ITS PENAL ENFORCEMENT A CRIME} 90 n.24 (London, Swan Sonnenschein & Co. 1898).


\textsuperscript{107} Lorna Wing, \textit{The History of Ideas on Autism}, 1 AUTISM 13, 13 (1997); see also Jan Blacher & Lisa Christensen, \textit{Sowing the Seeds of the Autism Field: Leo Kanner (1943)}, 49 INTELL. & DEVELOPMENTAL DISABILITIES 172, 172 (2011).

to a tragic misdirection about the cause of the disease. In 1949, Kanner dealt parents a devastating blow by blaming poor parenting as a major cause of autistic behaviors. He criticized mothers for a “lack of genuine warmth,” and fathers that “hardly know their autistic children.” Children with autism had parents who “just happen[ed] to defrost enough to produce a child.” Parents of children showing symptoms of autism “had been reared sternly in emotional refrigerators, have found at an early age that they could gain approval only through unconditional surrender to standards of perfection.” For Kanner, there was no brain dysfunction in children with autism, but rather they suffered emotional damage from their environment.

The effects were catastrophic. Parents were overwhelmed with guilt. Families split as mothers and fathers assigned blame for their “poor parenting” on one another. Families that could afford it spent substantial sums on psychoanalytic treatment. When their child improved, the therapist took the credit. If the child did not, the parents shouldered the blame. Children mostly received no useful treatment, and up to seventy-six percent of children with autism were institutionalized before they reached adulthood.

Not a single scientific evaluation was conducted at the time regarding whether the “refrigerator parent” theory had any basis in scientific reality. Nonetheless, the poisonous notion of a “refrigerator parent” chilling their sons and daughters into autism spread like an infection through numerous branches of medicine. The Kanner article advanced profoundly false and damaging ideas about what is now known as autism spectrum disorder.

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109. Leo Kanner, Problems of Nosology and Psychodynamics of Early Infantile Autism, 19 AM. J. ORTHOPSychiatry 416, 421–23 (1949); see also Wing, supra note 107, at 16.
110. Kanner, supra note 109, at 422.
112. Kanner, supra note 109, at 423.
113. Wing, supra note 107, at 15–16.
114. Id. at 16.
115. Id.
116. Id.
117. Id. at 16–17.
118. Id. at 17.
119. Id.
121. See Wing, supra note 107, at 17 (“I have been unable to find any single attempt at scientific evaluation of such treatment in the years when psychoanalytical theories were at their height, up to the end of the 1950s. Nor was there any study of the natural history of autism when no treatment was given, which is an essential basis for evaluation of methods of intervention.”).
122. Id. at 16; see also Kotler, supra note 120, at 333.
123. The fourth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM), an influential diagnostic manual used in the United States, was the first to classify autism as a spectrum of symptoms. Lina Zeldovich, The Evolution of ‘Autism’ as a Diagnosis, Explained, SPECTRUM NEWS (May 9, 2018),
misleading the public, it deceived medical professionals for twenty years and likely embedded a profound skepticism of establishment science to diagnose and treat autism.124

This painful history lingered until a single study galvanized the anti-vaccine movement through the question of autism. The Lancet would again be at the center of the vaccination debate, though this time the journal would be the source of anti-vaccination rhetoric. A 1998 study published by Andrew Wakefield and co-authors in The Lancet implicated the measles, mumps, and rubella (MMR) vaccine in autism-spectrum disorders.125 The study authors did not claim to prove a causative or even an associative connection between the MMR vaccine and autism.126

Picked up by the press, the study generated widespread publicity and ultimately sparked a global anti-vaccine movement.127 The study was later found to have a very small sample size and other questionable methodologies.128 The study was also found to be partially funded by lawyers hired by parents to sue manufacturers of vaccines.129 The article was retracted by The Lancet and subsequent research disproved the article’s findings.130 In spite of this, the article’s findings were widely disseminated and continued to have extraordinary influence over citizens fearful of the link between autism and vaccines.131 A number of autism-related organizations support Wakefield and his subsequent advocacy against vaccination of children.132

The fact that the autism-vaccination link has been attractive to so many appears to be, in hindsight, not entirely unexpected. Vaccines have been a source of controversy for over a century. Vaccine injections have no immediately obvious beneficial effects, the scourge of the diseases they prevent is fading from memory, and it is difficult for any parent to watch their child receive a painful injection. Autism, with its unclear diagnoses, widely varying symptoms, and medical advice that leaves parents with more questions than answers,


124. Kotler, supra note 120, at 333.


126. Id. at 641. The study also presented a call for further research, as is common of preliminary studies. Id.


129. Id.

130. Id. at 592; see also Retraction—Ileal-Lymphoid-Nodular Hyperplasia, Non-Specific Colitis, and Pervasive Developmental Disorder in Children, 375 LANCET 445, 445 (2010).


132. Thomas, supra note 123, at 469 & n.133.
March 2021] ANTI-GMO AND VAX-AUTISM

appears to be the ideal conduit for expressing modern social anxieties. The combination of these two forces created a perfect storm for anti-science skepticism about the safety of vaccines and their causative connection with autism spectrum disorder. The result today is a small but highly vocal movement that is attempting to derail one of the most important achievements in modern medicine.

III. ENGAGING PUBLIC OPINION ON GMO AND VACCINE PUBLIC POLICY

Both the anti-GMO and vax-autism movements are organized and assertive. How to most effectively respond to attempts to shift public policy remains an important and underexplored question. This Part examines whether changing public opinion through education can be an effective response. However, the shift of public opinion on a popular issue does not necessarily result in an equivalent shift at the public policy level. This Part will then highlight what methods are most likely to be successful in changing public opinion toward GMOs and vaccines. This Part finds that scientific education on GMOs and vaccines has potential for rolling back the misperceptions and halting the spread of, or perhaps counteracting, the legal and regulatory controls that legitimize and sustain these science-skeptic campaigns.

A. CAN CHANGING PUBLIC OPINION INFLUENCE SCIENCE-BASED PUBLIC POLICY?

Both movements are not merely threatening to change the legal landscape but have already substantially influenced public policy in the United States and around the world. In the United States, regulation has focused on GMO labeling, with over 100 bills involving GMOs winding their way through legislatures in 2015 and 2016. Vermont became the first state to pass a law that required GMO labeling of relevant products. The following year, President Obama signed into law the National Bioengineered Food Disclosure Standard, which directs the United States Department of Agriculture to implement specific rules for mandatory disclosure of bioengineered foods. The standard explicitly

133. NAT’L CONF. OF STATE LEGISLATURES, STATE LEGISLATION ADDRESSING GENETICALLY-MODIFIED ORGANISMS (2016), https://www.ncsl.org/Portals/1/Documents/agri/gmo_leg_tabl_6-16.pdf. While more information via labeling appears to be a tempting solution, such labeling of products containing GMOs can be misleading as much as it is helpful. See Brandon McFadden, “GMO Free Water”? Don’t Be Fooled by Misleading Labels, BIOTECHNOW (Sept. 6, 2017), https://www.biotech-now.org/blogs/gmo-free-water-dont-be-fooled-misleading-labels.


preempted state and local entities from enforcing their own GMO labeling legislation. This froze the enforcement of state labeling legislation until a federal standard can be fully implemented.\textsuperscript{136} Whatever the result, it will certainly not satisfy the anti-GMO movement, with groups renaming the federal law the Denying Americans Right to Know Act (DARK),\textsuperscript{137} with for some advocates the ultimate goal being a GMO-free United States.\textsuperscript{138} Outside the United States, robust regulation has imposed total or partial bans on products with GMOs.\textsuperscript{139} There is little chance that the fight for further GMO regulation and curtailment will slow down anytime soon.

The anti-vaccine movement had its own successes in bending public policy. While all fifty states retain mandatory vaccination policies, fifteen states permit those with philosophical exemptions and almost all states permit those with religious objections to decline required immunizations.\textsuperscript{140} While some state legislators are responding to remove various exemptions,\textsuperscript{141} numerous opportunities for parents to circumvent vaccination requirements remain. Exemptions have been blamed for causing a number of measles and other outbreaks in states where such exemptions have been particularly lenient.\textsuperscript{142} State legislatures have tried to curtail the abuse of these exemptions, but aggressive opposition from anti-vax organizations has successfully prevented change in several states.\textsuperscript{143} Even when legislatures succeed in curtailing one exemption, anti-vaccine adherents simply shift to another exemption.\textsuperscript{144} The results have been lamentably predictable, with diseases once “doomed by...
“science” remerging amongst populations, with particular resurgence in areas where exemptions are most readily sought and granted.145

Despite the absence of significant scientific credibility backing these movements, neither of the two campaigns can be halted through public policy reform alone. Change must begin with the public opinion that allows such movements to thrive. However, modifying public policy through changing the public opinion of relevant constituents is no simple measure, and the link between public opinion and public policy is not necessarily guaranteed. As changes in public opinion can change rapidly, and courts are not equipped to adapt with the same flexibility as legislatures, most courts are reluctant to modify doctrine on public opinion alone.146 Congress and state legislatures are susceptible to pressure from well-funded interest groups that may prioritize their own agendas over evidence-based practices. Confounding this problem still further is that decades of political science research has shown that the public at large is negligibly informed about American politics and has little ability to process the ever-increasing tidal wave of information presented in electronic media.147

Yet the power of public opinion should not be underestimated. While few, if any, scholars believe that public opinion always determines public policy, only a similarly small number of scholars believe the no public opinion-public policy link exists.148 A review of twenty years of relevant research has found that, although the ability to generalize is limited, public opinion appears to influence public policy most of the time.149 Further, one key element of public policy responsiveness is issue salience. Although its meaning varies, issue salience generally means the importance of an issue to a given group of people,


149. Id. at 36.
particularly voters. Voters who have high salience on a particular issue are more likely to have that issue influence their desire for regulatory change. Issue salience also impacts legislators. Significant public protest and controversy, which are robustly prominent in both anti-GMO and vax-autism issues, can increase issue salience amongst policymakers at the state and federal level.

Both the anti-GMO and vax-autism debates, when combined with other criteria, are strong candidates for issue salience. The issue of GMO regulation has been so important to voters that it sparked propositional votes in a number of states. Evidence exists that the anti-vaccination debate has attracted the attention of troll accounts linked to a Russian government-backed company specializing in online influence operations. The vaccine controversy thus has such power that it has been selected for weaponization by a foreign adversary.

Furthermore, neither issue, at least on a surface level, is so complex that it deters comprehension by citizens. Complex political questions are separate and remote from direct experiences of the public. Such issues require communication of the existence of the issue and interpretation for public consumption before salience can emerge. Neither GMOs nor vaccines face these hurdles. GMOs can be easily understood as changes to food that people consume from the supermarket. Almost every parent with a child has witnessed a vaccination, and the purposes of vaccinations for children are readily understood. Thus, information frictions to understanding the basics of these issues are low.

Finally, both issues are a potential source of emotional involvement. GMOs readily attach to our personal identity of who we are by what we do and do not eat, thus reinforcing our emotions and behaviors toward GMO policy.

151. See Burstein, supra note 148, at 30.
155. Id.
157. Id.
Vaccines implicate the very nature of what it means to be a parent, adherence to cultural norms, and whether and under what conditions we subject our children to the unpleasant task of medical vaccination.159 Both issues are primed for being emotionally charged.

The movements challenging GMOs and vaccines have the advantage of furthering simple, salient, and emotion-laden agendas that can accelerate any social campaign. However, this very advantage can be leveraged by scientists and other professionals dedicated to educating the American public. What can be learned can also be unlearned. The traits that make GMO and vaccine debates salient, simple, and emotional also mean that adherents to both issues are reachable and teachable. The next Part explores how public opinion can change towards evidence-based science and away from supposition, speculation, and fear.

B. TOWARDS PUBLIC EDUCATION OF GMOS AND VACCINES: WHAT WORKS

With an overwhelming amount of information available to the public, and substantial information also available that is either false or misleading, it is understandable how a portion of the public could be skeptical or even hostile toward GMOs and vaccines. Anti-GMO beliefs can create a seductive narrative about the need for purity, autonomy, and a “natural idealism” about the role of food in humanity160 even as millions of lives have been needlessly lost to malnutrition from efforts to delay and prevent the distribution of genetically modified food.161 Vax-autism fears offer the comforting consolation that the onset of autism is not the fault of bad parenting or poor genes, but caused by a conspiracy of predatory multinationals and governments to control children’s (finding that self-identity and emotions played a significant role in behavioral intentions); Elizabeth Whitman, GMO Labeling Debate: Controversy Over Genetically Modified Organisms Driven by Politics and Emotions, Not Science, Sociologist Says, INT’L BUS. TIMES (July 30, 2015, 9:12 AM), https://www.ibtimes.com/gmo-labeling-debate-controversy-over-genetically-modified-organisms-driven-politics-2031571.

159. Yaira Hamama-Raz, Eyal Ginossar-David & Menachem Ben-Ezra, Parental Regret Regarding Children’s Vaccines—The Correlation Between Anticipated Regret, Altruism, Coping Strategies and Attitudes Toward Vaccines, 5 ISR. J. HEALTH POL’Y RSCH. 1, 2 (2016) (“Decision-making regarding vaccination is a complex process which is dependent on emotional, cultural, social, spiritual and political factors as well as on cognitive factors.”).

160. See Katharina Glaab & Lena Partzsch, Utopia, Food Sovereignty, and Ethical Fashion: The Narrative Power of Anti-GMO Campaigns, 40 NEW POL. SCI. 691, 705 (2018); Michael J. Saks, Alexander F. Danvers, Roselle L. Wissler, Mariya K. Voytyuk, Keelah E.G. Williams, Denise A. Baker & Ashley M. Votruba, Psychological Aspects of Food Biodesign, 56 JURIMETRICS 165, 173 (2016) (summarizing US-focused studies finding that perceptions of naturalness arise from food that has been subject to less processing and human intervention). This belief may also be expressed through a “genetic essentialism,” a belief that certain natural categories, such as minerals and natural organisms, have “a fundamental nature that makes them what they are.” Ilan Dar-Nimrod & Steven J. Heine, Genetic Essentialism: On the Deceptive Determinism of DNA, 137 PSYCH. BULL. 800, 801 (2011). In developing countries, the narrative may invoke “the apocalyptic narrative of food colonialism, monocultures, increasing loss of biodiversity and disempowerment of farmers that is associated with GM food crops.” Glaab & Partzsch, supra, at 702.

161. McKie, supra note 6.
bodies.\textsuperscript{162} Fortunately, however, anti-GMO and vax-autism beliefs are neither immutable nor unchangeable.

Public education can address this skepticism. Proposing public education as a solution to the spread of anti-science beliefs may superficially seem trivial. However, education is not as simple as posting facts on Facebook or other social media. Some educational methods are effective, some are ineffective, and some backfire by entrenching even further science-skeptical ideas. Paramount to communicating scientific education is not what is said, but rather what people hear and internalize. This Part will examine what have been found to be most effective to change hearts and minds, which in turn can influence public opinion and public policy.

1. Public Education about GMOs

As with any coordinated media effort, GMO educational efforts should be targeted to the particular type of anti-GMO persona. Not all anti-GMO believers are entrenched activists. Some, known as “avoider” skeptics, may simply avoid searching for answers and accept what information is presented to them in its most convenient form.\textsuperscript{163} For this group, the most effective campaign may be push media or notifications about GMOs that place evidence-based information in the hands of the avoider through social media. Others skeptical of GMOs may rely on strong emotional reactions rather than rational risk calculations to make decisions.\textsuperscript{164} For this “emotional” skeptic, human-focused stories about the benefits of GMOs and GMO farming, as well as families and communities that benefit from GMOs, may be most attractive. Messaging to emotion-based skeptics would emphasize individuals who share a similar demographic as the target market who have overcome a human struggle through genetically modified food. This in turn creates an emotional bond between the reader and subject, associating GMOs with positive human-interest outcomes.

Other GMO skeptics may base their concerns on broader economic or political issues. For such groups, GMO education can be framed in the language and context that concerns people most. Skeptics suspect of conspiratorial pro-GMO campaigns by corporations may respond to the charge that the anti-GMO movement, far from being organic, is driven in part by coordinated efforts of the organic food industry.\textsuperscript{165} GMO skeptics driven by nationalist loyalties might take seriously the charge that anti-GMO disinformation is an information

\textsuperscript{162} Sy Mukherjee, \textit{The Anatomy of an Anti-Vaxxer}, \textit{FORTUNE} (May 13, 2019, 3:45 PM), https://fortune.com/2019/05/13/measles-outbreak-anti-vaxxers/.
\textsuperscript{164} Id.
warfare tool of a foreign government.\textsuperscript{166} Still others distrustful of government intrusion into individual liberty may be persuaded by framing GMO labeling as an unnecessary regulation and a government burden imposed on the consumers.\textsuperscript{167} Restrictions on food sales due to GMO ingredients may be interpreted as a constraint on consumer choice and free enterprise.\textsuperscript{168}

Direct experience with GMO foods can also change GMO attitudes. A study of European consumers, who tend to be more GMO-skeptical than their American counterparts, presented various cheeses to individuals with the disclosure that it was produced using GMOs.\textsuperscript{169} The study found that respondents who thought they were tasting a GMO-produced cheese, and in particular when the GMO-produced cheese was stated to have a health benefit, displayed better attitudes afterward toward GMO food production.\textsuperscript{170} Sample-based interactions with consumers need not be conducted in the lab, but through promotional displays, giveaways, and samples of GMO food that are now common in food retail.\textsuperscript{171}


\textsuperscript{167} I. Howard Beales III, \textit{Modification and Consumer Information: Modern Biotechnology and the Regulation of Information}, 55 FOOD & DRUG L.J. 105, 113 (2000). The author explains:

Mandatory labeling of products that contain GMOs or GMO-derived ingredients essentially imposes all of the costs of labeling on those who do not think the information is relevant—those who are willing to continue to use products containing GMOs. The real beneficiaries of the information are those who care about GMOs, and will use the information to avoid products containing them. As long as others pay the costs, these beneficiaries naturally will “demand” more information than they are willing to pay for. If society subsidizes the informational preferences of an increasing number of groups, labels will grow in complexity, without benefits that the majority of consumers value and for which they are willing to pay.


\textsuperscript{168} See Gary E. Marchant & Guy A. Cardineau, \textit{The Labeling Debate in the United States}, 4 GM CROPS & FOOD 126, 132 (2013) ("The purported objective of GM labeling to promote consumer choice is perplexing given the clear record that such labeling reduces rather than expands consumer choices in food purchases, and that existing alternatives already exist for consumers who wish to avoid GM foods to do so.").


\textsuperscript{170} \textit{Id.} at 102–04.

\textsuperscript{171} See Joel Gittelsohn, Sonali Suratkar, Hee-Jung Song, Suzanne Sacher, Radha Rajan, Irit R. Rasooly, Erin Bednarek, Sangita Sharma & Jean A. Anliker, \textit{Process Evaluation of Baltimore Healthy Stores: A Pilot Health Intervention Program with Supermarkets and Corner Stores in Baltimore City}, 11 HEALTH PROMOTION PRAC. 723, 730 (2010) (finding in a study that increase of health food alternatives was driven in part through promotions, free samples, colorful displays, and other materials).
Finally, demographic data may influence the success of GMO education. A survey of over 15,000 respondents found that attitudes toward GMOs vary according to gender, education level, socioeconomic status, and religious practice, among other variables. Women are more likely than men to perceive a problem with GMOs. Individuals with low levels of scientific knowledge are more likely to mistrust GMOs. Although a current survey shows only modest differences between families and different income levels, family wealth may emerge as a source of significant variation on opinions of GMOs. Each demographic can best respond to science education focused on the receptivity and responsiveness of that demographic’s interests, concerns, and risk-aversion.

Overall, science education and belief in science related to GMOs tends to result in increased positive attitudes toward genetically modified foods. This does not mean that GMO education is a simple task or that it is without risk. Simply presenting arguments that GMOs are safe may backfire, as “leading with the topic of GMOs is likely to trigger the backfire effect as cognitive defense mechanisms take over before the rational argument can be heard.” Instead educators must first affirm the worldview of their audience by endorsing their values, which in turn can increase receptivity for their audience. Whether it is risk-aversion, belief in genetic essentialism, fear of technology, lack of confidence or simply ignorance, women are more likely than men to mistrust GMOs. Additionally, those with low levels of scientific knowledge may embezzle as a source of significant variation on opinions of GMOs. Each demographic can best respond to science education focused on the receptivity and responsiveness of that demographic’s interests, concerns, and risk-aversion.

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173. Kennedy et al., supra note 88.
176. See, e.g., Jonathon McPhetres, Bastiaan T. Rutjens, Netta Weinstein & Jennifer A. Brisson, Modifying Attitudes about Modified Foods: Increased Knowledge Leads to More Positive Attitudes, 64 J. ENV’T PSYCH. 21, 25 (2019); Bastiaan T. Rutjens, Robbie M. Sutton & Romy van der Lee, Not All Skepticism Is Equal: Exploring the Ideological Antecedents of Science Acceptance and Rejection, 44 PERSONALITY & SOC. PSYCH. BULL. 384, 391 (2018) (finding faith in science a significant predictor for support of genetically modified food); Philip M. Fernbach, Nicholas Light, Sydney E. Scott, Yoel Inbar & Paul Rozin, Extreme Opponents of Genetically Modified Foods Know the Least but Think They Know the Most, 3 NATURE HUM. BEHAV. 251, 252 (2019) (“As extremity of opposition to GM foods increased, objective knowledge of science and genetics decreased, but self-assessed knowledge increased.”).
178. B. Elijah Carter, Caitlin C. Conn & Jason R. Wiles, Concern about Hunger May Increase Receptivity to GMOs, 21 TRENDS PLANT SCI. 539, 539 (2016).
179. Id.
understanding, or an intuitive desire for natural purity, GMO education must be tailored to the beliefs and interests of the education recipients. Anything less can result in a continuing skepticism of one of the most powerful and beneficial innovations in food biotechnology.

2. Public Education about Vaccines

A variety of researchers have examined how to respond to vaccine hesitancy and rejection. Changing attitudes on this important subject is not an easy task. Even five to ten minutes of exposure to anti-vaccine websites can erode confidence in the safety of vaccination and decrease intention to vaccinate.\textsuperscript{180} Parents that did not trust their child’s healthcare provider, and were in particular younger, more educated, and opposed to school vaccination requirements, were more likely to obtain vaccine information online.\textsuperscript{181} Individuals who resorted to the internet for information about vaccine safety were more likely to have lower perceptions of vaccine safety, vaccine protectiveness, and disease susceptibility.\textsuperscript{182} Searching for sites claiming that vaccines are unsafe is likely to create a path dependence effect when using search engines such as Google, where filters will return more information aligned with previous searches.\textsuperscript{183}

Similar to GMOs, direct messages to skeptics about the safety of vaccines can backfire.\textsuperscript{184} In one study, 1,759 adult parents were randomly assigned one of four interventions that corrected misinformation about the MMR vaccine, presented information on disease risks, displayed visuals of consequences of not vaccinating, or used dramatic narratives that could have been prevented by vaccination.\textsuperscript{185} Not one of the interventions increased intent to vaccinate amongst the most skeptical parents in the tested group.\textsuperscript{186} Worse, amongst the


\textsuperscript{181} Abbey M. Jones, Saad B. Omer, Robert A. Bednarczyk, Neal A. Halsey, Lawrence H. Moulton & Daniel A. Salmon, Parents’ Source of Vaccine Information and Impact on Vaccine Attitudes, Beliefs, and Nonmedical Exemptions, 2012 ADVANCES PREVENTIVE MED. 1, 4–5 (2012).

\textsuperscript{182} Id. at 4.

\textsuperscript{183} K.E. Wiley, M. Steffens, N. Berry & J. Leask, An Audit of the Quality of Online Immunisation Information Available to Australian Parents, 17 BMC PUBL. HEALTH 76, 82 (2017). The authors note: [M]ost people don’t clear their browser history to ensure their web search is unbiased: Filter bubble occurs when an algorithm is used by the search engine, such as Google’s Personalized Search function, to return hits based not only on the relevance of the web site, but on the sites the user (or someone using the same browser) has visited previously. This will result in the search returning web sites that confirm or agree with the user’s previously browsed pages, potentially filtering out information that disagrees with what the user is likely to read.

\textsuperscript{184} Christopher A. Swingle, How Do We Approach Anti-Vaccination Attitudes?, 115 MO. MED. 180, 181 (2018).

\textsuperscript{185} Brendan Nyhan, Jason Reifler, Sean Richey & Gary L. Freed, Effective Messages in Vaccine Promotion: A Randomized Trial, 133 PEDIATRICS e835, e837 (2014).

\textsuperscript{186} Id. at e840.
most skeptical parents, corrective information decreased intent to vaccinate.187 Dramatic images and narratives about measles and sick children actually increased beliefs that the MMR vaccine had serious side effects.188 Not all study results are so dire,189 but the authors of the study drew the right conclusion when they stated that “[t]hese results suggest the need to carefully test vaccination messaging before making it public.”190

How then can attitudes change? Like with GMOs, the first task is to realize that parents have a number of decision-making styles toward vaccines. Parents of least concern are “unquestioning acceptors” or “cautious acceptors,” whereby the former are supportive of vaccines while the latter have minor concerns about the safety of vaccines.191 “Hesitant” parents, who represent twenty to thirty percent of the pertinent population, have significant concerns about vaccine safety.192 These parents may also have a weak relationship with their healthcare provider.193 Although these parents ultimately vaccinate their child, reinforcing positive attitudes with concerned health professionals who can answer questions satisfactorily may be key to sustaining vaccination rates amongst this group.194 Between two and twenty-seven percent of parents are considered to be “late or selective vaccinators,” who either delay vaccinations or only accept select vaccinations for their child.195 Conflicted attitudes appear to typify this group, who actively seek information but may be unsure who to trust for reliable information.196 Such parents may feel alienated from both pro- and anti-vaccine groups.197 This group creates a tension for public health officials because such parents may want the health care system to run differently, such as allowing for spaced vaccines, but adhering to those wishes might undermine their effectiveness.198 Given that this group may be knowledgeable about vaccination issues, broader macro arguments may outweigh anecdotal information.199 Information that is rigorously neutral, at least in the perception of hesitant parents, may be more persuasive than facts derived from anti-vaccine groups or

187. Id.
188. Id. at e841.
190. Nyhan et al., supra note 185, at e842.
192. Id.
193. Id.
194. Id.
195. Id.
196. Id.
198. Id. at 4.
199. Leask et al., supra note 191, at 157.
the vaccine industry.\textsuperscript{200} A systematic review of the literature on vaccine hesitancy found that, while studies are limited and outcomes variable, dialogue-based engagements and multifaceted approaches tend to be most effective.\textsuperscript{201} On the micro level, approaches can include dialogue-based interventions with health care providers, religious leaders, and other social media, non-financial incentives to encourage vaccination, and reminders to the target population to spur vaccination.\textsuperscript{202} On the macro level, a coordinated public-private campaign with a targeted mix of regulatory reform, skillful marketing, and clear messaging can reduce disinformation.\textsuperscript{203}

Vaccine-hesitant individuals arguably comprise the front line of vaccine education, and successes with this group may make the difference between sustaining or eroding the herd immunity that allows vaccines to thrive amongst a general population. Finally, a small percentage of individuals, two percent or less, are outright “refusers” of vaccines.\textsuperscript{204} Refusers decline all vaccines for their children.\textsuperscript{205} They tend to cluster in communities that share certain religious or alternative beliefs and feel alienated or disenchanted with the medical establishment.\textsuperscript{206} Citing scientific research will likely not suffice, as these parents may have studies of their own that they trust or support.\textsuperscript{207} The least harmful outcome may be to agree to continue discussion or, if agreement to fully vaccinate is unlikely, to accept an individualized schedule according to the preferences of the parents.\textsuperscript{208}

\textbf{IV. \textsc{The Role of the Legal Scholar in GMO and VAX-AUTISM Public Policy Debates}}

While the factual questions of whether GMOs cause harm or vaccines cause autism are scientific matters, the appropriate regulatory consequences that follow are questions of law and public policy. Legal scholars are certainly comfortable opining on legal reforms to GMO or vaccine policy, as many scholars have already done. However, little scholarship has addressed how legal analysis and writing can engage with, and ultimately influence, perceptions embedded in public opinion. Although some legal scholarship can be obtuse,
this Part argues that properly expressed legal writing can be predisposed toward public engagement because it is topical, persuasive, and non-quantitative. This Part also highlights how legal scholars can engage public opinion directly, and also influence it indirectly through collaboration with researchers in other fields. Finally, this Part examines how legal publishing must protect itself from unwittingly disseminating pseudoscience through legal publications that have the capacity to reach the public at large.

A. LEGAL SCHOLARSHIP IS PREDISPOSED TO PUBLIC ENGAGEMENT

Although not normally the primary focus, legal scholarship can contemplate public education as a pertinent audience.\(^209\) Legal scholarship can engage that audience because it has the advantage of being more accessible than science-based research.\(^210\) This may be because scientific manuscripts are already highly “complex and esoteric”\(^211\) and are becoming harder to read over time.\(^212\) This may also be because lawyers receive training on effective communication. In addition, legal scholars are unique in that they cannot entirely write for fellow academics and publish successfully. With law students comprising the bulk of editorial review in U.S. law journals, legal writers must keep these relative newcomers to the law in mind when submitting for publication. The result is that the need to educate a talented second- or third-year law student with perhaps little or no knowledge of a particular subject necessitates a simplification and accessibility of legal scholarship. That simplification has the spillover effect of enabling the public, or public intermediaries such as the press, to have an increased understanding of the ideas expressed.

Furthermore, the goal of many law review articles is to not simply present findings and let their conclusions speak for themselves, but rather to convince an audience of a new and often unimplemented normative idea. This requires

\(^{209}\) Banks McDowell, The Audiences for Legal Scholarship, 40 J. LEGAL EDUC. 261, 261 (1990) (citing the “general public” as a possible audience for legal scholarship); David Feldman, The Nature of Legal Scholarship, 52 MOD. L. REV. 498, 503 (1989) (defining an ideal of legal scholarship as “the desire to publish the work for the illumination of students, fellow scholars or the general public and to enable others to evaluate and criticise it”).

\(^{210}\) See BDG, Who Should Be the Audience for Legal Scholarship?, PRAWSBLAWG (June 16, 2011, 2:47 PM), https://prawfsblawgblogs.com/prawfsblawg/2011/06/who-should-be-the-audience-for-legal-scholarship.html (“Nearly all legal scholarship is considerably more ‘practical’ or doctrinal than the median of any other major academic discipline.”).

\(^{211}\) Joseph W. Taylor, Marie Long, Elizabeth Ashley, Alex Denning, Beatrice Gout, Kayleigh Hansen, Thomas Huws, Leifa Jennings, Sinead Quinn, Patrick Sarkies, Alex Wojtowicz & Philip M. Newton, When Medical News Comes from Press Releases—A Case Study of Pancreatic Cancer and Processed Meat, 10 PLoS ONE 1, 10 (2015) (“Scientific findings are, by their very nature, often extremely complex and esoteric.”).

persuasion, a tool that is embedded in legal thinking from the very first days of law school.\textsuperscript{213} In addition, most law reviews lack complex empirical tables that could shut out an untrained reader. Perhaps most important, legal writing uses stories of human experiences to communicate.\textsuperscript{214} Such stories can challenge established narratives and encourage reader engagement.\textsuperscript{215} Stories generate empathy in the reader that encourage agreement with the underlying issue.\textsuperscript{216} Finally, law reviews address some of the most controversial issues in the public mind. The importance of abortion, contraception, same-sex marriage, privacy, free speech, and, of course, GMOs and vaccines, are readily appreciated by the public at large. Intuitively, an educated reader would need little convincing that these subjects are at least worth examining in legal scholarship.

Enhancing the ability of legal scholarship to influence public consciousness is the rise of readily available technology, such as QR codes linked to brief summaries of research, that can easily expose laypeople to views and theories of law faculty.\textsuperscript{217} In addition, the recent rise of online legal scholarship in the form of “pocket part” style publications, blogs, and other posts can also increase public awareness.\textsuperscript{218} Legal scholarship in these forms have had formidable impact in such areas as the Supreme Court’s Obamacare rulings, and compelling online writing about consumer debt may have helped former law professor Elizabeth Warren to become a national political figure.\textsuperscript{219} Legal writers that write with clarity, relevance, and wit, while not ubiquitous, are far from non-existent,\textsuperscript{220} and that potential predisposes legal scholarship and its derivative works to influencing public opinion.

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  \item[\textsuperscript{214}] See Marc A. Fajer, \textit{Can Two Real Men Eat Quiche Together? Storytelling, Gender-Role Stereotypes, and Legal Protection for Lesbians and Gay Men}, 46 U. MIAMI L. REV. 511, 528 (1992) (“Persuasive stories—stories that create empathy by revealing common ground in human experience—provide helpful counter-examples to the gross overgeneralizations that often make up pre-understanding [held by others].”).
  \item[\textsuperscript{215}] See, e.g., Tal Kastner, \textit{Policing Narrative}, 71 SMU L. REV. 1117, 1118 (2018) (“As a conceptual framework with its own boundaries, narrative offers a means to challenge the demarcation of norms.”).
  \item[\textsuperscript{217}] Michael N. Widener, \textit{Driving Pedestrian Traffic to Law Journals}, 104 LAW LIBR. J. 569, 575 (2012); cf. Jessica Silbey, Aaron Pezanowski & Marketa Trimble, \textit{Conferring about the Conference}, 52 HOU. L. REV. 679, 689 (2014) (“Digital technologies have opened possibilities [for legal scholars] for an unprecedented large-scale public engagement with copyright policy because the technologies are facilitating an environment in which more and more people are becoming authors, users, and disseminators of content.”).
  \item[\textsuperscript{219}] Walter Olson, \textit{Abolish the Law Reviews?}, ATLANTIC (July 5, 2012), https://www.theatlantic.com/national/archive/2012/07/abolish-the-law-reviews/259389/.
  \item[\textsuperscript{220}] Id.
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B. LEGAL SCHOLARSHIP CAN DISPEL LEGAL MYTHS THAT ENCOURAGE PSEUDOSCIENTIFIC BELIEFS

There is no shortage of public legal myths surrounding litigation and other areas that have found a home in the public consciousness.221 When media dedicate unusual attention to litigation, myths can sustain dangerous misperceptions about both science and the law.222 The legal academy, with its finger on the pulse of policy issues and ability to express ideas with clarity, has the power to frame how controversial lawsuits and verdicts are perceived in the minds of the public for both the present and the future.

The debates over GMOs and vaccines are ripe for public engagement. Take, for example, the multiple jury verdicts reached in 2018 and 2019 that ordered chemical giant Monsanto to pay $80 million, $289 million, and $2 billion in damages respectively to plaintiffs who claimed that its Roundup weed killer caused their cancer.223 Monsanto has been at the epicenter in the GMO debate.224 Although not every agency agrees,225 juries reached these verdicts in spite of continued findings by the Environmental Protection Agency, European Food Safety Authority, and other regulatory agencies worldwide, that glyphosate is not a carcinogen and is no risk to public health when used according to its current label.226

Such jury verdicts can encourage unjustified assumptions in the public mind. First, jury verdicts are conclusive evidence that the product is harmful and that the manufacturer is at fault. Second, all future jury verdicts will reach a similar result because of these prior cases. Third, jury verdicts represent final resolution of the adjudicated claims. Legal academics know better, and should

221. See, e.g., Rowland S. Miller, Confusion and Consternation, Misperceptions and Misconceptions on the Public’s Misunderstanding of the Law, 40 S. TEX. L. REV. 973, 976–80 (1999) (exploring how the public processes and in some cases misapprehends the rule of law).
not hesitate to educate the public on how the legal system works, even if it may seem too simple or pedestrian for some to warrant a law professor’s time. As any lawyer knows, the fact finding in these cases represents interpretations by juries and later juries are under no obligation to follow the findings of prior verdicts. In addition, verdicts, jury awards, or judgments at the trial court are not necessarily final and are often subject to appellate review. Jurys represent evaluations of whether particular propositions have met a given burden of proof, and should not be interpreted as definitive statements of law or science by the public.

Scholars can also articulate the benefits of, and dispel myths about, the vaccine court that resolves many vaccine-related injury claims. In the 1980s, Congress established a vaccine court to address claims by individuals who are injured as a result of a vaccine injection. Vaccine courts have been portrayed as inhumane to litigants, and that its awards provide evidence that vaccines are not safe for use. Activist websites have asserted that these rulings purportedly confirm that the MMR vaccine causes autism and courts issue awards to plaintiffs in order to “buy their silence.” To the contrary, vaccine courts serve a variety of positive functions. They establish a no-fault compensation system that reduces the likelihood of exorbitant costs or reduced availability for vaccines that could arise from inconsistent damage awards. This in effect stabilizes the national vaccine supply while still enabling vaccine victims to receive compensation for their injuries. In addition, plaintiffs should receive compensation more quickly, fairly, and generously than compared to filing an

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229. Cf. Gina M. Van Detta, The Select Steel Analytic Shortcut: An Outcome-Predictive Analytic Model Exposes the Flaws of the Select Steel Approach to Title VI, 25 N.C. CENT. L. J. 1, 25 (2002) (concluding in the negligence context that “there is no reason to believe that a jury verdict would provide a better resolution of the scientific issues, and frequently conflicting scientific opinions . . . . The best that any jury verdict can do is to pick between two simplified, polarized views of a body of science”).


233. Greenleaf, supra note 230, at 299.

234. Id.
action in a traditional state court proceeding. Without engaged responses from those who understand how the court works, myths about the court’s function and goals can continue to infect public consciousness.

Another myth to be dispelled, and one that has taken hold amongst some anti-vaccine advocates, is that mandatory vaccination violates the constitutional civil rights and civil liberties of vaccinated children. This question was resolved in 1905 by Jacobson v. Massachusetts, which upheld the constitutionality of mandatory vaccination laws for smallpox. Activists have cherry-picked language from Jacobson to serve their own ends, such as the Court’s reservation of its right to intervene in situations where application of vaccine laws would be “cruel and inhuman in the last degree.” The Court in that context was discussing “[e]xreme cases” where the state would hypothetically apply vaccine laws that would impose “injustice, oppression or absurd consequence.” However, such a situation was not before the Court, and the facts that the Court were hypothesizing were not attributes of the statute being challenged. Virtually all modern vaccination statutes do not run afoul of this cautionary language, and those with the legal expertise to interpret Court language such as this are ideal for bringing these ideas to the public.

C. Legal Knowledge Can Augment Evidence-Based Public Policy Research

Legal scholars can also enhance evidence-based research relevant to public opinion. For example, one of the more promising methods for increasing vaccine compliance is through carefully crafted nudges that shift human behavior. A
nudge is a behaviorally-informed practice that leverages scarce cognitive resources in others in order to change their behavior. Nudges may have been long applied in various contexts, but they were popularized by an economist and a legal scholar. Nudges have now received substantial examination in the legal literature, and with a nudge analogous to other forms of coercion familiar to legal scholars such as a mandate or prohibition, legal scholarship is well-poised to contribute to optimal solutions on how to use nudge theory to decrease anti-GMO and vax-autism attitudes and behavior.

Another promising area is empirical collaboration on the impacts of vaccine-related exemptions on vaccination compliance. Vaccine requirements and exemptions are a product of state law, and these exemptions vary on a state-by-state basis. Some states offer a religious exemption while others permit a personal belief exemption from vaccinations. Although it may seem logical that narrowing vaccine exemptions may increase vaccination rates, such a policy may actually backfire as parents will be encouraged to find new ways to circumvent vaccination requirements. With fifty states across numerous years enacting and modifying vaccine exemptions, the impact of these exemption laws becomes a testable empirical question. Researchers can find changes to vaccination rates before or after a certain exemption was passed, thus determining empirically the effectiveness of various state-level policies.

Legal scholars can make these studies more effective. State-by-state lists of vaccine requirements and exemptions are readily available, but such lists are typically blunt and binary classifications of whether or not an exemption exists. Coding all exemptions in this fashion, however, would not capture the subtle and varied nature of each state’s statutory language, thereby diluting the results

Overview, 14 Hum. Vaccines & Immunotherapeutics 218, 219 (2018) (noting favorably the role of parents who vaccinate their children as reinforcing nudges toward vaccine acceptance).

242. See Arden Rowell, Once and Future Nudges, 82 Mo. L. Rev. 709, 709 (2017); Victor Kumar, Nudges and Bumps, 14 Geo. J. L. & Pub. Pol’y 861, 865 (2016) ("[A] nudge is a way of using choice architecture to alter people’s behavior (1) without coercion or incentives, (2) either paternalistically or altruistically, and (3) via common heuristics and biases.") (emphases omitted).


244. See, e.g., Cass R. Sunstein, Do People Like Nudges?, 68 Admin. L. Rev. 177, 200–01 (2016) (exploring the distinction between nudges versus mandates).

245. See States with Religious and Philosophical Exemptions from School Immunization Requirements, supra note 12.


248. See States with Religious and Philosophical Exemptions from School Immunization Requirements, supra note 12.
of the study. For example, while Virginia and Missouri state laws both permit personal belief exemptions for vaccines, in Virginia the exemption is only available for the HPV vaccine and in Missouri it is only applicable to child care facilities and not public schools.\(^{249}\) Classifying these two statutes as simply allowing personal belief exemptions would be an imprecise characterization. Finding and determining such statutory differences across states is not trivial, especially for the layperson. Legal scholars working in partnership with empiricists can more precisely define and classify such statutory language for empirical testing. An empirical test is only as good as the data upon which it is based.\(^{250}\) and finely tuned results can better illuminate the impacts of certain types of exemptions on vaccination rates overall.

D. LAW REVIEWS SHOULD CLOSELY SCRUTINIZE MANUSCRIPTS FOR PSEUDOSCIENCE

Not only must the public be better engaged, but the law reviews which provide the grist for the mill of legal knowledge need to more effectively prevent the republication of pseudoscience. One of the greatest threats to scholarship generally is the predatory journal. A predatory journal is a journal that, among other criteria, lacks basic peer-review, accepts articles with impossible speed, charges exorbitantly to publish, spams aggressively, offers no transparency, and ignores industry publishing standards.\(^{251}\) They also accept most papers submitted and try to trick authors into submitting papers in order to extract author fees.\(^{252}\) Predatory journals pollute their literature with junk science that is unsupported by science-based standards.\(^{253}\)

Legal scholarship has managed thus far to avoid the “major havoc” that predatory journals create in other disciplines.\(^{254}\) Perhaps unsurprisingly, there is not a robust discussion of predatory journals in the law reviews. A Westlaw review of the literature finds the term “predatory journal” appearing, even in

\(^{249}\) Id. (citing VA. CODE ANN. § 32.1-46 (2020) and MO. REV. STAT § 210.003 (2020)); VA. CODE ANN. § 32.1-46(D)(3) ("Because the human papillomavirus is not communicable in a school setting, a parent or guardian, at the parent’s or guardian’s sole discretion, may elect for the parent’s or guardian’s child not to receive the human papillomavirus vaccine, after having reviewed materials describing the link between the human papillomavirus and cervical cancer approved for such use by the Board."); MO. REV. STAT § 210.003(2)(b) (stating that immunizations are not required in a day care setting if “[a] parent or guardian exemption, by which a child shall be exempted from the requirements of this section if one parent or guardian files a written objection to immunization with the day care administrator’").


\(^{252}\) Id. at 2.

\(^{253}\) Id.

\(^{254}\) Cf. H. Sharma & S. Verma, Predatory Journals: The Rise of Worthless Biomedical Science, 64 J. POSTGRADUATE MED. 226, 226 (2018) (arguing that biomedical science has seen a rise in predatory journals and cautioning researchers against publication).
passing, in only seven publications. Fortunately, structural forces largely insulate the U.S. legal discipline from predatory journals. With most law journals attached to law schools, there would be substantial reputational costs to the law school and to the broader university if the journal acted in a predatory fashion. In addition, there is no robust custom of submission fees that would entice a predatory journal to solicit the legal discipline for manuscripts.

This does not necessarily mean, however, that predatory law journals are not a threat to the U.S. legal academy. A popular list of predatory law journals claims six journals with the word “law” or “legal” in the title as predatory. The numbers are small, but the list could grow as the pressure increases for greater productivity from scholars at all ranks. Unvetted articles from predatory law journals, from profound sounding outlets such as the International Journal of Law and Legal Jurisprudence Studies or the European Law and Politics Journal, could potentially slip via citation into the mainstream legal literature.

The greater threat to law journals is that they become unwitting accomplices to disseminating pseudoscience. There is little doubt that student law review editors approach their responsibility to publish scholarship with a good faith effort toward impartiality, thoroughness, and diligence. Indeed, there may be some criteria, such as clarity of writing and expression, that law students perform better than their peer-reviewed counterparts. In spite of these efforts, law students as editors face pressures that can unwittingly facilitate the spread of pseudoscience. Cite checking hundreds of sources per article is tedious and time-consuming. Cite checking scientific sources will require even more substantial time and effort to confirm by law students untrained in the hard sciences. With law students already under great

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255. This search was conducted on February 6, 2021, searching for the quotation “predatory journals” in Westlaw databases “Law Reviews & Journals” and “Legal Newspapers & Newsletters.”


258. List of Predatory Journals, supra note 256.

259. Id.

260. See, e.g., Shari Seidman Diamond, Empirical Legal Scholarship: Observations on Moving Forward, 113 NW. U. L. REV. 1229, 1231 n.11 (2019) (“Although some would disagree . . . I am relatively confident that a comparison of the clarity of writing would on average give law reviews the advantage. Even when I resist the suggestions of the attentive and careful law review editors who edit the work I publish, I inevitably find that the review process makes me clarify what I mean to say. In contrast, the editors of most non-law review journals do a more cursory review of the prose.”).

261. Patricia A. Wilson, Recreating the Law School to Increase Minority Participation: The Conceptual Law School, 16 TEX. WESLEYAN L. REV. 577, 592 (2010) (“[M]any hours are devoted to tedious cite checking that would prove valuable to someone who aspires to be an editor, perhaps, but not to someone whose future is to represent clients.”).
pressure to achieve high grades, find a job, and manage other responsibilities.\textsuperscript{262} it would be tempting for a student editor to merely check the accuracy of the cited source, without questioning the source’s legitimacy or authority, and assume that the author has the science correct.

The pressure to defer grows exponentially when a law student is faced with the task of evaluating a professor’s work from her own institution. Faculty submissions to their own school’s law journal are not uncommon, and there is evidence supporting the notion that faculty use such journals as a repository for their less promising scholarly works.\textsuperscript{263} A law student could feel great pressure to accept such a work from someone who has indirect or direct power over their future career.\textsuperscript{264} After the work is accepted, that student will have the same pressure to accept factual assertions made by the professor, including arguments based on dubious pseudoscientific claims. The most extreme, and hopefully rare, scenario is when a faculty author demands the student editors to “take it or leave it,” and force the students to publish the article as written or not publish it at all. This problem goes to the very nature of law reviews and the appropriateness of a law professor submitting her scholarly work to a journal whose editors over which she has direct or indirect academic influence.\textsuperscript{265}

Analogous pressure may arise when a law student is evaluating the work of a fellow student for publication as a Note, Feature, or Comment. For the student author, the rejection of their submission can have career-impacting consequences that encourage the author to advocate for their submission. For the evaluating third-year law student editor, law school is already not a cooperative learning environment.\textsuperscript{266} Rejecting a fellow law student’s submission can negatively impact their social and professional network as strain arises between rejected student author and student editor or editorial board.\textsuperscript{267} These pressures can tempt editors to avoid conflict with their fellow students and let suspect scholarship, if not suspect pseudoscience, slip into publication.

\begin{thebibliography}{99}
\bibitem{Segerstrom262} Suzanne C. Segerstrom, \textit{Perceptions of Stress and Control in the First Semester of Law School}, 32 \textit{Williamette L. Rev.} 593, 595 (1996) (explaining that law students experience significantly higher levels of stress than even other graduate programs such as medical school).
\bibitem{Liptak264} Adam Liptak, \textit{The Lackluster Reviews That Lawyers Love to Hate}, \textit{N.Y. Times} (Oct. 21, 2013), https://www.nytimes.com/2013/10/22/us/law-scholarships-lackluster-reviews.html (“[S]tudents also favor professors for their own schools . . . This bias makes sense as a matter of self-interest, as the student editors are probably wise to accommodate people who have power over their futures.”).
\bibitem{Friedman265} Barry Friedman, \textit{Fixing Law Reviews}, 67 \textit{Duke L.J.} 1297, 1351–52 (2018) (“It is . . . the time to stop authors from submitting articles to journals at their home schools—and certainly to the flagship journal . . . The risks of bias—real and perceived—are overwhelming, and citation studies suggest the practice is doing no one any good.”).
\end{thebibliography}
There are additional steps that law journals can take to minimize the transmission of pseudoscience. During the submission phase, law journals can evaluate scholarship on a double-blind basis. This would neutralize the leverage that faculty or fellow students would have over the editorial board. In addition, in the evaluation process, articles with a significant scientific component could be submitted to an external reviewer with a scientific background to evaluate the science before the journal reaches a final decision. Mitigating this option, however, is that journal submissions and evaluations occur at a rapid pace, and it may be challenging to find an external review who can operate on such a timeline. However, this raises the question of whether the extraordinarily fast time pressures that law journals are subject to is a justifiable trait of law journal publishing.

Once a journal article is accepted, editors should give elevated scrutiny to important science-based citations and claims. Such scrutiny would involve not only checking the source, but the source’s source, especially if only an intermediary such as a blog or press release, rather than the original science, is relied upon in the manuscript. Finally, law review editors can make available mainstream lists of predatory journals to all journal staff. If a citation to a predatory journal with the purpose of relying on its substantive claims is found during the editing process, the journal can request an alternative source from the author or find an alternative confirmation of the point claimed.

V. CHALLENGING PSEUDOSCIENCE IN THE INFORMATION SUPPLY CHAIN

The spread of pseudoscience and its influence on public policy is not a matter only for policymakers and legal scholars. Pseudoscience is also the product of an entire system of checks and balances in an information supply chain, an interlinked system of transmitting scientific knowledge from researcher to final consumer, that has failed to respond. This Part briefly examines the roles of three of the most important stakeholders: the scientists who generate new knowledge, the publishers who disseminate that knowledge, and the consumers who use that knowledge to shape their attitudes about science and science-related policies.

A. SCIENTISTS MUST PROACTIVELY DETE THE SPREAD OF PSEUDOSCIENCE

Scientific research, including research on GMOs and vaccines, is by its very nature complex. Findings in their original form may only be fully comprehensible by experts in the field. As a result, it is increasingly the

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268. Friedman, supra note 265, at 1349–51.
270. Id.
271. See List of Predatory Journals, supra note 256.
272. Taylor et al., supra note 211, at 10.
responsibility of the creators of scientific knowledge to communicate that knowledge effectively to intermediaries and broader public.273 This is especially important where scientific discoveries are subject to controversy or public misapprehension.

Scientists need training in science communication.274 Communicating science to the public is neither an intuitive nor a simple task.275 Scientific journals are difficult to read and are becoming even more so over time.276 Most laypeople understandably do not have the scientific background to process and evaluate scientific claims directly from scientific journals.277 Compressing a complicated and nuanced scientific finding into a digestible, entertaining, newsworthy, and still fully accurate sound bite is difficult.278 Concepts such as “neuron,” “synapse,” and “allele” are so fundamental in scientific research that experts may assume that the general public knows what they mean.279 Science education should inculcate an obligation to interact with the public early on while aspiring scientists are still forming their values.280 Science education should also focus on improving their written skills for both their colleagues and a mass audience, making communication in scientific journals less obtuse and jargon-laden than is required to explain the necessary knowledge to others.281 Such education can also emphasize the importance of stories and storytelling to make science more relatable to the consuming public.282


274. See, e.g., Lauren A. Cirino, Zachary Emberts, Paul N. Joseph, Pablo E. Allen, David Lopatto & Christine W. Miller, Broadening the Voice of Science: Promoting Scientific Communication in the Undergraduate Classroom, 7 ECOLOGY & EVOLUTION 10124, 10124 (2017) (“Training future generations of scientists in effective communication is imperative.”).

275. Sara E. Brownell, Jordan V. Price & Lawrence Steinman, Opinion, Science Communication to the General Public: Why We Need to Teach Undergraduate and Graduate Students this Skill as Part of Their Formal Scientific Training, 12 J. UNDERGRADUATE NEUROSCIENCE EDUC. E6, E6–E7 (2013).

276. See Ball, supra note 212; Plavén-Sigray et al., supra note 212.


279. Brownell et al., supra note 275, at E7.

280. Id. at E8.

281. Id. at E8–E9. For an example of productive efforts toward science communication, see About the Alda Center, ALAN ALDA CTR. FOR COMMUNICATING SCI., https://www.aldacenter.org/get-started/about-us (last visited Feb. 26, 2021).

Scientists and their host academic institutions must support and reinforce a culture of public communication, particularly in matters where science and the public interest converge. In a time of increasing pressure to compete for fewer government research funds, there may be little incentive to promote one’s work to the general public or translate it for the benefit of evolving public policy. A poll by *Nature* revealed that many researchers believe that their academic institutions do not value press exposure and that it is not a factor determinative of career advancement. Critical public issues such as skepticism of overwhelmingly supported evidence of climate change, for example, have been credited in part by a breakdown of communication of primary data to the general public. If a scientist does not communicate her work, someone else will, and will likely do so to support their own agenda.

B. **Legitimate Publishers Must Denounce Spurious Competitors**

Scientific journals are big business, with scientific publishing exceeding 25 billion dollars in value and generating lucrative profit margins. Scientists fund their own work through grants, universities pay the scientists for their expertise, and peer reviewers evaluate the validity of the science at no cost. Publishers then sell the product back to the very universities that created the product in the first place. Publishers have a moral and financial mandate to denounce illegitimate journals and their publishers. Such journals exist not to advance knowledge, but to generate revenue from submission fees. One could argue that legitimate publishers have a similar purpose, but illegitimate publishers have little to no regard for the science in their journals. Peer review is perfunctory or absent and most if not all manuscripts are accepted. Some illegitimate publishers choose names deliberately designed to deceive potential authors, such as the *American Journal of Polymer Science* which has been accused of intentionally confusing

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287. Randy Olson, *Don’t Be Such a Scientist: Talking Substance in An Age of Style* 30 (2d ed. 2018).
289. Id.
290. Id.
292. Id. Some journals claim to peer review papers and offer little to no peer review at all. See Some Science Journals That Claim to Peer Review Papers Do Not Do So, ECONOMIST (June 23, 2018), https://www.economist.com/science-and-technology/2018/06/23/some-science-journals-that-claim-to-peer-review-papers-do-not-do-so (noting that there are an estimated 400,000 articles currently published in questionable journals).
readers with the Journal of Polymer Science, a long-standing and well-respected journal.\(^{293}\)

Fake and predatory publishers have the potential to erode the trust in scientific journals regardless of the source’s quality.\(^{294}\) They can also erode the open access movement allowing scientific research to be available to everyone.\(^{295}\) What is particularly disturbing is that predatory publishing practices are starting to spread into otherwise legitimate journals.\(^{296}\) Some legitimate journals are now spamming email inboxes with offers to publish authors with little or no subject matter connection to the journal.\(^{297}\) Other legitimate journals are gaming their impact factor through forced citation and tinkering with how and when journals are published.\(^{298}\) Trust in scientific scholarship, and the legitimacy of publishers that publish and profit from it, are eroded by these practices.\(^{299}\)

Public debates over GMOs and vaccines are not immune from the influence of questionable journals. For example, an article appearing in the weighty-sounding *International Journal for Human Nutrition and Functional Medicine* surveyed 3,256 adults and found that up to 85.2% reported health improvements including improved digestion, lower fatigue, reduced food allergies, better mood, and reduced clouding of consciousness when they reduced or stopped eating foods with GMOs.\(^{300}\) The article possessed the trappings of quality research, including abundant footnotes, review of scholarship, and ominous
medical images of the impact of GMOs on the digestive system. 301 The survey design, however, was entirely unsound. The survey permitted no negative responses to questions proposed, only allowing responses that reported degrees of improvement. 302 Surveys were only sent to those on the mailing list for the Institute for Responsible Technology, an anti-GMO advocacy group which the author of the study directs. 303 One scientist called it “scientific diarrhea” containing “staggering” levels of misinformation, 304 but a number of websites have relied on the study as legitimate evidence of the harm of GMOs. 305 Such spurious research not only dilutes the legitimate scientific literature, but also dilutes the quality of legitimate journals, especially by those readers who are unable to distinguish between the questionable International Journal of Human Nutrition and Functional Medicine and elite scientific journals such as Science, Cell, or Nature.

Coordinated efforts from a variety of stakeholders to discourage sham journal proliferation have been called for, 306 but long-term solutions are needed. Academic librarian John Beall maintained a blacklist of predatory journals, but that blacklist mysteriously disappeared in 2017. 307 Cabell’s has published a proprietary successor blacklist, which arguably dedicates greater resources and more transparency to the task than Beall, 308 but its long-term impact on sham publishing remains to be seen. The obligation to stem the tide of illegitimate publishers must rest at least in part to the industry that financially gains most from the research publication system.

C. CONSUMERS HAVE A RESPONSIBILITY TO SELF-MONITOR FOR MISLEADING SCIENTIFIC CLAIMS

Scholars, scientists, and other participants in the information supply chain can do much to deter the spread of pseudoscience and its influence on public policy. However, at least some responsibility still rests with the final consumers

301 Id. at 5.
302 Id. at 9–10.
303 Id.
of scientific information to be thoughtful and skeptical when consuming content. Whether reading blogs, consuming media, or scanning social media, consumers of information sit at the top of the information food chain, acting both as target market of information and repeaters of information content.309

Consumers are overwhelmed with too much information.310 The consolidation and personalization of media enable consumers to function within a self-confirming web of ideas that may be wholly inaccurate but comfortably safe and self-satisfying.311 Facebook and other social media only serve to amplify these echo chambers and wall off challenging facts or ideas that do not penetrate their friend network.312 The internet may change the way the human mind thinks,313 with the medium becoming a part of the message and its interpretation.

Furthermore, when scientific evidence reaches the reading public, whether directly or through intermediaries, it is too often accepted uncritically and without concern for source or context. Online readers have a troubling tendency to skim content, with most readers spending less than fifteen seconds, and as little as four seconds, reading a particular webpage.314 Six of ten online readers


311. Downey, supra note 309, at 143.

312. Id.


314. See, e.g., Farhad Manjoo, You Won’t Finish This Article: Why People Online Don’t Read to the End., SLATE (June 6, 2013, 7:03 PM), http://www.slate.com/articles/technology/technology/2013/06/how_people_read_online_why_you_wont_1_finish_this_article.html (noting, in reference to online content, “[w]e live in the age of skimming”); Jakob Nielsen, How Users Read on the Web, NIELSEN NORMAN GRP. (Sept. 30, 1997), https://www.nngroup.com/articles/how-users-read-on-the-web/ (“People rarely read Web pages word by word; instead, they scan the page, picking out individual words and sentences.”); Tony Haile, What You Think You Know About the Web Is Wrong, TIME (Mar. 9, 2014, 5:00 PM), https://time.com/12933/what-you-think-you-know-about-the-web-is-wrong/ (citing a study conducted by content analytics firm Chartbeat which examined “deep user behavior across 2 billion visits across the web over the course of a month and found that most people who click don’t read”); Harald Weinreich, Hartmut Obendorf, Eelco Herder & Matthias Mayer, Not Quite the Average: An Empirical Study of Web Use, 2 ACM TRANSACTIONS ON WEB, Feb. 2008, at 1. The authors stated:

Our data confirms the rapid interaction behavior with heavy tailed distributions already reported in previous studies: participants stayed only for a short period on most pages. 25% of all documents were displayed for less than 4 seconds, and 52% of all visits were shorter than 10 seconds (median: 9.4s). However, nearly 10% of the page visits were longer than two minutes. Figure 4 shows the distribution of stay times grouped in intervals of one second. The peak value of the average stay times is located between 2 and 3 seconds; these stay times contribute 8.6% of all visits.

Id. at 15 (citation omitted).
share article links without reading the article itself and most never reach the end of a given piece of online content.

Examples bring these startling statistics to life. Hockey legend Gordie Howe received scientifically unproven stem cell treatments in Mexico after suffering a stroke. A press release announcing his stem cell treatment and recovery was released. The press release was then picked up by several news media outlets and then circulated on Twitter. Over 78% of the 2,783 tweets accepted uncritically that Howe’s health improved following the stem cell treatment, with many calling the treatment “miraculous,” “dramatic,” “amazing,” or “remarkable.” Only 10% of tweets mentioned that researchers have challenged the efficacy and safety of stem cell treatments and only five tweets warned of health risks or cited the lack of proven evidence. Similarly, a published satirical article titled Study: 70% of Facebook Users Only Read the Headline of Science Stories Before Commenting, whose text was composed entirely of gibberish, was nonetheless shared by 46,000 “readers” of the article.

Consumers, to the extent they are interested in separating fact from fiction, have tools with which to respond. Consumers cannot blindly rely on online search results for accurate and non-misleading scientific information. Search engines cannot hand-evaluate every result for its accuracy and integrity, and thus search results may be heavily populated with false or misleading claims. Results are geared toward the individual, creating an echo chamber of information based in part upon query history, geographic location, and marketing profile. Offering multiple results, as search engines do, can be helpful, but millions of

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317. Li Du, Christen Rachul, Zhaochen Guo & Timothy Caulfield, Gordie Howe’s “Miraculous Treatment”- Case Study of Twitter Users’ Reactions to a Sport Celebrity’s Stem Cell Treatment, 2 JMIR PUB. HEALTH & SURVEILLANCE 1, 2 (2016).

318. Id. at 3.

319. Id.

320. Id.

321. Id. at 3–4.


results from a single search just produces information overload. Users reasonably look for shortcuts, and search engine Google provides just such a tool. Click the “I’m feeling lucky” button, and Google decides for the user, taking that user to the first site that its algorithms determine will best answer the proposed question.324

A consumer’s best defense against misleading science is basic scientific literacy. Scientific literacy is the ability to comprehend scientific information.325 This encompasses knowing what counts as science, understanding the benefits and risks of scientific work, and being able to think critically about scientific findings and methodologies.326 If a reader cannot cognitively process science, then no further use of that information can occur. The consumer must then be able to apply that information effectively. The ability to operationalize scientific knowledge in a practical way is essential for both private decision-making and public engagement with technological and scientific controversies.327 This understanding must be based upon not merely a grasp of scientific facts, but also a comprehension of the nature of science and its processes.328 Rigorous science education in schools and training in critical thinking improve an individual’s ability and confidence to evaluate scientific facts.329 Civic engagement does not merely increase political knowledge, but also enhances an individual’s willingness to engage with science-based political issues more objectively, reasonably, and critically.330

Finally, consumers, no matter how knowledgeable, must be educated in media literacy. Media literacy is the ability to understand the nature of communications and, in particular, communications related to mass media and online content.331 Media literacy helps consumers “understand, . . . produce and negotiate meanings in a culture of images, words and sounds.”332 Like scientific literacy, media literacy requires critical assessment of information, evaluation of the nature of the source of information, and a civic activity that is bound with

326. Other authors helpfully break down science literacy into at least four components: “(1) knowing what counts as science and how science differs from non-science, (2) knowledge needed for participating in science-related social issues, (3) knowing the risks and benefits of science, and (4) being able to think critically about science.” HAGOP A. YACOUBIAN, SCIENTIFIC LITERACY FOR DEMOCRATIC DECISION-MAKING, 40 INT’L J. SCI. EDUC. 308, 309 (2018).
327. Howell, supra note 325; at xv; see Douglas, supra note 325, at 301.
328. Douglas, supra note 325, at 300–01.
329. Yacoubian, supra note 326, at 310–11.
330. Id. at 318.
moral and social implications. Media literacy also encompasses access to content, particularly technological access, and the potential evolution of information haves and have-nots. Media literacy also addresses content creation and the ability of the creator to improve his or her critical competencies.

Media literacy can be effective in an educational context, whereby teachers instruct students on the effective and critical processing of media-obtained information. Beyond the classroom, media literacy can be improved through private or publicly funded education campaigns. Facebook, for example, is partnering with non-profit group Newseum to improve and distribute media literacy resources. The Center for Media Literacy has developed five core concepts that consumers should ask when encountering new content. The purpose of these concepts and questions is to build a habit for individuals to challenge media messages more effectively and thereby improve understanding. The state of media literacy in the United States is perceived as “bleak” and “dismaying,” especially among students. However, media

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Five Core Concepts</th>
<th>Five Key Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Authorship</td>
<td>All media messages are “constructed.”</td>
<td>Who created this message?</td>
</tr>
<tr>
<td>2. Format</td>
<td>Media messages are constructed using a creative language with its own rules.</td>
<td>What creative techniques are used to attract my attention?</td>
</tr>
<tr>
<td>3. Audience</td>
<td>Different people experience the same media message differently.</td>
<td>How might different people understand this message differently from me?</td>
</tr>
<tr>
<td>4. Content</td>
<td>Media have embedded values and points of view.</td>
<td>What lifestyles, values and points of view are represented in; or omitted from, this message?</td>
</tr>
<tr>
<td>5. Purpose</td>
<td>Most media are organized to gain profit and/or power.</td>
<td>Why is this message being sent?</td>
</tr>
</tbody>
</table>

Id.


331. Id.


333. Id. at 22.


literacy is a long-term solution to a long-term problem, and combined with campaigns supporting scientific literacy represent a meaningful last line of defense against false or misleading content.

For controversial science-related issues such as vaccines and GMOs, the consequences of scientific illiteracy are not theoretical. Attracted by economic opportunities, a thriving Somali immigrant community has emerged in Minnesota. Elevated rates of severe autism emerged in the Somali community, and state and university researchers offered no clear answers. Searching online, parents found anti-vaccine advocates who met with Somali families and fomented a movement against vaccines. This movement, backed by both anti-vaccine and anti-GMO groups, held meetings and educated Somali families on how to refuse vaccinations. Somali parents were told that the MMR vaccine, which is used to prevent child measles, mumps, and rubella, causes autism.

The campaign worked. Somali MMR vaccination rates in Minnesota plummeted from 92% to 42% over a ten-year period. The consequences were significant. In 2017, the Somali-American community experienced one of the worst measles outbreaks in Minnesota history. Seventy-nine cases appeared, mostly amongst Somali-American children in Minneapolis. State officials have rushed to encourage accelerated shot schedules and have considered quarantine orders for anyone exposed to the disease. Some Somali residents still remain uncertain about receiving vaccines. Leading anti-vaccine


345. Id.


347. Molteni, supra note 344.


349. Id.


352. Molteni, supra note 344.

353. Sun, supra note 348.
advocates, for their part, are unrepentant. When Andrew Wakefield, anti-vaccine advocate and author of the now-infamous Lancet article that sparked the modern anti-vaccine movement, was asked whether he bore fault for what happened to the Somali community, he replied, “I don’t feel responsible at all.”354

VI. MODERN RADICALISM AND THE POSSIBILITY OF A GMO-VACCINE META-MOVEMENT

While both campaigns possess substantial momentum on their own, there is emerging evidence that anti-GMO and anti-vaccine groups appear to be strengthening by finding common ground. An article by Mark Lynas, a former anti-GMO advocate who has now disavowed the movement,355 reported that the popular anti-GMO March Against Monsanto (MAM) website displayed an advertisement for an anti-vaccine documentary.356 MAM’s Facebook thread with over 1.2 million followers now promotes articles such as “Research Shows Vaccines Cause Serious Harm to Dogs.”357 In addition, the influential anti-GMO group Organic Consumers Association has also supported campaigns that claim vaccines are dangerous and without long-term benefits.358 Alternative health site Mercola, a prominent backer of anti-GMO causes,359 offers numerous anti-vaccine articles to readers.360 The movements have not yet fully merged,361 but significant coordination and support between the two movements appears to be evolving.

Although the anti-vaccine wing of the autism movement and anti-GMO groups appear to be separate issues, there is much in common beneath the

354. Id.
359. Lynas, supra note 356.
361. Lynas, supra note 356.
surface. Both groups have a deep suspicion of large corporations. Both groups also have a predisposition for “natural” alternatives to conventional products.\textsuperscript{362} Both groups mistrust mainstream science,\textsuperscript{363} discount contrary scientific studies,\textsuperscript{364} and counter with their own questionable research.\textsuperscript{365} With Jenny McCarthy, a long-time spokesperson against vaccinations,\textsuperscript{366} a variety of celebrities either in support of GMO labeling or against GMOs altogether,\textsuperscript{367} both have the backing of fame to popularize their cause.

Conspiracy theories influence both groups.\textsuperscript{368} Anti-GMO articles report that the Ebola virus is a GMO bioweapon deployed by the Department of Defense on African children and adults for the purpose of sinister experimentation.\textsuperscript{369} Anti-vaccine advocates argue that the government is covering up the risk that vaccines pose to children and that the Centers for Disease Control and Prevention has targeted Latino and African-American children with vaccines designed to harm them.\textsuperscript{370}

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I talked to a public health official and asked him what’s the best way to anticipate where there might be higher than normal rates of vaccine noncompliance, and he said take a map and put a pin wherever there’s a Whole Foods. I sort of laughed, and he said, “No, really, I’m not joking.” It’s those communities with the Prius driving, composting, organic food-eating people.

\textit{Id.}


\textsuperscript{365} See Lynas, supra note 304 (criticizing Smith, supra note 300).


\textsuperscript{368} See generally DAVID AARONOVITCH, \textit{Voodoo Histories: THE ROLE OF THE CONSPIRACY THEORY IN SHAPING MODERN HISTORY} (2010) (discussing how conspiracy theories have impacted major historical events).


With much in common and mutually compatible goals, the GMO-autism link has the potential to metastasize into an unshakeable and popular “health liberty” social movement that erodes the credibility of science, scientists, and the medical profession.371 Such a combined movement would have even greater political power to pressure governments to bend policy toward their goals. Readers susceptible to one body of pseudoscience would now be exposed to the other as websites swap content and conspiracies. The result could deeply influence how the public perceives the merits of GMOs, possible causes of autism, and the efficacy of vaccines.

Most GMO and vaccine skeptics are non-violent and well-intentioned. However, the combination of these campaigns could further embolden the most extreme wings of these social movements. A peasant leader and security guard were killed in a shootout at a genetically modified seed farm in Brazil.372 An article by self-described “health ranger” and anti-GMO activist Mike Adams made references to Monsanto and pro-GMO scientists, journalists, and publishers as Nazi war criminals.373 Though the article offered a disclaimer against violence, it stated that it is the “moral right—and even the obligation—of human beings everywhere to actively plan and carry out the killing of those engaged in heinous crimes against humanity.”374 The article was “replaced,”375 but not before attracting significant criticism of the calls to violence over GMOs. As more countries consider the growing and consumption of GMOs, the debate on their use will only become more controversial and more heated.

The anti-vaccine movement has its own radical wing. When an anti-vaccine advocate encountered a California state senator who supported the tightening of the state’s immunization laws, the advocate shoved the senator.

Marcella, Vaccines Are Poisoning African-American and Latino Babies—And the Rest of Our Children, VAXTRUTH (Oct. 13, 2015), http://vaxtruth.org/2015/10/toxic-vaccines/; see also Jolley & Douglas, supra note 8, at 6 (“[O]verall, anti-vaccine conspiracy theories appear to introduce undue suspicion about vaccine safety, and increase feelings of powerlessness and disillusionment, whilst decreasing trust in authorities, which in turn introduce reluctance to vaccinate.”).


375. Mike Adams, Science for Sale: The True History of Silencing Whistleblowers with Corporate Science, NAT. NEWS (July 21, 2014), https://www.naturalnews.com/046097_biotech_genocide_Monsanto_collaborators_media_sellouts.html (expressing decision to “replace” the earlier article “with a meta analysis of what the reaction to this story really says about today’s corrupt media and irresponsible ‘corporate science’ operators”).
from behind, sending him stumbling down the sidewalk.\textsuperscript{376} A mother who posted on social media about her four-year-old son’s tragic death from the flu received a deluge of hateful comments from anti-vaccine advocates who claimed that she was a terrible mother, she killed her child, her child’s death was fake, and her child never existed.\textsuperscript{377} Pro-vaccine opinions have been censored in blogs and online community forums.\textsuperscript{378} A pseudonymous blogger challenging the anti-vaccination movement was accused of having pharmaceutical ties, his university address was publicized, and his institution was bombarded with complaints about this supposed conflict of interest in order to get the blogger fired.\textsuperscript{379} Another blogger was forcibly silenced when a critic complained to his employer about his pro-vaccine viewpoints.\textsuperscript{380} One prominent critic was sued for libel, labeled with the term “biostitute” (a bioscience prostitute), and received death threats.\textsuperscript{381} After Seth Mnookin authored \textit{The Panic Virus: A True Story of Medicine, Science, and Fear}, a book criticizing the anti-vaccine movement and its proponents,\textsuperscript{382} his journalistic integrity was attacked.\textsuperscript{383} For Thanksgiving, he was photoshopped with two other vaccine advocates “sitting down to a dinner of a dead baby.”\textsuperscript{384} Former anti-GMO advocate Mark Lynas summarizes the future of anti-GMO and anti-vaccine movements:

My assessment is that the anti-GMO scene is getting more extreme as it becomes increasingly marginalised in the mainstream discourse, and that as the scientific community gets better organised in combating its myths and conspiracy theories—as has happened with combating anti-vaxxers—this tendency will only increase. Expect more AIDS denialism, vaccine-autism scaremogering and anti-GMO activism, all increasingly under the same banner.\textsuperscript{385}

These movements will likely get stronger as time passes. Scientists, publishers, consumers, and scholars both within and without the legal discipline have an obligation to advance policy that is evidence-based, scientifically sound, and promote a healthier and safer society.


\textsuperscript{378} Anna Kata, Anti-Vaccine Activists, Web 2.0, and the Postmodern Paradigm—An Overview of Tactics and Tropes Used Online by the Anti-Vaccination Movement, 30 VACCINE 3778, 3782 (2012).

\textsuperscript{379} Id.

\textsuperscript{380} Id.

\textsuperscript{381} Id.


\textsuperscript{383} Kata, supra note 378, at 3782.

\textsuperscript{384} Id.

CONCLUSION

A healthy skepticism of science is a positive trait, as it requires evidence before reaching any conclusions. Science denialism by contrast rejects an idea even when sound evidence is provided. Scientific denialism worldwide is increasing at an alarming rate. The movement against GMOs and the assertion that vaccines cause autism are two of the most powerful and well-entrenched examples of such denialism worldwide.

Denialism of GMOs and vaccines is not mere fantasy, but has substantial social, political, and economic consequences. However, public opinion can be changed. This cannot be accomplished with blunt assertions of scientific fact, which can backfire and further strengthen the beliefs of skeptics. Instead, public opinion campaigns must be carefully tailored to the demographics, preferences, and concerns of the given audience.

The legal academy can play a substantial role. While law reviews have contributed significant knowledge regarding various legal reforms, more can be done to engage the public at large. Myths about the law and the legal system are prevalent in society, and dispelling some of those myths can prevent legal proceedings and legal rules from being a mechanism by which scientific knowledge is misperceived. The law reviews must also be more rigorous about evaluating science-based works so that the legal academy is not contributing to scientific misinformation.

Public education is a challenging task, and decades of misinformation and simmering frustration about GMOs and vaccines cannot be remedied in a short time. However, sustained action by the academy as well as other participants in the information supply chain can move the needle toward a society that perceives GMOs and vaccines through evidence-based knowledge and not superstition, pseudoscience, and fear. Human lives have already been lost and profound economic harms have already occurred. There is no better time than now to take action.

In 1996, astronomer Carl Sagan wrote that he feared of a future world of science in which,

the people have lost the ability to set their own agendas or knowledgeably question those in authority; when, clutching our crystals and nervously consulting our horoscopes, our critical faculties in decline, unable to distinguish between what feels good and what’s true, we slide, almost without noticing, back into superstition and darkness.386

Sagan’s predictions then are alarmingly accurate now. Challenging pseudoscience perpetrated by anti-GMO and vax-autism groups, and disseminating evidence-based knowledge and education, is nothing less than a scholarly and scientific imperative to make sure that Sagan’s fateful admonition never comes true.
