Articles

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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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.[1] 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.[2] At its extreme, scientific knowledge can be perceived as subjective and socially constructed, and science and scientists are depicted as fundamentally anti-human.[3] Anti-science beliefs are becoming so powerful that they threaten the very functioning of both developed and developing democratic societies where scientific advancements materialize.[4]

Activism in support of anti-science extracts a substantial human cost.[5] 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.[6] Anti-vaccine activists are

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1. 3M, STATE OF SCIENCE INDEX: 2019 GLOBAL FINDINGS 11 (2019), https://multimedia.3m.com/mws/media/1665444O/3m-sosi-2019-global-findings.pdf; *see also* Cecelia Smith-Schoenwalder, *People Are Getting More Skeptical of Science, Poll Finds*, U.S. NEWS & WORLD REP. (Mar. 22, 2019, 12:34 PM), https://www.usnews.com/news/world/articles/2019-03-22/people-are-getting-more-skeptical-of-science-poll-finds; Renae Reints, *People Are Becoming Increasingly Skeptical of Science, Report Finds*, FORTUNE (Mar. 20, 2019, 6:00 AM), https://fortune.com/2019/03/20/state-of-science-report/; Ullrich K.H. Ecker, Stephan Lewandowsky, Ee Pin Chang & Rekha Pillai, *The Effects of Subtle Misinformation in News Headlines*, 20 J. EXPERIMENTAL PSYCH. 323, 332 (2014) (noting with concern "the generally decreasing trust in science experts among segments of the public").

2. Aaron Blake, *Americans' Increasing Distrust of Science—And Not Just on Climate Change*, WASH. POST (Jan. 30, 2015, 3:30 AM), https://www.washingtonpost.com/news/the-fix/wp/2015/01/30/americans-increasing-distrust-of-science-and-not-just-on-climate-change/; *see also* CARY FUNK, LEE RAINIE, AARON SMITH, KENNETH OLMSTEAD, MEAVE DUGGAN & DANA PAGE, PEW RSCH. CTR., PUBLIC AND SCIENTISTS' VIEWS ON SCIENCE AND SOCIETY 37 (2015), https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2015/01/PI_ScienceandSociety_Report_012915.pdf.

3. HELGE KASTRUP & JEFFRY V. MALLOW, STUDENT ATTITUDES, STUDENT ANXIETIES, AND HOW TO ADDRESS THEM 2-4 to 2-5 (2016).

4. *See* Shawn Lawrence Otto, *Antiscience Beliefs Jeopardize U.S. Democracy*, SCI. AM. (Nov. 1, 2012), https://www.scientificamerican.com/article/antiscience-beliefs-jeopardize-us-democracy/; Gauhar Raza, *Engagement with Science: A Necessary Condition for the Survival of Democracy*, 17 PAK. PERSPS. 5, 17 (2012) (examining history on the Indian subcontinent and concluding that "[i]n order to save and strengthen democracy, especially in culturally rich and varied countries (generally known as developing countries), constant engagement with science and thereby enlargement of scientific cognitive spaces is essential"); *see also Introduction*, *in* ANTI-SCIENCE AND THE ASSAULT ON DEMOCRACY: DEFENDING REASON IN A FREE SOCIETY 9–11 (Michael J. Thompson & Gregory R. Smulewicz-Zucker eds., 2018) (stating that "[t]he relation between science and democracy has been evident since the origins of the modern world" and providing examples through time); Henry I. Miller, *The Human Cost of Anti-Science Activism*, 154 POL'Y REV. 65, 77 (2009) ("[I]n the practice of medicine, popular approaches to farming and food, policies to reduce hunger and disease and many other practical issues, there is an undercurrent of irrationality that threatens science-dependent progress and even [threatens] the civilized basis of our democracy . . . .") (quoting DICK TAVERNE, THE MARCH OF UNREASON (2005)).

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

6. Robin McKie, *Block on GM Rice 'Has Cost Millions of Lives and Led to Child Blindness'*, GUARDIAN (Oct. 26, 2019), https://www.theguardian.com/environment/2019/oct/26/gm-golden-rice-delay-cost-millions-of-lives-child-blindness; Martin Enserink, *Tough Lessons from Golden Rice*, 320 SCI. 468, 468–69 (2008); Xudong Ye, Salim Al-Babili, Andreas Klöti, Jing Zhang, Paolo Lucca, Peter Beyer & Ingo Potrykus,

promoting the idea that giving vaccines to children causes autism spectrum disorder.[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.[8] As a result, long dormant diseases are now reappearing in both the developed and developing world,[9] potentially dismantling one of the greatest achievements of twentieth-century medicine.[10]

Public policy has in some cases become an unwitting co-conspirator. In part driven by fears that vaccines cause autism,[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.[12] Concerned parents have flooded vaccine courts with vaccine-autism claims.[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.[14] Disruptions in trade from these bans

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Engineering the Provitamin A (β- Carotene) Biosynthetic Pathway into (Cartoenoid-Free) Rice Endosperm, 287 SCI. 303, 303 (2000) (stating that improved vitamin A nutrition could prevent one to two million deaths of children annually).

7. *Social Medicine: The Effect of Social Media on the Anti-Vaccine Movement*, INFECTIOUS DISEASE ADVISOR (Oct. 31, 2018), https://www.infectiousdiseaseadvisor.com/home/topics/prevention/social-medicine-the-effect-of-social-media-on-the-anti-vaccine-movement/; Asma I. Abdulmalik, *Spreading Anti-Vaccine Rumors a Threat to Public Health*, ARAB NEWS (Jan. 27, 2019), https://www.arabnews.com/node/1442796 ("Perhaps the most widespread theory against vaccines is that they cause autism.").

8. Press Release, Pub. Pol'y Polling, Democrats and Republicans Differ on Conspiracy Theory Beliefs (Apr. 2, 2013), https://www.publicpolicypolling.com/wp-content/uploads/2017/09/PPP_Release_National_ConspiracyTheories_040213.pdf; *see also* Daniel Jolley & Karen M. Douglas, *The Effects of Anti-Vaccine Conspiracy Theories on Vaccination Intentions*, 9 PLOS ONE e89177, e89177 (2014).

9. *See* Peter Hotez, Editorial, *America and Europe's New Normal: The Return of Vaccine-Preventable Diseases*, 85 PEDIATRIC RSCH. 912, 912 (2019).

10. *See, e.g.*, Rosemary M. Killeen, Editorial, *Vaccines—One of the Greatest Medical Advances of Modern Times*, 140 CANADIAN PHARMACISTS J. S2, S2 (2007); CDC, *Ten Great Public Health Achievements—United States, 1900–1999*, 48 MORBIDITY & MORTALITY WKLY. REP. 241, 241 (1999).

11. *See* Steve P. Calandrillo, *Vanishing Vaccinations: Why Are So Many Americans Opting Out of Vaccinating Their Children?*, 37 U. MICH. J.L. REFORM 353, 398–99 (2004).

12. Hotez, *supra* note 9, at 912; Olivia M. Vaz, Mallory K. Ellingson, Paul Weiss, Samuel M. Jenness, Azucena Bardaji, Robert A. Bednarczyk & Saad B. Omer, *Mandatory Vaccination in Europe*, 145 PEDIATRICS 1, 4 (2020) (listing European countries offering nonmedical exemptions during study period); Elizabeth Hlavinka, *Does Europe Have the Right Idea on Vax Policy?*, MEDPAGE TODAY (Jan. 13, 2020), https://www.medpagetoday.com/pediatrics/vaccines/84330 (citing the Czech Republic and Latvia as examples); *States with Religious and Philosophical Exemptions from School Immunization Requirements*, NAT'L CONF. OF STATE LEGISLATURES, https://www.ncsl.org/research/health/school-immunization-exemption-state-laws.aspx#Table1 (last visited Feb. 25, 2021); Cristina Caron, *Vaccine Laws are Changing. Here's What You Need to Know.*, N.Y. TIMES (Apr. 18, 2020), https://parenting.nytimes.com/health/vaccine-exemptions-measles. States are fighting back, though anti-vaccine advocates have become adept at shifting from one exemption another. Kip Randall, *Kansas, Please Protect Our Children: Why Kansas Should Remove the Religious Exemption for Mandatory School Vaccinations,* 64 U. KAN. L. REV. 1217, 1248–49 (2016); Arman Azad, *Anti-Vaxxers May Be Exploiting Widespread Religious Exemptions, Research Suggests*, CNN (Nov. 4, 2019, 6:45 AM), https://www.cnn.com/2019/11/04/health/religious-vaccine-exemptions-study/index.html.

13. Laura A. Binski, Note, *Balancing Policy Tensions of the Vaccine Act in Light of the Omnibus Autism Proceeding: Are Petitioners Getting a Fair Shot at Compensation?*, 39 HOFSTRA L. REV. 683, 701 (2011) (noting that vaccine-autism claims increased from the first petition in 1998 to over 10,000 petitions filed or pending by 2011).

14. *Several European Countries Move to Rule Out GMOs*, EUR. COMM'N, https://ec.europa.eu/environment/europeangreencapital/countriesruleoutgmos/ (last visited Feb. 25, 2021).

and regulatory delays in introducing GMOs in African nations have cost an estimated hundreds of millions of dollars and thousands of human lives.[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,[16] including scientists, publishers, and consumers, can also respond

15. Justus Wesseler, Richard D. Smart, Jennifer Thomson & David Zilberman, *Foregone Benefits of Important Food Crop Improvements in Sub-Saharan Africa*, 12 PLOS ONE 1, 8 (2017); *see also* Ben Johnson, *The Human Cost of the EU's Anti-GMO Policy*, ACTON INST. (Sept. 15, 2017), https://acton.org/publications/transatlantic/2017/09/15/human-cost-eus-anti-gmo-policy; Giovanni Tagliabue, *The EU Legislation on "GMOs" Between Nonsense and Protectionism: An Ongoing Schumpeterian Chain of Public Choices*, 8 GM CROPS & FOOD 57, 60 (2017) (accusing the EU of implementing a "double standard" that prohibits cultivation of GMO crops and permits importation GMO plants for internal uses).

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.[17] This Part then examines the scientific evidence regarding the safety of vaccines, specifically in reference to autism, for human and animal consumption.[18]

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."[19] Genetic modification has been practiced by humans for over 30,000 years.[20] Corn began its life as a genetic modification of

17. Part II.A is circumscribed to evidence related to the safety of GMOs for consumption by humans and animals. Some have argued that GMOs are being used as a tool for corporate control over the system of global food production to the detriment of individual consumers. Maria DeGiovanni, *The Future of GMO Labeling: How a New Federal Labeling Scheme Will Alter Public Disclosure*, 95 WASH. U. L. REV. 705, 716–17 (2017); Kiley Fisher, *GMOs as a Corporate Control Tactic*, FOOD & WATER WATCH (May 27, 2016), https://www.foodandwaterwatch.org/news/gmos-corporate-control-tactic; *Why We Are Against GMOs*, SLOW FOOD, https://www.slowfood.com/what-we-do/themes/gmos/why-we-are-against-gmos/ (last visited Feb. 25, 2021). Others argue that GMOs are a threat to small-scale farms, inhibit biodiversity, or promote the use of chemicals. Gwynn MacCarrick & Jackson Maogoto, *The Significance of the International Monsanto Tribunal's Findings with Respect to the Nascent Crime of Ecocide*, 48 TEX. ENV'T L.J. 217, 231–32 (2018); *Why We Are Against GMOs*, *supra*. Although some of these issues are addressed briefly, see, for example, *infra* notes 28, 36 and accompanying text (addressing issue of environmental harm of GMOs), they are beyond the focus of this Article.

18. Part II.B is circumscribed to evidence related to the safety of vaccines and their causal relation to autism spectrum disorder. Concerns about vaccines related to the use of aborted fetal issue in vaccine development, see Eric Wombwell, Mary T. Fangman, Alannah K. Yoder & David L. Spero, *Religious Barriers to Measles Vaccination*, 40 J. CMTY. HEALTH 597, 602 (2015), or distrust of the pharmaceutical industry, see Alex Keown, *Anti-Vaxxer Movement Cites Distrust of Pharma Industry as Big Reason to Skip Shots*, BIOSPACE (Apr. 23, 2019), https://www.biospace.com/article/anit-vaxxer-movement-cites-distrust-of-pharma-industry-as-big-reason-to-skip-shots-considered-essential-by-medical-community/, are beyond the focus of this Article.

19. R. Nelson Godfrey, *Case Studies of African Agricultural Biotechnology Regulation: Precautionary and Harmonized Policy-Making in the Wage of the Cartagena Protocol and the AU Model Law*, 35 LOY. L.A. INT'L & COMP. L. REV. 409, 417 (2013).

20. Gabriel Rangel, *From Corgis to Corn: A Brief Look at the Long History of GMO Technology*, HARV. UNIV. GRADUATE SCH. OF ARTS & SCI. (Aug. 9, 2015), http://sitn.hms.harvard.edu/flash/2015/from-corgis-to-

wild grass.[21] Broccoli, bananas, and apples with desirable traits that we consume today are the product of long-ago genetic selection.[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.[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.[24] Such crops have also helped alleviate poverty for over 16.5 million small farmers and their families.[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.[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.[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."[28] A variety of scholarship, including one of the most detailed and far-reaching

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corn-a-brief-look-at-the-long-history-of-gmo-technology/; *see also* Jessica A. Murray, *One Turkey, Seven Drumsticks: A Look at Genetically Modified Food Labeling Laws in the United States and the European Union*, 39 SUFFOLK TRANSNAT'L L. REV. 145, 148 (2016) (stating that farmers and breeders of livestock have been selecting and breeding desirable characteristics for at least 10,000 years).

21. Rangel, *supra* note 20.

22. *Id.*

23. David Zilberman, Tim G. Holland & Itai Trilnick, *Agricultural GMOs—What We Know and Where Scientists Disagree*, 10 SUSTAINABILITY, May 22, 2018, at 1, 1; Graham Brookes & Peter Barfoot, *Economic Impact of GM Crops: The Global Income and Production Effects 1996–2012*, 5 GM CROPS & FOOD 65, 69, 67–72 (2014) (citing numerous scientific studies); *see also* Ruchir Raman, *The Impact of Genetically Modified (GM) Crops in Modern Agriculture: A Review*, 8 GM CROPS & FOOD 195, 200 (2017) ("[Genetically modified] *Bt*-cotton has resulted in economic prosperity among *Bt*-cotton growers, with 2002–11 often being called a white gold period for India's GM cotton industry.").

24. *ISAAA Brief 46-2013: Top Ten Facts*, INT'L SERV. FOR THE ACQUISITION OF AGRI-BIOTECH APPLICATIONS, http://www.isaaa.org/resources/publications/briefs/46/topfacts/default.asp (last visited Feb. 25, 2021).

25. *Id.*

26. Daniel Norero, *GMO Crops Have Been Increasing Yield for 20 Years, with More Progress Ahead*, CORNELL ALL. FOR SCI. (Feb. 23, 2018), https://allianceforscience.cornell.edu/blog/2018/02/gmo-crops-increasing-yield-20-years-progress-ahead/ (reviewing studies reporting the benefits of genetically modified crops).

27. Elisa Pellegrino, Stefano Bedini, Marco Nuti & Laura Ercoli, *Impact of Genetically Engineered Maize on Agronomic, Environmental and Toxicological Traits: A Meta-Analysis of 21 Years of Field Data*, 8 SCI. REPS., Feb. 15, 2018, at 1, 9.

28. Alessandro Nicolia, Alberto Manzo, Fabio Veronesi & Daniele Rosellini, *An Overview of the Last 10 Years of Genetically Engineered Crop Safety Research*, 34 CRITICAL REVS. BIOTECHNOLOGY 77, 84–85 (2014).

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."[29]

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.[30] A letter signed by these laureates urges GMO opponents to reconsider their resistance to genetically modified agriculture.[31] Nobel Laureate Richard Roberts writes that,

> [a]ll 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.[32]

Billions of animals are raised on GMO food each year with no evidence of harm to animals or humans.[33]

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29. NAT'L ACADS. SCI., ENG. & MED., GENETICALLY ENGINEERED CROPS: EXPERIENCES AND PROSPECTS 2 (2016), https://www.nap.edu/catalog/23395/genetically-engineered-crops-experiences-and-prospects.

30. Richard J. Roberts, *The Nobel Laureates' Campaign Supporting GMOs*, 3 J. INNOVATION & KNOWLEDGE 61, 61 (2018). The author planned the Nobel Laureate campaign defending GMOs as a positive method of improving agriculture. *Id.* at 64.

31. *Laureates Letter Supporting Precision Agriculture (GMOs)*, SUPPORT PRECISION AGRICULTURE (June 29, 2016), http://supportprecisionagriculture.org/nobel-laureate-gmo-letter_rjr.html. The letter reads in part:

> The United Nations Food & Agriculture Program has noted that global production of food, feed and fiber will need approximately to double by 2050 to meet the demands of a growing global population. Organizations opposed to modern plant breeding, with Greenpeace at their lead, have repeatedly denied these facts and opposed biotechnological innovations in agriculture. They have misrepresented their risks, benefits, and impacts, and supported the criminal destruction of approved field trials and research projects.
>
> We urge Greenpeace and its supporters to re-examine the experience of farmers and consumers worldwide with crops and foods improved through biotechnology, recognize the findings of authoritative scientific bodies and regulatory agencies, and abandon their campaign against "GMOs" in general and Golden Rice in particular.
>
> Scientific and regulatory agencies around the world have repeatedly and consistently found crops and foods improved through biotechnology to be as safe as, if not safer than those derived from any other method of production. There has never been a single confirmed case of a negative health outcome for humans or animals from their consumption. Their environmental impacts have been shown repeatedly to be less damaging to the environment, and a boon to global biodiversity.
>
> . . . .
>
> How many poor people in the world must die before we consider this a "crime against humanity"?

Id.; *see also* Joel Achenbach, *107 Nobel Laureates Sign Letter Blasting Greenpeace over GMOs*, WASH. POST (June 30, 2016, 6:10 AM), https://www.washingtonpost.com/news/speaking-of-science/wp/2016/06/29/more-than-100-nobel-laureates-take-on-greenpeace-over-gmo-stance/?noredirect=on&utm_term=.c7487054e82a.

32. Roberts, *supra* note 30, at 64.

33. Jane E. Brody, *Are G.M.O. Foods Safe?*, N.Y. TIMES (Apr. 23, 2018), https://www.nytimes.com/2018/04/23/well/eat/are-gmo-foods-safe.html.

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.[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."[35] Entities ranging from the World Health Organization[36] and the American Medical Association[37] to the Pontifical Academy of Sciences[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.[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.[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.[41] Vaccines have also saved $295 billion in direct costs and $1.38 trillion in total costs to society.[42] Vaccines are one of the greatest medical advances in the modern era.[43]

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34. FUNK ET AL., *supra* note 2, at 37.

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.

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.").

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=%2FAMADoc%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").

38. *Head of Pontifical Academy for Sciences Says GMOs Are Step Forward for Evolution*, CATHOLIC CULTURE (Oct. 15, 2012), https://www.catholicculture.org/news/headlines/index.cfm?storyid=15909.

39. *What Are Vaccines?*, IMMUNIZEBC, https://immunizebc.ca/what-are-vaccines (May 19, 2020).

40. *Vaccines: The Basics*, CTRS. FOR DISEASE CONTROL & PREVENTION (Mar. 14, 2012), https://www.cdc.gov/vaccines/vpd/vpd-vac-basics.html.

41. Cynthia G. Whitney, Fangjun Zhou, James Singleton & Anne Schuchat, *Benefits from Immunization During the Vaccines for Children Program Era—United States, 1994–2013*, 63 MORBIDITY & MORTALITY WKLY REP. 352, 352 (2014).

42. *Id*

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."[44] 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.[45] A review of numerous studies examining the safety of vaccines found that adverse effects were "extremely rare" and that "absolute risk is low."[46] For example, estimated adverse effects for a vaccine against rotavirus were as low as 1.1 to 1.5 cases per 100,000 doses.[47] This extremely small risk is roughly similar to the U.S. plane accident fatality rate per 100,000 flight hours[48] or the risk of death from playing soccer.[49] Vaccines avert an estimated two to three million deaths per year worldwide.[50]

Vaccines do not cause autism.[51] 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.[52] Numerous methodologically sound studies have been conducted on the issue and have consistently shown no association between vaccines and autism spectrum disorder.[53] A nationwide cohort study of 657,461 children tracked from 1999 through 2010 concluded that, "our study does not support that MMR

year they avert an estimated 2 to 3 million deaths."); Donald C. Arthur, *Negative Portrayal of Vaccines by Commercial Websites: Tortious Misrepresentation*, 11 U. MASS. L. REV. 122, 149–50 (2016) (citing Robert M. Wolfe, *Content and Design Attributes of Antivaccination Websites*, 287 J. AM. MED. ASS'N 3245, 3245 (2002)); Killeen, *supra* note 10, at S2.

44. *Vaccine Safety*, CTRS. FOR DISEASE CONTROL & PREVENTION, https://www.cdc.gov/vaccinesafety/index.html (last visited Feb. 25, 2021); *see also* INST. OF MED., THE CHILDHOOD IMMUNIZATION SCHEDULE AND SAFETY: STAKEHOLDER CONCERNS, SCIENTIFIC EVIDENCE, AND FUTURE STUDIES S-1 (2013), https://www.cdc.gov/vaccinesafety/index.html ("Vaccines are among the most effective and safe public health interventions available to prevent serious disease and death.").

45. *See Safety Information by Vaccine*, CTRS. FOR DISEASE CONTROL & PREVENTION, https://www.cdc.gov/vaccinesafety/vaccines/index.html (July 16, 2020) (linking to numerous studies).

46. Margaret A. Maglione, Lopamudra Das, Laura Raaen, Alexandria Smith, Ramya Chari, Sydne Newberry, Roberta Shanman, Tanja Perry, Matthew Bidwell Goetz & Courtney Gidengil, *Safety of Vaccines Used for Routine Immunization of US Children: A Systematic Review*, 134 PEDIATRICS 325, 334 (2014).

47. *Id.*

48. *Fact Sheet—General Aviation Safety*, FED. AVIATION ADMIN. (July 30, 2018), https://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=21274.

49. DAVID R. WILLIAMS, WHAT IS SAFE: THE RISKS OF LIVING IN A NUCLEAR AGE 61 (1998).

50. Bustreo & Kieny, *supra* note 43.

51. *Autism and Vaccines*, CTRS. FOR DISEASE CONTROL & PREVENTION, https://www.cdc.gov/vaccinesafety/concerns/autism.html (Aug. 25, 2020) (citing various studies); *see also* Luke E. Taylor, Amy L. Swerdfeger & Guy D. Eslick, *Vaccines Are Not Associated with Autism: An Evidence-Based Meta-Analysis of Case-Control and Cohort Studies*, 32 VACCINE 3623, 3627 (2014).

52. Anjali Jain, Jaclyn Marshall, Ami Buikema, Tim Bancroft, Jonathan P. Kelly & Craig J. Newschaffer, *Autism Occurrence by MMR Vaccine Status among US Children with Older Siblings with and without Autism*, 313 J. AM. MED. ASS'N 1534, 1539 (2015); *see also No MMR Vaccine-Autism Link in Large Study*, AUTISM SPEAKS (Apr. 21, 2015), https://www.autismspeaks.org/science-news/no-mmr-autism-link-large-study-vaccinated-vs-unvaccinated-kids.

53. *Do Vaccines Cause Autism?*, INST. FOR VACCINE SAFETY, http://vaccinesafety.edu/vs-autism.htm (Nov. 11, 2020) (citing various studies).

vaccination increases the risk for autism, triggers autism in susceptible children, or is associated with clustering of autism cases after vaccination."[54] There also appears to be no reliable scientific evidence that vaccines are causally related to autism in dogs.[55] 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.[56] An early conference of scientists, lawyers, and government officials agreed that genetic engineering projects were viable within guidelines.[57] Genetic engineering quietly continued with scientific innovations and regulatory approvals for the next twenty years.[58]

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

54. Anders Hviid, Jørgen Vinsløv Hansen, Morten Frisch & Mads Melbye, *Measles, Mumps, Rubella Vaccination and Autism*, 170 ANNALS INTERNAL MED. 513, 519 (2019).

55. *See, e.g.*, Ceylan Yeginsu, *No, Your Dog Can't Get Autism from a Vaccine*, N.Y. TIMES (Apr. 27, 2018), https://www.nytimes.com/2018/04/27/world/europe/britain-dogs-autism-vaccine.html. The article quoted a British Veterinary Association tweet, which concluded that "[t]here's currently no reliable scientific evidence to indicate autism in dogs (or its link to vaccines)." *Id.* (quoting BritishVets (@BritishVets), TWITTER (Apr. 24, 2018, 12:43 PM), https://twitter.com/BritishVets/status/988820757215145984); Stanley Coren, *Can Vaccinations Cause Autism in Dogs?*, PSYCH. TODAY (Sept. 26, 2017), https://www.psychologytoday.com/us/blog/canine-corner/201709/can-vaccinations-cause-autism-in-dogs (describing the risk dogs face when their owners do not vaccinate and concluding that refusing to vaccinate is "a pretty severe risk to take with your pet dog on the basis of a scientifically disproved association between vaccination and autism").

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.[59] Fallout from the 1986 Chernobyl nuclear disaster contaminated European agricultural fields, making Europeans more suspicious of scientific assurances that agricultural technology is safe.[60] During the early 1990s news of the spread of bovine spongiform encephalopathy, also known as mad cow disease, appalled European and American consumers.[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.[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.[63] It was during and shortly thereafter this pivotal period that Jeremy Rifkin,[64] or perhaps others,[65] sparked the modern anti-GMO movement, and questioned the health of GMO foods for consumption in humans. The popular 1990 white paper *Biotechnology's Bitter Harvest* criticized the introduction of genetically modified crops that better tolerated herbicide.[66] During the early 1990s, the Keystone Center, a nonprofit organization, hosted a series of "national conversations" on the ethical use of genetic technologies.[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.[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

59. Paul B. Thompson, *How We Got to Now: Why the US and Europe Went Different Ways on GMOs*, CONVERSATION (Nov. 5, 2015, 9:44 PM), https://theconversation.com/how-we-got-to-now-why-the-us-and-europe-went-different-ways-on-gmos-48709.

60. *Id.*

61. Robyn Mallon, *The Deplorable Standard of Living Faced by Farmed Animals in America's Meat Industry and How to Improve Conditions by Eliminating the Corporate Farm*, 9 MICH. STATE U. J. MED. & L. 389, 393–95 (2005).

62. *Id.* at 394.

63. LISA H. WEASEL, FOOD FRAY: INSIDE THE CONTROVERSY OF GENETICALLY MODIFIED FOOD 31 (2009).

64. Some claim that Jeremy Rifkin founded the anti-GMO movement in the 1970s with the publication of *Who Should Play God?* in 1977. Louis Anslow, *Meet the Man Behind the Three-Decade Crusade Against GMOs*, TIMELINE (July 7, 2016), https://timeline.com/gmo-food-labeling-rifkin-d5f125ba19f7 (citing TED HOWARD & JEREMY RIFKIN, WHO SHOULD PLAY GOD? (1977)); *see also* Alan McHughen, *GM Crops and Foods: What Do Consumers Want to Know?*, 4 GM CROPS & FOOD 172, 172 (2013) (citing Rifkin's early influence).

65. *See, e.g.*, *Why the Founder of the Anti-GMO Movement Converted to the Side of Science*, BIOTECHNOW (Apr. 28, 2015), https://www.bio.org/blogs/why-founder-anti-gmo-movement-converted-side-science (crediting Mark Lynas as the founder of the anti-GMO movement).

66. REBECCA GOLDBURG, JANE RISSLER, HOPE SHAND & CHUCK HASSEBROOK, BIOTECHNOLOGY'S BITTER HARVEST: HERBICIDE-TOLERANT CROPS AND THE THREAT TO SUSTAINABLE AGRICULTURE 6 (1990), http://blog.ucsusa.org/wp-content/uploads/2012/05/Biotechnologys-Bitter-Harvest.pdf ("[H]erbicide-tolerant crops represent a major misstep on the road toward an environmentally sound system of agriculture.").

67. Thompson, *supra* note 59.

68. Marc Firestone, *A Quick Look at Two Areas of Doctrinal Difference Between EU and U.S. Decision Makers*, 20 TUL. J. INT'L & COMP. L. 1, 36 (2011).

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 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

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69. SHEILA JASANOFF, DESIGNS ON NATURE: SCIENCE AND DEMOCRACY IN EUROPE AND THE UNITED STATES 89 (2005).

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.

72. G. Bruening & J.M. Lyons, *The Case of the FLAVR SAVR Tomato*, CAL. AGRIC., July–Aug. 2000, at 6, 6; *see also* BELINDA MARTINEAU, FIRST FRUIT: THE CREATION OF THE FLAVR SAVR TOMATO AND THE BIRTH OF BIOTECH FOOD (2001).

73. Bruening & Lyons, *supra* note 72, at 6.

74. *Id.* at 6–7; *see also* Jordan James 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)).

75. John Schwartz, *FDA Clears Tomato with Altered Genes*, WASH. POST (May 19, 1994), https://www.washingtonpost.com/archive/politics/1994/05/19/fda-clears-tomato-with-altered-genes/45edf2d7-f51e-4400-a15f-509dedb23505/.

76. Bruening & Lyons, *supra* note 72, at 7.

77. *Id.*

78. *Id.*; *see also* Anton E. Wohlers, *Regulating Genetically Modified Food: Policy Trajectories, Political Culture, and Risk Perceptions in the U.S., Canada, and EU*, 29 POL. & LIFE SCIS. 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.[81] Pusztai's study proved hotly controversial, with disputed accounts lingering for years afterward.[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.[83] This illustrated both substantial and remarkable stability regarding support of biotechnology.[84] GMOs were generally associated with improved quality of life and low threats to human health.[85] However, campaigns by interest groups in the late 1990s helped change public opinion.[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.[87] Today, Americans are narrowly divided on the question of whether GMOs are harmful to human health.[88]

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

81. *Id.*

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. Claus 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).

83. Wohlers, *supra* note 78, at 22.

84. *Id.*

85. *Id.* at 23.

86. *Id.*

87. *Id.*

88. Brian Kennedy, Meg Hefferon & Cary Funk, *Americans Are Narrowly Divided over Health Effects of Genetically Modified Foods*, PEW RSCH. CTR. (Nov. 19, 2018), https://www.pewresearch.org/fact-tank/2018/11/19/americans-are-narrowly-divided-over-health-effects-of-genetically-modified-foods/.

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.

90. Mark Lynas, *With G.M.O. Policies, Europe Turns Against Science*, N.Y. TIMES (Oct. 24, 2015), https://www.nytimes.com/2015/10/25/opinion/sunday/with-gmo-policies-europe-turns-against-science.html.

91. *Id.*

92. *Id.*

the implications of GMOs.[93] Although earlier surveys reported general support,[94] approval of GMOs in China has become increasingly controversial. While the Chinese government and press are supportive of GMOs, the public remains widely skeptical.[95]

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.[96] 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.[97] GMOs have even been perceived as a violation of a sacred trust between humankind and its creator.[98] Although the three major western religions do not have unified stances for or against GMOs,[99] 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 punishes us all.[100]

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.").

94. Quan Li, Kynda R. Curtis, Jill J. McClusky & Thomas I. Wahl, *Consumer Attitudes Toward Genetically Modified Foods in Beijing, China*, 5 AGBIOFORUM 145, 146 (2002).

95. Adam Minter, Opinion, *China Wants GMOs. The Chinese People Don't.*, BLOOMBERG (Sept. 27, 2016, 5:00 PM), https://www.bloomberg.com/view/articles/2016-09-28/china-wants-gmos-the-chinese-people-don-t; Dominique Patton, *China Launches Media Campaign to Back Genetically Modified Crops*, REUTERS (Sept. 30, 2014, 4:20 AM), https://www.reuters.com/article/us-china-gmo/china-launches-media-campaign-to-back-genetically-modified-crops-idUSKCN0HP13X20140930; *see also* David Talbot, *China's GMO Stockpile*, MIT TECH. REV. (Oct. 21, 2014), https://www.technologyreview.com/s/531721/chinas-gmo-stockpile/.

96. RACHEL SCHURMAN & WILLIAM A. MUNRO, FIGHTING FOR THE FUTURE OF FOOD: ACTIVISTS VERSUS AGRIBUSINESS IN THE STRUGGLE OVER BIOTECHNOLOGY, at xv–xvi (2010).

97. *Id.* at xvi.

98. Keith G. Davies, *What Makes Genetically Modified Organisms So Distasteful?*, 19 TRENDS BIOTECHNOLOGY 424, 424 (2001).

99. *See* Emmanuel B. Omobowale, Peter A. Singer & Abdallah S. Daar, *The Three Main Monotheistic 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.[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.[102] Wallace believed that the vaccine upset the balance of human nature and would cause disastrous harm.[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!"[104]

During the twentieth century, a time of great successes for vaccines,[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,[106] the modern understanding upon which autism is based originates from Leo Kanner, a psychiatrist and physician at Johns Hopkins Hospital.[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.[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

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101. Donald E. Greydanus & Luis H. Toledo-Pereyra, *Historical Perspectives on Autism: Its Past Record of Discovery and Its Present State of Solipsism, Skepticism, and Sorrowful Suspicion*, 59 PEDIATRIC CLINICS N. AM. 1, 3 (2012). *See generally History of Anti-Vaccination Movements*, HIST. OF VACCINES, https://www.historyofvaccines.org/content/articles/history-anti-vaccination-movements (Jan. 10, 2018).

102. Greydanus & Toledo-Pereyra, *supra* note 101, at 3. For a detailed exploration of Wallace's arguments and influence, see Martin Fichman & Jennifer E. Keelan, *Resister's Logic: The Anti-Vaccination Arguments of Alfred Russel Wallace and Their Role in the Debates over Compulsory Vaccination in England, 1870–1907*, 38 STUD. HIST. & PHIL. BIOLOGICAL & BIOMEDICAL SCIS. 585 (2007).

103. Greydanus & Toledo-Pereyra, *supra* note 101, at 3.

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

105. Jason L. Schwartz, *New Media, Old Messages: Themes in the History of Vaccine Hesitancy and Refusal*, 14 AMA J. ETHICS 50, 50–52 (2012). At least thirty-one vaccines were developed that are licenses to prevent infectious diseases in the United States. Gregory Poland & Alan Barrett, *The Old and the New: Successful Vaccines of the 20th Century and Approaches to Making Vaccines for the Important Diseases of the 21st Century*, 21 CURRENT OP. IMMUNOLOGY 305, 305 (2009). By one estimate, vaccines have prevented 103.1 million cases of contagious diseases since 1924. Willem G. van Panhuis, John Grefenstette, Su Yon Jung, Nian Shong Chok, Anne Cross, Heather Eng, Bruce Y. Lee, Vladimir Zadorozhny, Shawn Brown, Derek Cummings & Donald S. Burke, *Contagious Diseases in the United States from 1888 to the Present*, 369 NEW ENG. J. MED. 2152, 2156 (2013).

106. Greydanus & Toledo-Pereyra, *supra* note 101, at 2 (summarizing sixteenth- and eighteenth-century descriptions of children with symptoms similar to autism); *see also* JOHN HASLAM, OBSERVATIONS ON MADNESS AND MELANCHOLY 185–206 (London, G. Hayden 2d ed. 1809); E.M. ITARD, AN HISTORICAL ACCOUNT OF THE DISCOVERY AND EDUCATION OF A SAVAGE MAN 20–22 (London, Richard Phillips, 1802).

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

108. Daniela Caruso, *Autism in the U.S.: Social Movement and Legal Change*, 36 AM. J.L. & MED. 483, 489 (2010).

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.[109] He criticized mothers for a "lack of genuine warmth," and fathers that "hardly know their autistic children."[110] Children with autism had parents who "just happen[ed] to defrost enough to produce a child."[111] 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."[112] For Kanner, there was no brain dysfunction in children with autism, but rather they suffered emotional damage from their environment.[113]

The effects were catastrophic. Parents were overwhelmed with guilt.[114] Families split as mothers and fathers assigned blame for their "poor parenting" on one another.[115] Families that could afford it spent substantial sums on psychoanalytic treatment.[116] When their child improved, the therapist took the credit.[117] If the child did not, the parents shouldered the blame.[118] Children mostly received no useful treatment,[119] and up to seventy-six percent of children with autism were institutionalized before they reached adulthood.[120]

Not a single scientific evaluation was conducted at the time regarding whether the "refrigerator parent" theory had any basis in scientific reality.[121] Nonetheless, the poisonous notion of a "refrigerator parent" chilling their sons and daughters into autism spread like an infection through numerous branches of medicine.[122] The Kanner article advanced profoundly false and damaging ideas about what is now known as autism spectrum disorder.[123] Instead of

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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.

111. *Medicine: The Child Is Father*, TIME (July 25, 1960), http://autismedsp5310s20f10.pbworks.com/w/file/fetch/31008356/Time-The%20Child%20Is%20Father.pdf.

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.*

120. Martin A. Kotler, *The Individuals with Disabilities Education Act: A Parent's Perspective and Proposal for Change*, 27 U. MICH. J.L. REFORM 331, 333 (1994) (citing P. Mittler, Susan Gilles & Eunice Jukes, *Prognosis in Psychotic Children: Report of a Follow-up Study*, 10 J. MENTAL DEFICIENCY RSCH. 73, 75 (1966)).

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,

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https://www.spectrumnews.org/news/evolution-autism-diagnosis-explained/. Eugene Bleuler, a Swiss psychiatrist, was the first use the term "autism" for a medical diagnosis in 1911. John Thomas, *Autism, Medicine, and the Poison of Enthusiasm and Superstition*, 7 J. HEALTH & BIOMEDICAL L. 449, 455 (2012).

124. Kotler, *supra* note 120, at 333.

125. The vaccine-autism link was sparked by a now-discredited article in *The Lancet.* A.J. Wakefield, S.H. Murch, A. Anthony, J. Linnell, D.M. Casson, M. Malik, M. Berelowitz, A.P. Dhillon, M.A. Thomson, P. Harvey, A. Valentine, S.E. Davies & J.A. Walker-Smith, *Ileal-Lymphoid-Nodular Hyperplasia, Non-Specific Colitis, and Pervasive Developmental Disorder in Children*, 351 LANCET 637, 637–41 (1998).

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

127. SETH MNOOKIN, THE PANIC VIRUS: A TRUE STORY OF MEDICINE, SCIENCE, AND FEAR 106–17 (2011).

128. Erwin Chemerinsky & Michele Goodwin, *Compulsory Vaccination Laws Are Constitutional*, 110 NW. U. L. REV. 589, 591–92 (2016).

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).

131. *See generally* PAUL A. OFFIT, DEADLY CHOICES: HOW THE ANTI-VACCINE MOVEMENT THREATENS US ALL (2011).

132. Thomas, *supra* note 123, at 469 & n.133.

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.[133] Vermont became the first state to pass a law that required GMO labeling of relevant products.[134] 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.[135] 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 misdealing 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.

134. VT. STAT. ANN. tit. 9, §§ 3042–43 (2017).

135. *See* 7 U.S.C. § 1639(b) (2018); *see also* Lucas A. Westerman, *Consumer Choice or Confusion: That GMO Label Doesn't Mean What You Think It Means*, 23 DRAKE J. AGRIC. L. 199, 204–05 (2018); Dan Charles, *Congress Just Passed a GMO Labeling Bill. Nobody's Super Happy About It*, NPR: THE SALT (July 14, 2016, 5:34 PM), https://www.npr.org/sections/thesalt/2016/07/14/486060866/congress-just-passed-a-gmo-labeling-bill-nobodys-super-happy-about-it; Press Release, USDA, Establishing the National Bioengineered Food Disclosure Standard (Dec. 20, 2018), https://www.usda.gov/media/press-releases/2018/12/20/establishing-national-bioengineered-food-disclosure-standard.

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.[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),[137] with for some advocates the ultimate goal being a GMO-free United States.[138] Outside the United States, robust regulation has imposed total or partial bans on products with GMOs.[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.[140] While some state legislators are responding to remove various exemptions,[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.[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.[143] Even when legislatures succeed in curtailing one exemption, anti-vaccine adherents simply shift to another exemption.[144] The results have been lamentably predictable, with diseases once "doomed by

136. *GE Food Labeling Rule*, VT. ATT'Y GEN., https://ago.vermont.gov/ge-food-labeling-rule/ (last visited Feb. 25, 2021) ("Following President Obama's signing of S.764, which establishes a 'National Bioengineered Food Disclosure Standard,' the Vermont Attorney General will no longer be enforcing Act 120, Vermont's first-in-the-nation law requiring the labeling of food produced with genetic engineering (GE).").

137. Westerman, *supra* note 135, at 205; *see also* Christian Detisch, *President Obama Signs DARK Act into Law*, FOOD & WATER WATCH (Aug. 1, 2016), https://www.foodandwaterwatch.org/news/president-obama-signs-dark-act-law.

138. *See, e.g.*, *Overview*, GMO FREE USA, https://gmofreeusa.org/about-us/overview/ (last visited Feb. 7, 2021) (describing that their vision is to see a world "whose food and ecological systems are clean, accessible to all, and fully protected from contamination by GMOs").

139. Walden Bello & Foreign Policy in Focus, *Twenty-Six Countries Ban GMOs—Why Won't the US?*, NATION (Oct. 29, 2013), https://www.thenation.com/article/twenty-six-countries-ban-gmos-why-wont-us/.

140. *States with Religious and Philosophical Exemptions from School Immunization Requirements*, *supra* note 12.

141. *Id.*

142. *Measles Cases and Outbreaks*, CTRS. FOR DISEASE CONTROL & PREVENTION, https://www.cdc.gov/measles/cases-outbreaks.html (last visited Feb. 25, 2021) ("Measles is more likely to spread and cause outbreaks in U.S. communities where groups of people are unvaccinated.").

143. Michael Ollove, *Amid Measles Outbreak, Little Effort to Kill Vaccine Exemptions*, PEW TRUSTS: STATELINE (May 10, 2019), https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2019/05/10/amid-measles-outbreak-little-effort-to-kill-vaccine-exemptions.

144. Michael Devitt, *Study Examines Fallout of California Vaccine Exemption Law*, AM. ACAD. FAM. PHYSICIANS (Nov. 27, 2018, 8:47 AM), https://www.aafp.org/news/health-of-the-public/20181127califvaccstudy.html.

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,

145. EMILY OSHIMA LEE, LINDSAY ROSENTHAL & GABRIEL SCHEFFLER, CTR. FOR AM. PROGRESS, THE EFFECT OF CHILDHOOD VACCINE EXEMPTIONS ON DISEASE OUTBREAKS 4–5 (2013), https://www.americanprogress.org/issues/healthcare/reports/2013/11/14/76471/the-effect-of-childhood-vaccine-exemptions-on-disease-outbreaks/.

146. *See* James C. Foster, *The Interplay of Legitimacy, Elections, and Crocodiles in the Bathtub: Making Sense of Politicization of Oregon's Appellate Courts*, 39 WILLAMETTE L. REV. 1313, 1330 (2003) ("Even if judges seem to take public opinion into consideration as they make decisions on controversial public policy issues, this does not make judges mere weather vanes, blowing with the prevailing winds of public attitudes."); *cf.* James G. Fannon, Note, *The Public Policy Exception to the Employment at Will Doctrine: Searching for Clear Mandates in the Pennsylvania Constitution*, 27 RUTGERS L.J. 927, 929 (1996) (noting judicial reluctance to be swayed by public policy in employment context). Courts that may be more susceptible to public opinion, however, are those populated by judges elected, rather than appointed, into their positions. *See* Adam Liptak, *Judges Who Are Elected Like Politicians Tend to Act Like Them*, N.Y. TIMES (Oct. 3, 2016), https://www.nytimes.com/2016/10/04/us/politics/judges-election-john-roberts.html.

147. Aziz Z. Huq, *Binding the Executive (by Law or by Politics)*, 79 U. CHI. L. REV. 777, 818 & nn.180–81 (2012) (reviewing ERIC A. POSNER & ADRIAN VERMEULE, THE EXECUTIVE UNBOUND: AFTER THE MADISONIAN REPUBLIC (2010)) (citing various studies in support).

148. Paul Burstein, *The Impact of Public Opinion on Public Policy: A Review and an Agenda*, 56 POL. RSCH. Q. 29, 29 (2003).

149. *Id.* at 36.

particularly voters.[150] Voters who have high salience on a particular issue are more likely to have that issue influence their desire for regulatory change.[151] 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.[152]

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.[153] 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.[154] The vaccine controversy thus has such power that it has been selected for weaponization by a foreign adversary.[155]

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.[156] Such issues require communication of the existence of the issue and interpretation for public consumption before salience can emerge.[157] 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.[158]

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150. Christopher Wlezien, *On the Salience of Political Issues: The Problem with 'Most Important Problem'*, 24 ELECTORAL STUD. 555, 556 (2005).

151. *See* Burstein, *supra* note 148, at 30.

152. *Cf.* Jon Agnone, *Amplifying Public Opinion: The Policy Impact of the U.S. Environmental Movement*, 85 SOC. FORCES 1593, 1608–09 (2007) (reaching this finding in the environmental context).

153. *See, e.g.*, Michael Pollan, *Vote for the Dinner Party*, N.Y. TIMES (Oct. 10, 2012), https://www.nytimes.com/2012/10/14/magazine/why-californias-proposition-37-should-matter-to-anyone-who-cares-about-food.html (discussing California's Proposition 37); *Colorado Mandatory Labeling of GMOs Initiative, Proposition 105 (2014)*, BALLOTPEDIA, https://ballotpedia.org/Colorado_Mandatory_Labeling_of_GMOs_Initiative,_Proposition_105_(2014) (last visited Feb. 25, 2021).

154. David A. Broniatowski, Amelia M. Jamison, SiHua Qi, Lulwah AlKulaib, Tao Chen, Adrian Benton, Sandra C. Quinn & Mark Dredze, *Weaponized Health Communication: Twitter Bots and Russian Trolls Amplify the Vaccine Debate*, 108 AM. J. PUB. HEALTH 1378, 1379 (2018).

155. *Id.*

156. William G. Jacoby, *Issue Framing and Public Opinion on Government Spending*, 44 AM. J. POL. SCI. 750, 751 (2000).

157. *Id.*

158. Andrej Šorgo, Norbert Jaušovec, Ksenija Jaušovec & Miro Puhek, *The Influence of Intelligence and Emotions on the Acceptability of Genetically Modified Organisms,* 15 ELEC. J. BIOTECHNOLOGY 1, 9 (2012) (finding that emotions play a significant role in GMO attitudes); Alexa Spence & Ellen Townsend, *Examining Consumer Behavior Toward Genetically Modified (GM) Food in Britain*, 26 RISK ANALYSIS 657, 668–69 (2006)

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 humanity[160] 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) ("[D]ecision-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.[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.[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.[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.[165] GMO skeptics driven by nationalist loyalties might take seriously the charge that anti-GMO disinformation is an information

162. Sy Mukherjee, *The Anatomy of an Anti-Vaxxer*, FORTUNE (May 13, 2019, 3:45 PM), https://fortune.com/2019/05/13/measles-outbreak-anti-vaxxers/.

163. Kristina Sinemus & Marc Egelhofer, *Transparent Communication Strategy on GMOs: Will It Change Public Opinion?*, 2 BIOTECHNOLOGY J. 1141, 1144 (2007).

164. *Id.*

165. *See* Amanda Zaluckyj, *The Organic Industry's GMO Hoax*, HILL (Mar. 24, 2016, 10:00 AM), https://thehill.com/blogs/congress-blog/274069-the-organic-industrys-gmo-hoax; Michelle Miller, *'Follow the Money': Why the Organic Industry Funds Anti-GMO Campaigns*, GENETIC LITERACY PROJECT (May 5, 2017), https://geneticliteracyproject.org/2017/05/05/follow-money-organic-industry-funds-anti-gmo-campaigns/.

warfare tool of a foreign government.[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.[167] Restrictions on food sales due to GMO ingredients may be interpreted as a constraint on consumer choice and free enterprise.[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.[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.[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.[171]

166. *See* Justin Cremer, *Russia Uses 'Information Warfare' to Portray GMOs Negatively*, CORNELL ALL. FOR SCI. (Feb. 28, 2018), https://allianceforscience.cornell.edu/blog/2018/02/russia-uses-information-warfare-portray-gmos-negatively/; Donnelle Eller, *Anti-GMO Articles Tied to Russian Sites, ISU Research Shows*, DES MOINES REG. (Feb. 25, 2018, 8:42 PM), https://www.desmoinesregister.com/story/money/agriculture/2018/02/25/russia-seeks-influence-usa-opinion-gmos-iowa-state-research/308338002/; Shawn F. Dorius & Carolyn J. Lawrence-Dill, *Sowing the Seeds of Skepticism: Russian State News and Anti-GMO Sentiment*, 9 GM CROPS & FOOD 53, 54–55 (2008).

167. J. Howard Beales III, *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.

Id. How much labeling will cost consumers, ranging from trivial to significant, remains debated. *Compare* William Lesser, Costs of Labeling Genetically Modified Food Products in N.Y. State (unpublished manuscript), http://publications.dyson.cornell.edu/docs/LabelingNY.pdf (last visited Feb. 25, 2021), *with What You Need to Know About GMO Labeling*, CONSUMER REP. (Oct. 8, 2015), https://www.consumerreports.org/cro/food/gmo-labeling (concluding that cost to consumers of GMO labelling would be "less than a penny a day").

168. *See* Gary E. Marchant & Guy A. Cardineau, *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.").

169. Klaus G. Grunert, Tino Bech-Larsen, Liisa Lähteenmäki, Øydis Ueland & Annika Åström, *Attitudes Towards the Use of GMOs in Food Production and Their Impact on Buying Intention: The Role of Positive Sensory Experience*, 20 AGRIBUSINESS 95, 97–98 (2004).

170. *Id.* at 102–04.

171. *See* Joel Gittelsohn, Sonali Suratkar, Hee-Jung Song, Suzanne Sacher, Radha Rajan, Irit R. Rasooly, Erin Bednarek, Sangita Sharma & Jean A. Anliker, *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.[172] Women are more likely than men to perceive a problem with GMOs.[173] Individuals with low levels of scientific knowledge are more likely to mistrust GMOs.[174] 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.[175] 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.[176] This does not mean that GMO education is a simple task or that it is without risk.[177] 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."[178] Instead educators must first affirm the worldview of their audience by endorsing their values, which in turn can increase receptivity for their audience.[179] Whether it is risk-aversion, belief in genetic essentialism, fear of technology, lack of

172. John Hudson, Anetta Caplanova & Marcel Novak, *Public Attitudes to GM Foods. The Balancing of Risks and Gains*, 92 APPETITE 303, 306–10 (2015).

173. Kennedy et al., *supra* note 88.

174. Cary Funk, Brian Kennedy & Meg Hefferon, *Public Perspectives on Food Risks*, PEW RSCH. CTR. (Nov. 19, 2018), https://www.pewresearch.org/science/2018/11/19/public-perspectives-on-food-risks/.

175. *See* CARY FUNK & BRIAN KENNEDY, PEW RSCH. CTR., THE NEW FOOD FIGHTS: U.S. PUBLIC DIVIDES OVER FOOD SCIENCE 53 (2016), https://www.pewresearch.org/internet/wp-content/uploads/sites/9/2016/11/PS_2016.12.01_Food-Science_FINAL.pdf.

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.").

177. Ian Sample, *Strongest Opponents of GM Foods Know the Least but Think They Know the Most*, GUARDIAN (Jan. 14, 2019, 11:00 AM), https://www.theguardian.com/environment/2019/jan/14/gm-foods-scientific-ignorance-fuels-extremist-views-study (mentioning briefly a "backfire effect" by which "how people can become entrenched in their original positions after rejecting new information"); Joseph Clayton, *GMOs Have Had a Good 2016, but Teachable Moments Lie Ahead*, FORBES (Nov. 30, 2016, 9:32 AM), https://www.forbes.com/sites/gmoanswers/2016/11/30/gmos-had-a-good-2016/?sh=781093757f90 (mentioning backfire effect in the context of information overload). *See generally* Gregory T. Trevors, Krista R. Muis, Reinhard Pekrun, Gale M. Sinatra & Philip H. Winne, *Identity and Epistemic Emotions During Knowledge Revision: A Potential Account for the Backfire Effect*, 53 DISCOURSE PROCESSES 339 (2016) (examining how the information backfire effect arises in scientific discourse and in particular through challenges of self-concept).

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.[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.[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.[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.[183]

Similar to GMOs, direct messages to skeptics about the safety of vaccines can backfire.[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.[185] Not one of the interventions increased intent to vaccinate amongst the most skeptical parents in the tested group.[186] Worse, amongst the

180. Cornelia Betsch, Frank Renkewitz, Tilmann Betsch & Corina Ulshöfer, *The Influence of Vaccine-Critical Websites on Perceiving Vaccination Risks*, 15 J. HEALTH PSYCH. 446, 453 (2010).

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).

182. *Id.* at 4.

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 PUB. 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.

Id.

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

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

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.

189. Zachary Horne, Derek Powell, John E. Hummel & Keith J. Holyoak, *Countering Antivaccination Attitudes*, 112 PNAS 10321, 10324 (2015) (finding that highlighting factual information about dangers of communicable disease positively impacted attitudes toward vaccination).

190. Nyhan et al., *supra* note 185, at e842.

191. Julie Leask, Paul Kinnersley, Cath Jackson, Francine Cheater, Helen Bedford & Greg Rowles, *Communicating with Parents about Vaccination: A Framework for Health Professionals*, 12 BMC PEDIATRICS 154, 157 (2012).

192. *Id.*

193. *Id.*

194. *Id.*

195. *Id.*

196. *Id.*

197. Katie Attwell, *The Politics of Picking: Selective Vaccinators and Population-Level Policy*, 7 SSM—POPULATION HEALTH 1, 5 (2019).

198. *Id.* at 4.

199. Leask et al., *supra* note 191, at 157.

the vaccine industry.[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.[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.[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.[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.[204] Refusers decline all vaccines for their children.[205] They tend to cluster in communities that share certain religious or alternative beliefs and feel alienated or disenchanted with the medical establishment.[206] Citing scientific research will likely not suffice, as these parents may have studies of their own that they trust or support.[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.[208]

IV. 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,

200. Attwell, *supra* note 197, at 3–4.

201. Caitlin Jarrett, Rose Wilson, Maureen O'Leary, Elisabeth Eckersberger, Heidi J. Larson & the SAGE Working Group on Vaccine Hesitancy, *Strategies for Addressing Vaccine Hesitancy—A Systematic Review*, 33 VACCINE 4180, 4186 (2015).

202. *Id.* at 4181.

203. *See* Editorial, *How to Inoculate Against Anti-Vaxxers*, N.Y. TIMES (Jan. 19, 2019), https://www.nytimes.com/2019/01/19/opinion/vaccines-public-health.html.

204. Leask et al., *supra* note 191, at 157. Perhaps the most visible work supporting the vaccine-autism connection that parents might rely on is the now-discredited study by Andrew Wakefield and co-authors. For a discussion of that study, see *supra* text accompanying notes 125–132.

205. Leask et al., *supra* note 191, at 157.

206. *Id.*

207. *Id.* at 158.

208. *Id.*

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?*, PRAWFSBLAWG (June 16, 2011, 2:47 PM), https://prawfsblawg.blogs.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.").

212. Philip Ball, *It's Not Just You: Science Papers Are Getting Harder to Read*, NATURE: MUSE (Mar. 30, 2017), https://www.nature.com/news/it-s-not-just-you-science-papers-are-getting-harder-to-read-1.21751 (citing Pontus Plavén-Sigray, Granville James Matheson, Björn Christian Schiffler & William Hedley Thompson, *The Readability of Scientific Texts Is Decreasing over Time*, ELIFE (Sept. 5, 2017), https://www.elifesciences.org/articles/27725).

persuasion, a tool that is embedded in legal thinking from the very first days of law school.[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.[214] Such stories can challenge established narratives and encourage reader engagement.[215] Stories generate empathy in the reader that encourage agreement with the underlying issue.[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.[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.[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.[219] Legal writers that write with clarity, relevance, and wit, while not ubiquitous, are far from non-existent,[220] and that potential predisposes legal scholarship and its derivative works to influencing public opinion.

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213. For examples of the methods used in persuasive legal writing, see Brian J. Pattison, *Writing to Persuade*, 24 UTAH B.J. 10 (2011); Michael R. Smith, *Levels of Metaphor in Persuasive Legal Writing*, 58 MERCER L. REV. 919 (2007); Kathryn M. Stanchi, *The Science of Persuasion: An Initial Exploration*, 2006 MICH. ST. L. REV. 411 (2006).

214. *See* Marc A. Fajer, *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].").

215. *See, e.g.*, Tal Kastner, *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.").

216. *See* Joe W. (Chip) Pitts III, *Business, Human Rights, & the Environment*: *The Role of the Lawyer in CSR & Ethical Globalization*, 26 BERKELEY J. INT'L L. 479, 497 (2008).

217. Michael N. Widener, *Driving Pedestrian Traffic to Law Journals*, 104 LAW LIBR. J. 569, 575 (2012); *cf.* Jessica Silbey, Aaron Perzanowski & Marketa Trimble, *Conferring about the Conference*, 52 HOUS. 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.").

218. *See generally* Steven W. Bender, *The Value of Online Law Review Supplements for Junior and Senior Faculty*, 33 TOURO L. REV. 387 (2017); Paul L. Caron, *Are Scholars Better Bloggers? Bloggership: How Blogs Are Transforming Legal Scholarship*, 84 WASH. U. L. REV. 1025 (2006).

219. Walter Olson, *Abolish the Law Reviews!*, ATLANTIC (July 5, 2012), https://www.theatlantic.com/national/archive/2012/07/abolish-the-law-reviews/259389/.

220. *Id.*

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

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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).

222. *See* BRIAN H. BORNSTEIN & EDIE GREENE, THE JURY UNDER FIRE: MYTH, CONTROVERSY, AND REFORM 7 (2017).

223. *See, e.g.*, Patricia Cohen, *$2 Billion Verdict Against Monsanto Is Third to Find Roundup Caused Cancer*, N.Y. TIMES (May 13, 2019), https://www.nytimes.com/2019/05/13/business/monsanto-roundup-cancer-verdict.html. Monsanto, which is now owned by Bayer, faces thousands of similar lawsuits across the United States. Kate Z. Graham, *Federal Regulation of Pesticide Residues: A Brief History and Analysis*, 15 J. FOOD L. & POL'Y 98, 130 (2019).

224. Karen Graham, *Op-Ed: Why the GMO Debate Is Far from Over*, DIGIT. J. (Feb. 22, 2015), http://www.digitaljournal.com/news/environment/op-ed-the-gmo-debate-is-far-from-over/article/426669.

225. Dan Charles, *Safe or Scary? The Shifting Reputation of Glyphosate, AKA Roundup*, NPR: THE SALT (May 30, 2019, 5:00 AM), https://www.npr.org/sections/thesalt/2019/05/30/727914874/safe-or-scary-the-shifting-reputation-of-glyphosate-aka-roundup.

226. Rachel Siegel & Brady Dennis, *Bayer's Stock Falls After $2 Billion Verdict Against Roundup Maker Monsanto*, WASH. POST (May 14, 2019, 7:05 AM), https://www.washingtonpost.com/business/2019/05/14/bayers-stock-falls-after-billion-verdict-against-roundup-maker-monsanto/; Press Release, EPA, EPA Takes Next Step in Review Process for Herbicide Glyphosate, Reaffirms No Risk to Public Health (Apr. 30, 2019), https://www.epa.gov/newsreleases/epa-takes-next-step-review-process-herbicide-glyphosate-reaffirms-no-risk-public-health. Other regulatory agencies globally have agreed with this conclusion. *See Is Glyphosate (Roundup) Dangerous?*, GENETIC LITERACY PROJECT, https://gmo.geneticliteracyproject.org/FAQ/is-glyphosate-roundup-dangerous/ (last visited Feb. 26, 2021).

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.[227] Jury verdicts represent evaluations of whether particular propositions have met a given burden of proof,[228] and should not be interpreted as definitive statements of law or science by the public.[229]

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.[230] Vaccine courts have been portrayed as inhumane to litigants, and that its awards provide evidence that vaccines are not safe for use.[231] 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."[232] 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.[233] This in effect stabilizes the national vaccine supply while still enabling vaccine victims to receive compensation for their injuries.[234] In addition, plaintiffs should receive compensation more quickly, fairly, and generously than compared to filing an

227. *See generally* Eric Schnapper, *Judges Against Juries—Appellate Review of Federal Civil Jury Verdicts*, 1989 WISC. L. REV. 237 (1989) (describing the history and development of appellate review of federal civil jury verdicts). In fact, an attorney's challenging of an adverse jury verdict begins the moment a jury verdict has been announced. *See, e.g.*, Charles W. Douglas, *What to Do When the Jury Gets It Wrong*, 33 LITIG. 20, 20–22 (2006) (recommending reviewing a jury verdict form for inconsistencies and polling each jury member to confirm their agreement with the verdict).

228. Michael S. Pardo, *Group Agency and Legal Proof; or, Why the Jury Is an "It"*, 56 WM. & MARY L. REV. 1793, 1817 (2015).

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").

230. Rachel A. Greenleaf, Note, *Why Plaintiffs Shouldn't Have It Their Way—Revisiting Concurrent Jurisdiction of Autism Claims against Thimerosal Manufacturers*, 21 FED. CIRCUIT B.J. 299, 299 (2011); National Childhood Vaccine Injury Act of 1986, Pub. L. No. 99-660, tit. III, 100 Stat. 3743, 3755 (codified as amended at 42 U.S.C. § 300aa-1 to aa-34 (2019)).

231. *See, e.g.*, WAYNE ROHDE, THE VACCINE COURT: THE DARK TRUTH OF AMERICA'S VACCINE INJURY COMPENSATION PROGRAM 3–5 (2014); ALAN PALMER, TRUTH WILL PREVAIL: 1200 STUDIES TO VACCINATE OR NOT TO VACCINATE? 282–85 (2018), http://www.wellnessdoc.com/wp-content/uploads/2018/12/1200-studies-The-Truth-Will-Prevail-v2.pdf.

232. *Courts Quietly Confirm MMR Vaccine Causes Autism*, WORLDTRUTH.TV, https://worldtruth.tv/courts-quietly-confirm-mmr-vaccine-causes-autism%e2%80%8f/ (last visited Feb. 26, 2021).

233. Greenleaf, *supra* note 230, at 299.

234. *Id.*

action in a traditional state court proceeding.[235] 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.[236] This question was resolved in 1905 by *Jacobson v. Massachusetts*, which upheld the constitutionality of mandatory vaccination laws for smallpox.[237] 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."[238] The Court in that context was discussing "[e]xtreme cases" where the state would hypothetically apply vaccine laws that would impose "injustice, oppression or absurd consequence."[239] 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.[240] 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.[241] A

235. James B. Currier, Note, *Too Sick, Too Soon?: The Causation Burden Under the National Vaccine Injury Compensation Program Following* De Bazan v. Secretary of Health & Human Services, 19 FED. CIRCUIT B.J. 229, 234–35 (2009); *see also id.* at 236 (concluding that "while claimants ceded some legal ground to vaccine-makers, the Compensation Program provided an informal and generous opportunity to receive relief") (footnote omitted).

236. *See, e.g.*, Barbara Loe Fisher, *Forcing Vaccination on Every Child Undermines Civil Liberties*, LEAPSMAG (Mar. 28, 2019), https://leapsmag.com/forcing-vaccination-on-every-child-undermines-civil-liberties/.

237. Jacobson v. Massachusetts, 197 U.S. 11, 37–39 (1905); *see also* Zucht v. King, 260 U.S. 174, 176–77 (1922) (upholding requirement for school vaccinations).

238. *Jacobson*, 197 U.S. at 38–39; *see* Fisher, *supra* note 236 (relying on this language in part to argue against mandatory vaccination); Steve Martin (@mepatriot), *Proof that the VAXXERS & Their Inbred Cousins at the CDC and in Congress Won't Stop Until No Exceptions Are Allowed to Mandatory Vaccination*, STEEMIT, https://steemit.com/vaccines/@mepatriot/proof-that-the-vaxxers-and-their-inbred-cousins-at-the-cdc-and-in-congress-won-t-stop-until-no-exceptions-are-allowed-to (last visited Feb. 25, 2021) (arguing similarly).

239. *Jacobson*, 197 U.S. at 38–39.

240. *See* Teri Dobbins Baxter, *Tort Liability for Parents Who Chose Not to Vaccinate Their Children and Whose Unvaccinated Children Infect Others*, 82 U. CIN. L. REV. 103, 117 (2013).

241. *See, e.g.*, Alberto Giubilini, Lucius Caviola, Hannah Maslen, Thomas Douglas, Anne-Marie Nussberger, Nadira Faber, Samantha Vanderslott, Sarah Loving, Mark Harrison & Julian Savulescu, *Nudging Immunity: The Case for Vaccinating Children in School and Day Care by Default*, 31 HEC F. 325, 341 (2019) ("[O]ne feasible, ethically acceptable, and potentially effective vaccination strategy is the use of vaccination nudges . . . ."); Noni E. MacDonald, Robb Butler & Eve Dubé, *Addressing Barriers to Vaccine Acceptance: An*

nudge is a behaviorally-informed practice that leverages scarce cognitive resources in others in order to change their behavior.[242] Nudges may have been long applied in various contexts, but they were popularized by an economist and a legal scholar.[243] 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,[244] 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.[245] 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.[246] With fifty states across numerous years enacting and modifying vaccine exemptions, the impact of these exemption laws becomes a testable empirical question.[247] 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 exception exists.[248] 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

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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).

243. *See* RICHARD H. THALER & CASS R. SUNSTEIN, NUDGE: IMPROVING DECISIONS ABOUT HEALTH, WEALTH, AND HAPPINESS (2008).

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.

246. Daniela Blei & Tamara Venit Shelton, *Vaccines Save Lives. But Stricter Laws May Backfire.*, WASH. POST (Aug. 30, 2019, 3:00 AM), https://www.washingtonpost.com/outlook/2019/08/30/danger-stricter-vaccine-laws/.

247. *Cf.* John J. Donohue, Abhay Aneja & Kyle D. Weber, *Right-to-Carry Laws and Violent Crime: A Comprehensive Assessment Using Panel Data and a State-Level Synthetic Control Analysis*, 16 J. EMPIRICAL LEGAL STUD. 198 (2019) (using state panel data across states and over time to assess impact of right-to-carry laws on violent crime); Robert C. Bird & John D. Knopf, *Do Wrongful-Discharge Laws Impair Firm Performance?*, 52 J.L. & ECON. 197 (2009) (using changes in wrongful discharge protections across states and over time to determine the impact of such laws on firm profitability).

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").

250. *See, e.g.*, DAVID H. KAYE, DAVID E. BERNSTEIN & JENNIFER L. MNOOKIN, THE NEW WIGMORE: A TREATISE ON EVIDENCE: EXPERT EVIDENCE § 12.5 (2d ed. 2020).

251. Jeffrey Beall, *Essential Information about Predatory Publishers and Journals*, 86 INT'L HIGHER EDUC. 2, 2–3 (2016).

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.[255] 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.[256] The numbers are small, but the list could grow as the pressure increases for greater productivity from scholars at all ranks.[257] Unvetted articles from predatory law journals, from profound sounding outlets such as the *International Journal of Law and Legal Jurisprudence Studies*[258] or the *European Law and Politics Journal*,[259] 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.[260]

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.[261] 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

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."

256. Even experienced scholars can fall prey to predatory journals. *See List of Predatory Journals*, STOP PREDATORY JS., https://predatoryjournals.com/journals/ (last visited Feb. 26, 2021).

257. *See, e.g.*, Ken Budd, *The Problem of Predatory Journals*, AAMC (Apr. 9, 2019), https://www.aamc.org/news-insights/problem-predatory-journals.

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,[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.[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.[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.[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.[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.[267] These pressures can tempt editors to avoid conflict with their fellow students and let suspect scholarship, if not suspect pseudoscience, slip into publication.

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262. Suzanne C. Segerstrom, *Perceptions of Stress and Control in the First Semester of Law School*, 32 WILLAMETTE L. REV. 593, 595 (1996) (explaining that law students experience significantly higher levels of stress than even other graduate programs such as medical school).

263. Albert H. Yoon, *Editorial Bias in Legal Academia,* 5 J. LEGAL ANALYSIS 309, 336–37 (2013).

264. Adam Liptak, *The Lackluster Reviews That Lawyers Love to Hate*, 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.").

265. Barry Friedman, *Fixing Law Reviews*, 67 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.").

266. *E.g.*, David L. Baker, *Should Law-School Applications Include a Warning Label?*, 96 IOWA L. REV. 1495, 1503 (2011).

267. *See* Debra S. Austin, *Positive Legal Education: Flourishing Law Students and Thriving Law Schools,* 77 MD. L. REV. 649, 656 (2018) ("The socialization process of legal education incubates the law student professional identity.").

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.[268] 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.[269] 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.[270] Finally, law review editors can make available mainstream lists of predatory journals to all journal staff.[271] 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 DETER THE SPREAD OF PSEUDOSCIENCE

Scientific research, including research on GMOs and vaccines, is by its very nature complex.[272] Findings in their original form may only be fully comprehensible by experts in the field. As a result, it is increasingly the

268. Friedman, *supra* note 265, at 1349–51.

269. *See* Robert C. Bird, *Vaccinating Legal Scholarship from Distorted Science: Evidence from the Anti-GMO Movement*, 90 UKMC L. REV. (forthcoming 2021) (manuscript at 24–26), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3511682.

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]

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273. *See, e.g.*, M.R.C. Greenwood & Donna Gerardi Riordan, *Civic Scientist/Civic Duty*, 23 SCI. COMM. 28, 28–32 (2001) (describing the origin, definition, and importance of being a "civic scientist"); Alan I. Leshner, Editorial, *Public Engagement with Science*, 299 SCI. 977, 977 (2003) ("The centrality of science to modern life bestows an obligation on the scientific community to develop different and closer links with the general population.").

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.

277. Lisa Scharrer, Yvonne Rupieper, Marc Stadtler & Rainer Bromme, *When Science Becomes Too Easy: Science Popularization Inclines Laypeople to Underrate Their Dependence on Experts*, 26 PUB. UNDERSTANDING SCI. 1003, 1004 (2017).

278. *Cf.* Judith Stacey, *Marital Suitors Court Social Science Spin-sters: The Unwittingly Conservative Effects of Public Sociology*, 51 SOC. PROBS. 131, 141 (2004) ("Sound-bite social science cannot accommodate complexity, nuance, ambiguity, or uncertainty—the fundamental features of critical reason and intellectual inquiry.").

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).

282. *See* 3M, SCIENTISTS AS STORYTELLERS GUIDE: EXPERT ADVICE FOR STEM COMMUNICATORS ON HOW TO MAKE SCIENCE STORIES MORE RELATABLE (2019), https://multimedia.3m.com/mws/media/1667242O/sosi-3-13-toolkit-pdf.pdf.

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,[283] there may be little incentive to promote one's work to the general public or translate it for the benefit of evolving public policy.[284] 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.[285] 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.[286] If a scientist does not communicate her work, someone else will, and will likely do so to support their own agenda.[287]

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.[288] 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.[289] Publishers then sell the product back to the very universities that created the product in the first place.[290]

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.[291] 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.[292] 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

283. John Wilkes, *Training Scientists to Be Journalists*, 3 EMBO REPS. 1005, 1005 (2002).

284. Micah L. Berman & Annice E. Kim, *Bridging the Gap Between Science and Law: The Example of Tobacco Regulatory Science*, 43 J.L. MED. & ETHICS 95, 95–96 (2015).

285. Erik Vance, *Scientist as Star*, 468 NATURE 365, 365 (2010).

286. Brownell et al., *supra* note 275, at E6.

287. RANDY OLSON, DON'T BE SUCH A SCIENTIST: TALKING SUBSTANCE IN AN AGE OF STYLE 30 (2d ed. 2018).

288. Stephen Buranyi, *Is the Staggeringly Profitable Business of Scientific Publishing Bad for Science?*, GUARDIAN (June 27, 2017), https://www.theguardian.com/science/2017/jun/27/profitable-business-scientific-publishing-bad-for-science.

289. *Id.*

290. *Id.*

291. Walter Klyce & Edward Feller, *Junk Science for Sale: Sham Journals Proliferating Online*, 100 R.I. MED. J. 27, 27 (2017).

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

293. Klyce & Feller, *supra* note 291, at 28; *see also* Larissa Shamseer, David Moher, Onyi Maduekwe, Lucy Turner, Virginia Barbour, Rebecca Burch, Jocalyn Clark, James Galipeau, Jason Roberts & Beverly J. Shea, *Potential Predatory and Legitimate Biomedical Journals: Can You Tell the Difference? A Cross-Sectional Comparison*, 15 BMC MED., Mar. 16, 2017, at 1, 1.

294. *See, e.g.*, Stefan Eriksson & Gert Helgesson, *The False Academy: Predatory Publishing in Science and Bioethics*, 20 MED. HEALTH CARE & PHIL. 163, 168 (2017) ("Predatory publishing is a growing phenomenon that affects bioethics as well as science at large."); Alex Hern & Pamela Duncan, *Predatory Publishers: The Journals that Churn Out Fake Science*, GUARDIAN (Aug. 10, 2018), https://www.theguardian.com/technology/2018/aug/10/predatory-publishers-the-journals-who-churn-out-fake-science.

295. *See generally* Jeffrey Beall, *Predatory Publishers Are Corrupting Open Access*, 489 NATURE 179 (2012).

296. Eriksson & Helgesson, *supra* note 294, at 167.

297. *Id.*

298. *See* Editorial, *The Impact Factor Game*, 3 PLOS MED. 0707, 0707 (2006). The editors of PLoS Medicine explain:

> [I]t is well known that editors at many journals plan and implement strategies to massage their impact factors. Such strategies include attempting to increase the numerator in the above equation by encouraging authors to cite articles published in the journal or by publishing reviews that will garner large numbers of citations. Alternatively, editors may decrease the denominator by attempting to have whole article types removed from it (by making such articles superficially less substantial, such as by forcing authors to cut down on the number of references or removing abstracts) or by decreasing the number of research articles published. These are just a few of the many ways of "playing the impact factor game."

Id.

299. Eriksson & Helgesson, *supra* note 294, at 167.

300. Jeffrey M. Smith, *Survey Reports Improved Health After Avoiding Genetically Modified Foods*, INT'L J. HUM. NUTRITION & FUNCTIONAL MED., 2017, at 1, 1.

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.*

304. *See* Mark Lynas, *Anti-GMO Former Dance Instructor Jeffrey Smith Writes 'Scientific Paper'*, CORNELL ALL. FOR SCI. (Nov. 12, 2017), https://allianceforscience.cornell.edu/blog/2017/11/anti-gmo-former-dance-instructor-jeffrey-smith-writes-scientific-paper/ (quoting Dr. Alison Van Eenennaam, Extension Specialist: Animal Biotechnology and Genomics, Department of Animal Science at U.C. Davis).

305. *See, e.g.*, Ruth Milka, *Here's How Many Health Problems Improved When People Stopped Eating So Many GMO Foods*, NATION OF CHANGE (Nov. 13, 2017), https://www.nationofchange.org/2017/11/13/heres-many-health-problems-improved-people-stopped-eating-many-gmo-foods/; *Clamour for GM Safety Testing*, GM-FREE SCOT. (Mar. 2018), https://gmfreescotland.blogspot.com/2018/03/clamour-for-gm-safety-testing.html?m=0 (noting that "[t]his isn't a scientific study," but still concluding that "Smith's results certainly indicate there's something very wrong with the 'average' American diet").

306. *See* Klyce & Feller, *supra* note 291, at 29; *see also* David Moher & Ester Moher, *Stop Predatory Publishers Now: Act Collaboratively*, 164 ANNALS INTERNAL MED. 616, 616 (2016).

307. *See* Roger Watson, *Beall's List of Predatory Open Access Journals: RIP*, 4 NURSING OPEN 60, 60 (2017).

308. Rick Anderson, *Cabell's New Predatory Journal Blacklist: A Review*, SCHOLARLY KITCHEN (July 25, 2017), https://scholarlykitchen.sspnet.org/2017/07/25/cabells-new-predatory-journal-blacklist-review/.

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

309. Gregory J. Downey, *Making Media Work: Time, Space, Identity, and Labor in the Analysis of Information and Communication Infrastructures*, *in* MEDIA TECHNOLOGIES: ESSAYS ON COMM., MATERIALITY & SOC'Y 141, 142 (Tarleton Gillespie, Pablo J. Boczkowski & Kirsten A. Foot eds. 2014).

310. *See* Karen Bradshaw Schulz, *Information Flooding*, 48 IND. L. REV. 755, 762–64 (2015). *See generally* MARK ANDREJEVIC, INFOGLUT: HOW TOO MUCH INFORMATION IS CHANGING THE WAY WE THINK AND KNOW (2013).

311. Downey, *supra* note 309, at 143.

312. *Id.*

313. *See, e.g.*, John Naughton, *The Internet: Is It Changing the Way We Think?*, GUARDIAN (Aug. 14, 2010), https://www.theguardian.com/technology/2010/aug/15/internet-brain-neuroscience-debate. *See generally* NICHOLAS CARR, THE SHALLOWS: WHAT THE INTERNET IS DOING TO OUR BRAINS (2010).

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_won_t_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[315] and most never reach the end of a given piece of online content.[316]

Examples bring these startling statistics to life. Hockey legend Gordie Howe received scientifically unproven stem cell treatments in Mexico after suffering a stroke.[317] A press release announcing his stem cell treatment and recovery was released.[318] The press release was then picked up by several news media outlets and then circulated on Twitter.[319] 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."[320] 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.[321] 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.[322]

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.[323] Offering multiple results, as search engines do, can be helpful, but millions of

315. Caitlin Dewey, *6 in 10 of You Will Share This Link Without Reading It, a New, Depressing Study Says*, WASH. POST (June 16, 2016, 7:19 AM), https://www.washingtonpost.com/news/the-intersect/wp/2016/06/16/six-in-10-of-you-will-share-this-link-without-reading-it-according-to-a-new-and-depressing-study/?utm_term=.bd5c28a1cb10 (citing Maksym Gabielkov, Arthi Ramachandran, Augustin Chaintreau & Arnaud Legout, *Social Clicks: What and Who Gets Read on Twitter?*, ACM SIGMETRICS (2016), https://hal.inria.fr/hal-01281190/document).

316. *See* Jordyn Holman, *Why You Probably Won't Finish Reading This Article*, HUFFPOST (May 11, 2015, 5:59 PM), https://www.huffingtonpost.com/jordyn-holman/why-you-probably-wont-finish-reading-this-article_b_6850042.html; Manjoo, *supra* note 314.

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.

322. Dewey, *supra* note 315 (citing *Study: 70% of Facebook Users Only Read the Headline of Science Stories Before Commenting*, SCI. POST (Mar. 5, 2018), http://thesciencepost.com/study-70-of-facebook-commenters-only-read-the-headline/); *see also* David Gee, *Study Confirms Most People Share Articles Based Only on Headlines,* PATHEOS (Sept. 14, 2018), https://www.patheos.com/blogs/nosacredcows/2018/09/study-confirms-most-people-share-articles-based-only-on-headlines (citing Gabielkov et al., *supra* note 315).

323. Caroline L. Osborne, *Programming to Promote Information Literacy in the Era of Fake News*, 46 INT'L J. LEGAL INFO. 101, 103 (2018); Davide S. Levine, *Confidentiality Creep and Opportunistic Piracy*, 20 TUL. J. TECH. & INTELL. PROP. 11, 34–35 (2017).

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

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324. *See* Kai A. Olsen & Alessio Malizia, *Automated Personal Assistants*, 44 COMPUTER 112, 111 (2011).

325. *See* Heather Douglas, *Politics and Science: Untangling Values, Ideologies, and Reasons*, 658 ANNALS AM. ACAD. POL. & SOC. SCI. 296, 300–01 (2015); DOROTHY J. HOWELL, SCIENTIFIC LITERACY AND ENVIRONMENTAL POLICY: THE MISSING PREREQUISITE FOR SOUND DECISION MAKING, at xv (1992).

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.

331. Robin A. Arzón, *Exploring Iraq War News Coverage and a New Form of Censorship in Violation of the Quickly Evaporating Public Interest Requirement and Public Right to Receive Information*, 12 VILL. SPORTS & ENT. L.J. 327, 364 n.248 (2005).

332. Tibor Koltay, *The Media and the Literacies: Media Literacy, Information Literacy, Digital Literacy*, 33 MEDIA, CULTURE & SOC'Y 211, 212 (2011).

moral and social implications.[333] Media literacy also encompasses access to content, particularly technological access, and the potential evolution of information haves and have-nots.[334] Media literacy also addresses content creation and the ability of the creator to improve his or her critical competencies.[335]

Media literacy can be effective in an educational context, whereby teachers instruct students on the effective and critical processing of media-obtained information.[336] Beyond the classroom, media literacy can be improved through private or publicly funded education campaigns.[337] Facebook, for example, is partnering with non-profit group Newseum to improve and distribute media literacy resources.[338] The Center for Media Literacy has developed five core concepts that consumers should ask when encountering new content.[339] The purpose of these concepts and questions is to build a habit for individuals to challenge media messages more effectively and thereby improve understanding.[340] The state of media literacy in the United States is perceived as "bleak" and "dismaying," especially among students.[341] However, media

333. Tarlach McGonagle, *Media Literacy: No Longer the Shrinking Violet of European Audiovisual Media Regulation?*, 20 MEDIA L. & POL'Y 187, 191 (2013).

334. *Id.*

335. *Id.*

336. Elizabeth Thoman & Tessa Jolls, *Media Literacy—A National Priority for a Changing World*, 48 AM. BEHAV. SCIENTIST 18, 21–22 (2004).

337. *Id.* at 22.

338. *Newseum Partners with Facebook on Media Literacy Initiative*, NEWSEUMED (Oct. 6, 2017), https://newseumed.org/news/newseum-partners-facebook-media-literacy-initiative.

339. *Five Key Questions Form Foundation for Media Inquiry*, CTR. FOR MEDIA LITERACY, http://www.medialit.org/reading-room/five-key-questions-form-foundation-media-inquiry/ (last visited Feb. 26, 2021).

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

Id.

340. *Id.*

341. Camila Domonoske, *Students Have 'Dismaying' Inability to Tell Fake News from Real, Study Finds*, NPR (Nov. 23, 2016, 12:44 PM), https://www.npr.org/sections/thetwo-way/2016/11/23/503129818/study-finds-students-have-dismaying-inability-to-tell-fake-news-from-real (quoting SAM WINEBURG, SARAH MCGREW, JOEL BREAKSTONE & TERESA ORTEGA, STAN. HIST. EDUC. GRP., EVALUATING INFORMATION: THE CORNERSTONE OF CIVIC ONLINE REASONING 4–7 (2016), https://stacks.stanford.edu/file/druid:fv751yt5934/SHEG%20Evaluating%20Information%20Online.pdf).

literacy is a long-term solution to a long-term problem,[342] 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.[343] Elevated rates of severe autism emerged in the Somali community, and state and university researchers offered no clear answers.[344] Searching online, parents found anti-vaccine advocates who met with Somali families and fomented a movement against vaccines.[345] This movement, backed by both anti-vaccine and anti-GMO groups,[346] held meetings and educated Somali families on how to refuse vaccinations.[347] Somali parents were told that the MMR vaccine, which is used to prevent child measles, mumps, and rubella, causes autism.[348]

The campaign worked. Somali MMR vaccination rates in Minnesota plummeted from 92% to 42% over a ten-year period.[349] The consequences were significant. In 2017, the Somali-American community experienced one of the worst measles outbreaks in Minnesota history.[350] Seventy-nine cases appeared, mostly amongst Somali-American children in Minneapolis.[351] State officials have rushed to encourage accelerated shot schedules and have considered quarantine orders for anyone exposed to the disease.[352] Some Somali residents still remain uncertain about receiving vaccines.[353] Leading anti-vaccine

342. *See, e.g.*, Seow Bei Yi, *Media Literacy a Long-Term Measure*, STRAITS TIMES (Apr. 1, 2018, 5:00 AM), https://www.straitstimes.com/politics/media-literacy-a-long-term-measure; Rebecca Watson & Lisa M. Vaughn, *Limiting the Effects of the Media on Body Image: Does the Length of a Media Literacy Intervention Make a Difference?*, 14 EATING DISORDERS 385, 395 (2006) (finding that in the context of body image long-term media literacy interventions are more effective than shorter-term counterparts).

343. *See* Kyle Almond, *Somalis Finding Their Place in Minnesota*, CNN, http://www.cnn.com/interactive/2017/02/us/somali-minnesota-photos/ (last visited Feb. 26, 2021).

344. Megan Molteni, *Anti-Vaxxers Brought Their War to Minnesota—Then Came Measles*, WIRED (May 7, 2017, 7:00 AM), https://www.wired.com/2017/05/anti-vaxxers-brought-war-minnesota-came-measles/.

345. *Id.*

346. Mark Zdechlik, *Unfounded Autism Fears Are Fueling Minnesota's Measles Outbreak*, NPR (May 3, 2017, 4:24 PM), https://www.npr.org/sections/health-shots/2017/05/03/526723028/autism-fears-fueling-minnesotas-measles-outbreak.

347. Molteni, *supra* note 344.

348. Lena H. Sun, *Anti-Vaccine Activists Spark a State's Worst Measles Outbreak in Decades*, WASH. POST (May 5, 2017), https://www.washingtonpost.com/national/health-science/anti-vaccine-activists-spark-a-states-worst-measles-outbreak-in-decades/2017/05/04/a1fac952-2f39-11e7-9dec-764dc781686f_story.html?noredirect=on&utm_term=.b2db740876bd.

349. *Id.*

350. *Id.*; *Why Is Minnesota Experiencing the Worst Measles Outbreak in Nearly 30 Years?*, CBS NEWS (May 9, 2017, 12:04 PM), https://www.cbsnews.com/news/minnesota-measles-outbreak-vaccine-misinformation-targeting-somali-americans/.

351. Julia Belluz, *Minnesota's Measles Outbreak Is What Happens When Anti-Vaxxers Target Immigrants*, VOX (Oct. 26, 2017, 12:59 PM), https://www.vox.com/science-and-health/2017/10/26/16552864/minnesotas-measles-outbreak-immigrants-anti-vaxxers.

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.*

355. *See generally* MARK LYNAS, SEEDS OF SCIENCE: WHY WE GOT IT SO WRONG ON GMOS (2018) (chronicling his conversion).

356. Mark Lynas, *Are the Anti-GMO and Anti-Vaccine Movements Merging?*, CORNELL ALL. FOR SCI. (Dec. 6, 2017), https://allianceforscience.cornell.edu/blog/2017/12/are-the-anti-gmo-and-anti-vaccine-movements-merging/.

357. Alex Berezow, *'March Against Monsanto' Is Now an Anti-Vaccine, Conspiracy Movement*, AM. COUNCIL ON SCI. & HEALTH (Sept. 19, 2016), https://www.acsh.org/news/2016/09/19/march-against-monsanto-now-anti-vaccine-conspiracy-movement-10186; *see also* Nick Meyer, *"What Vets Don't Tell You about Vaccines:" University Research Shows Evidence of Serious Harm Caused to Dogs*, MARCH AGAINST MONSANTO (Sept. 19, 2016), https://web.archive.org/web/20180129091902/https://www.march-against-monsanto.com/what-vets-dont-tell-you-about-vaccines-university-research-shows-evidence-of-serious-harm-caused-to-dogs/.

358. Berezow, *supra* note 357; *see also Organic Consumers Association: Activist Trade Group Funding Biogate FOIA Scandal Promotes 'Fear and Deception'?*, GENETIC LITERACY PROJECT (Dec. 31, 2018), https://geneticliteracyproject.org/glp-facts/organic-consumers-association-2/. For a sample of articles from the Organic Consumers Association's website, see All. for Nat. Health, *More Vaccine Mandates for Kids?*, ORGANIC CONSUMERS ASS'N (Feb. 1, 2018), https://www.organicconsumers.org/news/more-vaccine-mandates-kids; Joseph Mercola, *The Vaccine Revolution for Truth*, ORGANIC CONSUMERS ASS'N (May 9, 2017), https://www.organicconsumers.org/news/vaccine-revolution-truth; Joseph Mercola, *Vaccines: Are They Still Contributing to the Greater Good?*, ORGANIC CONSUMERS ASS'N (Nov. 19, 2016), https://www.organic consumers.org/news/vaccines-are-they-still-contributing-greater-good-0.

359. Lynas, *supra* note 356.

360. *See Vaccines Articles*, MERCOLA, https://vaccines.mercola.com/ (last visited Feb. 26, 2021).

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.[362] Both groups mistrust mainstream science,[363] discount contrary scientific studies,[364] and counter with their own questionable research.[365] With Jenny McCarthy, a long-time spokesperson against vaccinations,[366] a variety of celebrities either in support of GMO labeling or against GMOs altogether,[367] both have the backing of fame to popularize their cause.

Conspiracy theories influence both groups.[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.[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.[370]

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362. *See* Greg Miller, *Why the 'Prius Driving, Composting' Set Fears Vaccines*, AM. ASS'N FOR ADVANCEMENT OF SCI. (Jan. 31, 2011, 11:22 AM), http://www.sciencemag.org/news/2011/01/why-prius-driving-composting-set-fears-vaccines. Miller interviewed science writer Seth Mnookin, who commented:

> 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.

Id.

363. *See*, *e.g.*, Dorit Rubinstein Reiss & Lois A. Weithorn, *Responding to the Childhood Vaccination Crisis: Legal Frameworks and Tools in the Context of Parental Vaccine Refusal*, 63 BUFF. L. REV. 881, 946–47 (2015); Susan Johnson, *Genetically Modified Food: A Golden Opportunity?*, 14 SUSTAINABLE DEV. L. & POL'Y 34, 34 (2014).

364. Reiss & Weithorn, *supra* note 363, at 945 ("[V]accine opponents reject or disbelieve studies examining the safety of specific ingredients."); Cassie B., *GMO "Safety" Has Been Systematically and Deliberately Falsified*, NAT. NEWS (Aug. 27, 2017), https://www.naturalnews.com/2017-08-27-gmo-safety-systematically-and-deliberately-falsified.html.

365. *See* Lynas, *supra* note 304 (criticizing Smith, *supra* note 300).

366. *See*, *e.g.*, Jason L. Schwartz, *Unintended Consequences: The Primacy of Public Trust in Vaccination*, 107 MICH. L. REV. FIRST IMPRESSIONS 100, 101 (2009); Joëlle Anne Moreno, *It's Just a Shot Away: MMR Vaccines and Autism and the End of the* Daubertista *Revolution*, 35 WM. MITCHELL L. REV. 1511, 1524 (2009). Jim Carrey has also backed the connection between the MMR vaccine and autism, leading a "Green Our Vaccines" rally in Washington, which included a keynote address by fellow skeptic Robert Kennedy. MNOOKIN, *supra* note 127, at 258; *see also* Moreno, *supra*, at 1524.

367. *See*, *e.g.*, Joel Edwards, *Celebrities Against GMOs*, ORGANIC LIFESTYLE MAG., http://www.organiclifestylemagazine.com/celebrities-against-gmos (Oct. 29, 2015).

368. *See generally* DAVID AARONOVITCH, VOODOO HISTORIES: THE ROLE OF THE CONSPIRACY THEORY IN SHAPING MODERN HISTORY (2010) (discussing how conspiracy theories have impacted major historical events).

369. *University Professor Says Ebola Is a "Genetically Modified, Lab-Made" Virus*, NAT. SOC'Y (July 28, 2015), http://naturalsociety.com/university-professor-says-ebola-is-a-genetically-modified-lab-made-virus/; Mike Adams, *Ebola Conspiracy Theories Abound: GMO Bioweapon? DoD Experiment Gone Wrong? Five Incredible Theories Explored*, NAT. NEWS (Sept. 17, 2014), https://www.naturalnews.com/046915_Ebola_conspiracy_theories_biological_weapons.html.

370. Sarah Kaplan, *The Truth about Vaccines, Autism and Robert F. Kennedy Jr.'s Conspiracy Theory*, WASH. POST (Jan. 10, 2007, 2:40 PM), https://www.washingtonpost.com/news/speaking-of-science/wp/2017/01/10/the-facts-about-vaccines-autism-and-robert-f-kennedy-jr-s-conspiracy-theory/; Nancy Shute, *Half of Americans Believe in Medical Conspiracy Theories*, NPR (Mar. 19, 2014, 3:25 PM), https://www.npr.org/sections/health-shots/2014/03/19/291405689/half-of-americans-believe-in-medical-conspiracy-theories;

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

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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.").

371. *See, e.g.*, *About Health Liberty*, HEALTH LIBERTY, http://www.health-liberty.org/sites/healthliberty/about-healthliberty.aspx (last visited Feb. 26, 2021) (claiming an apparent coalition between anti-GMO, anti-vaccine, anti-fluoride, and other groups).

372. *Two Killed in Shoot-Out at Syngenta GM Farm*, SWISSINFO.CH (Oct. 23, 2007), https://www.swissinfo.ch/eng/two-killed-in-shoot-out-at-syngenta-gm-farm/6208040.

373. Jennifer Raff, *The "Health Ranger" Crosses the Line, Then Backpedals*, VIOLENT METAPHORS (July 26, 2014), https://violentmetaphors.com/2014/07/26/mike-adams-goes-too-far/.

374. Keith Kloor, *Mike Adams Escalates His Ugly Anti-GMO Campaign*, DISCOVER (July 24, 2014, 11:10 AM), http://www.discovermagazine.com/environment/mike-adams-escalates-his-ugly-anti-gmo-campaign (discussing the article).

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.[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.[377] Pro-vaccine opinions have been censored in blogs and online community forums.[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.[379] Another blogger was forcibly silenced when a critic complained to his employer about his pro-vaccine viewpoints.[380] One prominent critic was sued for libel, labeled with the term "biostitute" (a bioscience prostitute), and received death threats.[381] After Seth Mnookin authored *The Panic Virus: A True Story of Medicine, Science, and Fear*, a book criticizing the anti-vaccine movement and its proponents,[382] his journalistic integrity was attacked.[383] For Thanksgiving, he was photoshopped with two other vaccine advocates "sitting down to a dinner of a dead baby."[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 scaremongering and anti-GMO activism, all increasingly under the same banner.[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.

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376. Antonia Noori Farzan, *'Yeah, I Pushed You': Anti-Vaxxer Cited for Assaulting Lawmaker While Live-Streaming on Facebook*, WASH. POST (Aug. 22, 2019, 3:59 AM), https://www.washingtonpost.com/nation/2019/08/22/yeah-i-pushed-you-anti-vaxxer-cited-assaulting-lawmaker-while-live-streaming-facebook/.

377. Elizabeth Cohen & John Bonifield, *Her Son Died. And Then Anti-Vaxers Attacked Her*, CNN (Mar. 21, 2019, 2:47 PM), https://www.cnn.com/2019/03/19/health/anti-vax-harassment-eprise/index.html.

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).

379. *Id.*

380. *Id.*

381. *Id.*

382. *Id.* (citing MNOOKIN, *supra* note 127); *see also* Abigail Zuger, *Defending Vaccination Once Again, With Feeling*, N.Y. TIMES (Mar. 28, 2011), https://www.nytimes.com/2011/03/29/health/views/29zuger.html (reviewing Mnookin's book).

383. Kata, *supra* note 378, at 3782.

384. *Id.*

385. Mark Lynas, *Anti-GMO and Anti-Vaccination Campaigns—Two Faces of the Same Movement?*, MARK LYNAS: ENV'T NEWS & COMMENT (Mar. 30, 2016), http://www.marklynas.org/2016/03/anti-gmo-anti-vaccination-campaigns-two-faces-movement/.

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.

386. CARL SAGAN, THE DEMON-HAUNTED WORLD: SCIENCE AS A CANDLE IN THE DARK 25 (1996).

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