

2022

Terrified by Technology: How Systemic Bias Distorts U.S. Legal and Regulatory Responses to Emerging Technology

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TERRIFIED BY TECHNOLOGY: HOW SYSTEMIC BIAS DISTORTS U.S. LEGAL AND REGULATORY RESPONSES TO EMERGING TECHNOLOGY

Steve Calandrillo*
Nolan Kobuke Anderson**

“Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less.”

—Marie Curie

Americans are becoming increasingly aware of the systemic biases we possess and how those biases preclude us from collectively living out the true meaning of our national creed. But to fully understand systemic bias we must acknowledge that it is pervasive and extends beyond the contexts of race, privilege, and economic status. Understanding all forms of systemic bias helps us to better understand ourselves and our shortcomings. At first glance, a human bias against emerging technology caused by systemic risk misperception might seem uninteresting or unimportant. But this Article demonstrates how the presence of systemic bias anywhere, even in an area as unexpected as technology regulation, creates inefficiencies and inequalities that exact heavy costs in the form of human lives, standards of living, and lost economic opportunities. The decision to regulate or implement an emerging technology, like any other complex decision, naturally involves some form of cost-benefit or risk-reward analysis. However, in the context of emerging technology, that analysis is biased by systemic risk misperception. Immutable characteristics existing in emerging technology combine with interrelated characteristics in human decisionmakers and regulators to inflate perceptions of risks and depress perceptions of benefits. This artificial shifting of cost-benefit curves results in suboptimal legislative and regulatory responses to emerging technology, and ultimately, in the loss of American lives.

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The authors are grateful for the excellent insight and comments of Scott Launius, Chryssa Deliganis, Jonathan Moskow, Irwin Yoon, Alyse Merritt, George Webb, James Anderson, Louise Anderson, and Sophia Calandrillo. Thanks as well to the Jeffrey & Susan Brotman Professorship for its generous financial support.

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I. INTRODUCTION

Technology saves lives.¹ Yet our legislative and regulatory responses to emerging technologies often reflect feelings of trepidation and irrationality rather than wonder and excitement. Many of us fear new technology.² Some even hate it.³ Why? Examples of technology saving and improving lives are legion but so are examples of human distrust of technology. What is it about emerging technology that causes us to systematically and consistently misperceive the risk that it poses to society? Articles and studies dealing with the causes of risk misperception are a dime a dozen, but few have sought to explain how those factors target emerging technology in an invidious and particularized manner. That is the task this Article confronts head on.

Our predisposition to oppose new technology stems in part from how our brains are hardwired. The shortcuts and heuristics that our brains rely on to navigate everyday life can cause us to formulate biases against new technology that threaten to disturb the status quo.⁴ Moreover, these heuristics interact with characteristics inherent to emerging technologies to bias us even further. Systemic technological risk misperception, as we call it, causes us to inflate perceived risks associated with a given technology and clouds our perceptions of the benefits that technology promises to offer. In other words, it shifts the perceived cost curve higher and depresses the perceived benefit curve lower. Because we live in a democracy with millions of individual decisionmakers, this human bias against emerging technology inevitably percolates into the highest levels of government. The end product is deadweight loss resulting from suboptimal decision-making, legislative and regulatory overreaction, and an accompanying decrease in social welfare.

This is not an academic problem. Systemic technological risk misperception is deadly. When legislators or regulators restrict or refuse to implement a piece of technology as a result of risk misperception, we lose the opportunity to save lives, improve lives, and maintain our position on the world stage as a leader in technological development. Unfortunately, because the consequences come in the form of lost benefits and opportunities, the high toll it exacts is not always readily apparent. We are able to lull ourselves into a false sense of security by telling ourselves that it is “better to be safe than sorry.” Sadly, this simple maxim frequently proves perverse with respect to technological implementation and its regulation.

1. See V. P. Weinberger, C. Quiñáno & P. A. Marquet, *Innovation and the Growth of Human Population*, 372 PHIL. TRANSACTIONS ROYAL SOC'Y B 1, 1–2 (2017) (discussing the impact of technology on the maximum sustainable population of the Earth).

2. See Odai Y. Khasawneh, *Technophobia: Examining Its Hidden Factors and Defining It*, 54 TECH. SOC'Y 93, 94 (2018) (defining technophobia).

3. See Roisin Kiberd, *Burn It All Down: A Guide to Neo-Luddism*, GIZMODO (Jan. 28, 2015, 11:40 AM), <https://gizmodo.com/the-many-faces-of-neo-luddism-1682139778> [<https://perma.cc/PV46-7L9J>] (defining various forms of neo-luddism ranging from sensible to violent).

4. For a background on cognitive biases and heuristics, see the foundational work of Amos Tversky and Daniel Kahneman. See generally Amos Tversky & Daniel Kahneman, *Judgment Under Uncertainty: Heuristics and Biases*, 185 SCI. 1124 (1984).

Fortunately, as we continue to learn more about cognitive biases and heuristics, we have discovered that they are not shackles that bind human decision-makers and regulators.⁵ There are affirmative measures that each and every one of us can take to mitigate the effects of our own misperceptions and overcome the shortcomings of our subconscious.⁶ There are also legal and structural changes that we can adopt in order to insulate the decision-making process from systemic risk misperception.⁷ However, it is important to understand that the first step in solving a problem is recognizing that there is one. That is the primary contribution of this Article. Only after we accept the presence of systemic technological risk misperception inside each and every one of us, can we then begin the hard work of counteracting its effects on our decisional processes.

To that end, Part II of this Article recounts classical examples of both risk under-perception and risk over-perception outside the context of emerging technology, including our nation's close call with thalidomide, our fundamental misunderstanding of the risks associated with flying, and our panicked responses to perceived threats to child safety. Part III examines how characteristics inherent to human cognition pair with characteristics inherent to emerging technologies to create a recipe for systemic risk misperception. Part IV highlights the insidious nature of the costs that systemic technological risk misperception produces. Part V proposes a two-pronged remedial approach designed to shelter both individual and governmental decision-making from the impacts of systemic technological risk misperception in order to unleash the welfare-enhancing effects that technology can offer our society.

II. HISTORICAL EXAMPLES OF RISK MISPERCEPTION

Humans are notoriously bad at processing and assessing risk.⁸ Examples of this cognitive deficiency are commonplace, such as the tendency to fear flying but not driving.⁹ Risk misperception manifests itself in two ways: under-perception and over-perception. Generally speaking, when humans under-perceive the risk of some new technology or product, they will likely implement that technology or product before it is ready for safe consumption. This inefficient introduction can result in economic costs and in some cases the preventable loss of life. Conversely, when humans over-perceive the risks associated with a new

5. *See id.* at 1131.

6. *See infra* Part V.

7. *See infra* Part V.

8. *See, e.g.,* Steve P. Calandrillo, *Responsible Regulation: A Sensible Cost-Benefit, Risk Versus Risk Approach to Federal Health and Safety Regulation*, 81 B.U. L. REV. 957, 998–1002 (2001) (“Although [some] risks can be calculated with reasonable certainty, the public’s perception of their frequency and their severity is often highly inaccurate.”); W. Kip Viscusi, *Valuing Risk of Death from Terrorism and Natural Disasters*, 38 J. RISK & UNCERTAINTY 191, 210–11 (2009) (comparing the disparate valuations of different sources of risk); W. KIP VISCUSI, JOSEPH E. HARRINGTON JR. & JOHN M. VERNON, *ECON. OF REGUL. & ANTITRUST* (5th ed. MIT Press 2005); Cass R. Sunstein & Richard Zeckhauser, *Overreaction to Fearsome Risks*, 48 ENV’T & RES. ECON. 435 (2011).

9. *See, e.g.,* Garrick Blalock, Vrinda Kadiyal & Daniel H. Simon, *Driving Fatalities After 9/11: A Hidden Cost of Terrorism*, 41 APPLIED ECON. 1717, 1717 (2009).

technology or product, they will often delay or even prohibit implementation.¹⁰ Inhibiting market introduction results in costs of a more insidious sort.¹¹ These costs come in the form of lost opportunities: to generate revenue, for example, or to improve lives or prevent needless deaths.¹² The examples below, some historical and some more recent, help to illustrate the operation of risk misperception and its serious costs to society's overall welfare.

A. *The Costs of Risk Under-Perception*

While this Article is primarily concerned with risk over-perception as it relates to emerging technologies, it should be noted that risk under-perception exacts equally prohibitive costs. In fact, as the below examples demonstrate, risk under-perception can often lead to subsequent risk over-perception, thus compounding the costs. When under-perception of risks results in premature implementation or introduction of a product or technology, the consequences can be catastrophic. This can lead to a pervasive sense of distrust or fear in the minds of consumers, which in turn causes many to avoid the emerging technology or product altogether, even after its flaws have been addressed.

1. *America's Close Call: Thalidomide*

America's close call with the teratogen thalidomide offers a salient example of the costs associated with risk under-perception.¹³ In 1957, a West German pharmaceutical company introduced a newly synthesized sleep aid, thalidomide.¹⁴ It was touted as a "wonder drug . . . in the treatment of a range of conditions, in particular morning sickness."¹⁵ In the fall of 1960, William S. Merrell Company sought approval to introduce the drug to the American market.¹⁶ "[S]ince thalidomide was already widely used, the [approval] was thought to be routine . . ."¹⁷ In fact, thalidomide was considered so safe that a doctor need not write a prescription for its consumption.¹⁸

The task of reviewing the New Drug Application ("NDA") was dropped in the lap of a greenhorn FDA medical officer, Dr. Francis Kelsey, for her rubberstamp.¹⁹ However, after careful review revealed several discrepancies and omissions in the NDA, the young doctor refused to approve the drug.²⁰ Merrell

10. Calandrillo, *supra* note 8, at 965.

11. *See id.* at 970.

12. *Id.* at 1031–32.

13. *See* Lisa A. Seidman & Noreen Warren, *Frances Kelsey & Thalidomide in the US: A Case Study Relating to Pharmaceutical Regulations*, 64 AM. BIOLOGY TCHR. 495, 499 (2002).

14. *Id.* at 497.

15. Neil Vargesson, *Thalidomide Embryopathy: An Enigmatic Challenge*, ISRN DEVELOPMENTAL BIOLOGY 1, 1 (2013) (discussing how eagerness to introduce a new medicine into the market caused serious adverse health effects).

16. Seidman & Warren, *supra* note 13, at 497.

17. *Id.*

18. *Id.*

19. *See id.*

20. *See id.* at 497–98.

responded by launching a pressure campaign against Dr. Kelsey and her superiors.²¹ As she recalled, “[t]hey came to Washington, it seemed, in droves They wrote letters and . . . [t]hey telephoned my superiors and they came to see them too. Most of the things they called me you wouldn’t print.”²²

Meanwhile, reports from Europe were beginning to trickle in that thalidomide was causing nerve deterioration in the extremities of long-term users.²³ Then, finally, came the bombshell that the Germans were taking the drug off the market because it was causing congenital defects.²⁴ In the end, “anywhere from 8,000 to 80,000 thalidomide-deformed babies were born in Europe.”²⁵ Dr. Kelsey “undoubtedly prevented an epidemic of thalidomide-induced birth defects in the USA,”²⁶ as Merrell had already imported five tons of thalidomide just waiting for the moment of FDA approval.²⁷ For her profile in courage, Dr. Kelsey was awarded the President’s Award for Distinguished Federal Civilian Service by President John F. Kennedy.²⁸

This close call demonstrates the heavy costs that occur when risk under-perception leads to premature implementation of a new product. Thalidomide no doubt offered, and continues to offer, significant benefits in treating ailments other than morning sickness,²⁹ but its suboptimal implementation in Europe resulted in deadweight loss to society and unnecessary pain and suffering on the part of the affected families.³⁰ In an irony that perfectly encapsulates humankind’s inability to weigh risk accurately, it appears that this highly visible example of risk under-perception now leads physicians³¹ and their pregnant patients³² to *over*-perceive the risk of a teratogenic birth. Insofar as this risk over-perception results in a suboptimal treatment of pregnant women, the legacy of thalidomide continues to exact social costs.³³

21. *Id.* at 498.

22. John Mulliken, *A Woman Doctor Who Would Not Be Hurried*, LIFE 28 (Aug. 10, 1962).

23. Seidman & Warren, *supra* note 13, at 498.

24. *See id.*

25. *Id.*

26. Vargesson, *supra* note 15, at 1.

27. Seidman & Warren, *supra* note 13, at 497.

28. Vargesson, *supra* note 15, at 1.

29. *See id.* at 2.

30. *See id.* at 1.

31. *See generally* Christine Damase-Michel, Juliette Pichereau, Atul Pathak, Isabelle Lacroix & Jean Louis Montastruc, *Perception of Teratogenic and Foetotoxic Risk by Health Professionals: A Survey in Midi-Pyrenees Area*, 6 PHARM. PRAC. 15, 17 (2008) (discussing misperception of teratogenic risk in doctors).

32. *See, e.g.*, Marco De Santis et al., *Use of the Internet by Women Seeking Information About Potentially Teratogenic Agents*, 151 EUR. J. OBSTETRICS & GYNECOLOGY & REPROD. BIOLOGY 154, 155 (2010); Irene Peterson, Rachel L. McCrea, Angela Lupattelli & Hedvig Nordeng, *Women’s Perception of Risks of Adverse Fetal Pregnancy Outcomes: A Large-Scale Multinational Survey*, 5 BMJ OPEN 1, 1 (2015); Hedvig Nordeng, Eivind Yström & Adrienne Einarsen, *Perception of Risk Regarding the Use of Medications and Other Exposures During Pregnancy*, 66 EUR. J. CLINICAL PHARMACOLOGY 207 (2010) (discussing misperception of teratogenic risks by pregnant women).

33. *See* Petersen et al., *supra* note 32, at 7.

2. *A Modern Analogue: Boeing 737 MAX*

Consumers currently over-perceive the risk of defect in new plane models but under-perceive the growing risk of pilot error and inadequate maintenance. Airplanes are safer than ever before; the reverse is true of pilots.³⁴ And yet, consumers and politicians are unable to apportion risk accordingly.³⁵ In fact, consumers are largely unaware of the risks posed by decreasing pilot acumen and inadequate maintenance in foreign budget airlines.³⁶ The rhetoric surrounding the Boeing 737 MAX's grounding demonstrates this phenomenon perfectly.³⁷

Most readers familiar with the tragic crashes of Lion Air Flight 610 and Ethiopian Airlines Flight 302 will likely recognize the narrative of how Boeing cut corners in a rush to bring the new plane to market and how the Federal Aviation Administration ("FAA") abdicated its regulatory duties, causing the deaths of 346 passengers.³⁸ The images of the Boeing CEO's bipartisan lambasting before Congress will not soon fade from the national memory.³⁹ For many consumers, the narrative largely begins and ends with Boeing.⁴⁰ To be sure, Boeing failed airlines and passengers alike.⁴¹ Massively. But as is so often the case, there is more to the story.⁴²

In his provocative and controversial *New York Times* feature, pilot and aviation journalist William Langewiesche, calls attention to consumers' ignorance surrounding the risks associated with flying.⁴³ In the rush to adopt a narrative placing the lion's share of the blame on Boeing, consumers are largely oblivious to Lion Air's share.⁴⁴ Here, context is crucial.

Unbeknown to most consumers, there has been a silent, creeping trend in the aviation industry that represents a substantial source of risk.⁴⁵ As air travel becomes increasingly democratized, the demand for pilots has risen

34. See Chris Palmer, *The Boeing 737 MAX Saga: Automating Failure*, 6 ENG'G 2, 3 (2020) (explaining how the increase in automation has led to a decrease in skilled pilots).

35. See William Langewiesche, *What Really Brought Down the Boeing 737 Max?*, N.Y. TIMES (Jan. 21, 2020), <https://www.nytimes.com/2019/09/18/magazine/boeing-737-max-crashes.html> [<https://perma.cc/2R58-MWVG>].

36. See *id.*

37. *Id.*

38. See *id.*

39. See Brianna Gurciullo, *Boeing's CEO Takes Bipartisan Heat in Second 737 MAX Hearing*, POLITICO (Oct. 30, 2019, 3:40 PM), <https://www.politico.com/news/2019/10/30/boeing-ceo-bipartisan-heat-hearing-061952> [<https://perma.cc/64YV-UES2>].

40. See *id.*

41. See Peter Robison, *Boeing Built an Unsafe Plane, and Blamed the Pilots When it Crashed*, (November 16, 2021), <https://www.bloomberg.com/news/features/2021-11-16/are-boeing-planes-unsafe-pilots-blamed-for-corporate-errors-in-max-737-crash> [<https://perma.cc/ZE4A-KXG2>].

42. See Langewiesche, *supra* note 35.

43. *Id.*

44. See *id.* But see Robison, *supra* note 41 (arguing Boeing unfairly placed the blame on Lion Air).

45. See Palmer, *supra* note 34, at 3.

dramatically.⁴⁶ This has led to a drop in the average pilot's skills.⁴⁷ Manufacturers like Boeing and Airbus have responded to this decrease in airmanship by attempting to automate pilot error out of the equation.⁴⁸ This led to "a decades-long transformation . . . in which airplanes became so automated and accidents so rare that a cheap air-travel boom was able to take root around the world."⁴⁹ Unfortunately, this means that in the rare instances where automation fails, pilots are now ill-trained to meet the task.⁵⁰ "The more automation there is, the less pilots get to fly manually, making them less capable of dealing with emergencies."⁵¹

Langewiesche points out that Boeing's job is made impossibly difficult by the decisions of foreign budget airlines, like Lion Air, to compromise their training and internal procedures in the pursuit of razor-thin margins.⁵² He describes Lion Air as a prime example of the "challenges facing airline safety."⁵³ It has a history of pushing deregulation, corrupting government officials, pressuring flight crews to keep unsafe planes in the air, and paying employees meager wages for longer hours.⁵⁴ He goes on to explain how the pilots' actions prior to the crashes of both planes were "textbook failure[s] of airmanship."⁵⁵ Furthermore, the plane had been experiencing problems over the course of three days leading up to Lion Air Flight 610.⁵⁶ In the flight immediately preceding the crash an "off-duty pilot hitching a ride on that earlier flight correctly diagnosed [and rectified] the [exact same] problem . . ."⁵⁷ A "replacement [angle-of-attack] sensor that was installed [by Lion Air maintenance] on the accident aircraft had been mis-calibrated during an earlier repair."⁵⁸ This mis-calibrated sensor in turn was feeding erroneous data to the Boeing software which regulators argue did not have enough redundancies.⁵⁹ In what Langewiesche describes as an act of "grotesque

46. *Id.*

47. Jack Nicas & Zach Wichter, *A Worry for Some Pilots: Their Hands-On Flying Skills Are Lacking*, N.Y. TIMES (Mar. 14, 2019), <https://www.nytimes.com/2019/03/14/business/automated-planes.html> [<https://perma.cc/6Q2H-LC9X>] ("Pilots now spend more time learning these automated systems than practicing hands-on flying, so newer pilots are less comfortable with taking manual control when the computer steers them wrong, according to interviews with a dozen pilots and pilot instructors at major airlines and aviation universities around the world.").

48. *See* Langewiesche, *supra* note 35.

49. *Id.*

50. *See id.*; Palmer, *supra* note 34, at 3.

51. Palmer, *supra* note 34, at 3 (quoting Carlos Varela, associate professor of computer science at Rensselaer Polytechnic Institute); *see also* Nicas & Wichter, *supra* note 47.

52. *See* Langewiesche, *supra* note 35.

53. *Id.*

54. *See id.*

55. *Id.* *But see* Robison, *supra* note 41 (implying that racism and xenophobia contribute to the decision to apportion blame to Lion Air's pilots).

56. *See* Langewiesche, *supra* note 35 ("[Th]e story actually starts three days before the accident, when the same airplane . . . experienced errors in airspeed and altitude indications . . . that weren't properly addressed.").

57. Palmer, *supra* note 34, at 2.

58. National Transportation Safety Committee, Aircraft Accident Investigation Report 215 (2018), http://knkt.dephub.go.id/knkt/ntsc_aviation/baru/2018%20-%20035%20-%20PK-LQP%20Final%20Report.pdf [<https://perma.cc/V8Q8-NH9Y>].

59. *Id.*

negligence,” Lion Air’s maintenance crew ran a few cursory tests and cleared the plane for takeoff.⁶⁰

Langewiesche’s conclusion that “it was the decisions made by four of those pilots, more than the failure of a single obscure component, that led to 346 deaths . . .”⁶¹ has faced strong criticism from many aviation insiders, including Captain Chesley “Sully” Sullenberger.⁶² But the most damning and concerning portions of Langewiesche’s piece are not his conclusions that fault lay primarily with the pilots. Rather, it is his unrefuted⁶³ descriptions of the inner-workings of a budget airline that are most alarming.⁶⁴ They represent a disturbing source of risk that is almost entirely absent from the narrative surrounding the risks of flying in general, let alone flying in a 737 MAX.

The inability of consumers to adequately recognize the different sources of risk that contribute to a catastrophic accident means they cannot apportion blame with precision. Because blame is not being apportioned correctly, prescriptive resources cannot be allocated in an efficient manner that takes into account all sources of risk. This over-perception of the risk posed by manufacturing failures and under-perception of the risks posed by airline company and employee malpractice exacts immense costs in terms of dollars and lives.⁶⁵ As the 737 MAX returns to the air, Boeing has suffered \$20 billion in losses, including a \$2.5 billion dollar criminal settlement.⁶⁶ The true economic costs of this backlash against Boeing will likely extend much further.⁶⁷ Meanwhile, Lion Air continues to operate flights.

60. See Langewiesche, *supra* note 35.

61. *Id.*

62. See Chesley “Sully” Sullenberger, *My Letter to the Editor of New York Times Magazine*, SULLY SULLENBERGER (Oct. 13, 2019), <http://www.sullysullenberger.com/my-letter-to-the-editor-of-new-york-times-magazine/> [<https://perma.cc/RS9T-MSG4>].

63. Even Captain Sullenberger, in his critique of Langewiesche, acknowledged that “[i]nadequate pilot training and insufficient pilot experience are problems worldwide . . .” *Id.* (emphasis added). This is alarming and largely unknown to the general public.

64. See Langewiesche, *supra* note 35 (describing “an onrush of inexperienced pilots willing to work long hours for low pay; discouragement among mechanics, ramp workers and dispatchers; pressure to keep airplanes flying despite component failures that should have grounded them; the falsification of cargo and passenger manifests; dual maintenance and flight logs; and corruption permeating the entire system, including even air-traffic control.”).

65. Leslie Josephs, *Boeing to Pay More than \$2.5 Billion to Settle Criminal Conspiracy Charge over 737 Max*, CNBC (Jan. 8, 2021, 8:37 AM), <https://www.cnbc.com/2021/01/07/doj-fines-boeing-over-2point5-billion-charges-it-with-fraud-conspiracy-over-737-max-crashes.html> [<https://perma.cc/C8SC-VH84>]; Langewiesche, *supra* note 35.

66. Josephs, *supra* note 65.

67. See, e.g., Dominic Gates, *Boeing Reports Worst Full-Year Loss in Its History, but CEO Calhoun Vows ‘We’ll Get Through It’*, SEATTLE TIMES (Jan. 29, 2020, 4:40 PM), <https://www.seattletimes.com/business/boeing-aerospace/boeing-doubles-the-projected-cost-of-the-737-max-grounding-to-18-4-billion/> [<https://perma.cc/GJ6N-2A26>].

Examples of risk under-perception are legion. Whether it be failing to get a flu shot⁶⁸ or persisting in a red meat diet,⁶⁹ humans have an uncanny ability to minimize their perceptions of certain risks. As seen in the examples above, this under-perception of risk can often lead to a catastrophic event, causing consumers to over-perceive risk for years, even decades, after the event. This seesaw effect exacts tremendous social and economic costs. When new technologies and products are introduced too soon, as with thalidomide and the 737 MAX, lives can be cut short and companies can be left battered.⁷⁰ But when subsequent risk over-perception prevents these technologies from entering the market when they are ready or for a different, safer application, the costs can be much more insidious.

B. *The Costs of Risk Over-Perception*

As evidenced by the 737 MAX example, risk perception can sometimes approximate a zero-sum game. By under-perceiving the risk of pilot error, flyers and regulators over-perceive the risk of design failure. But the nature of risk over-perception is fundamentally different from under-perception. Typically, risk over-perception causes decisionmakers to maintain the status quo (*i.e.*, preventing or delaying implementation of a new technology) for fear of an unknown risk or to choose an alternative that might have equally unknown consequences.⁷¹ Consequently, the costs associated with over-perception tend to be more incidental and insidious because the risks that are over-perceived, and thus protected against, are typically the most obvious and apparent ones.⁷² As the examples below demonstrate, the costs associated with maintaining the status quo or opting for a more comfortable alternative can be quite difficult for most people to comprehend.

68. *Estimates of Flu Vaccination Coverage Among Children—United States, 2017–18 Flu Season*, CTRS. FOR DISEASE CONTROL & PREVENTION (Sept. 27, 2018), <https://www.cdc.gov/flu/fluview/coverage-1718estimates-children.htm> [<https://perma.cc/9RVS-YWV8>] (estimating flu vaccination coverage among children at 57.9%); *Estimates of Influenza Vaccination Coverage among Adults—United States, 2017–18 Flu Season*, CTRS. FOR DISEASE CONTROL & PREVENTION (Oct. 25, 2018), <https://www.cdc.gov/flu/fluview/coverage-1718estimates.htm> [<https://perma.cc/7C7K-PF4C>] (estimating flu vaccination coverage among adults at 37.1%).

69. See Frank Qian, Matthew C. Riddle, Judith Wylie-Rosett & Frank B. Hu, *Red and Processed Meats and Health Risks: How Strong Is the Evidence?*, 43 *DIABETES CARE* 265, 269 (2020) (“While more evidence regarding the health effects of red and processed meats is needed, the body of epidemiologic data showing their associations with type 2 diabetes, [cardiovascular disease], and cancer is large and consistent.”); see also Rui Gasper et al., *Consumers’ Avoidance of Information on Red Meat Risks: Information Exposure Effects on Attitudes and Perceived Knowledge*, 19 *J. RISK RSCH.* 533, 544 (2016) (“[I]nformation avoidance appears to protect people against [cognitive] dissonance by shielding attitudes toward red meat from information on risk that may be inconsistent with consumers’ positive views of it.”).

70. See Seidman & Warren, *supra* note 13, at 500; Langewiesche, *supra* note 35.

71. See, e.g., Calandrillo, *supra* note 8, at 965.

72. See *id.* at 961.

1. School Bus Regulation

In their book, *The Struggle for Auto Safety*, Jerry Mashaw and David Harfst differentiate between “near opposite ends of a [legislative] continuum ranging from autocratic control to populist uprising.”⁷³ In the former, congressional committees, working with interest groups, pass regulation without much public debate.⁷⁴ In the latter, “dissenting committees with jurisdictional authority are circumvented by new players who use general public sentiment to move a Congress acting as a committee of the whole. *Public demand is neither suppressed nor mediated by expertise.*”⁷⁵ In their section on school bus regulation, they explain how public over-perception of the risks associated with school busses resulted in a more populist form of lawmaking.⁷⁶ “Instead of protecting and rewarding expert judgment, the committees ultimately embraced the passions of legislative and administrative outsiders”⁷⁷

In the 1960s and 70s, a movement for school bus safety began snowballing after some members of Congress—whose districts had experienced school bus tragedies—and some physicians groups began to call for heightened safety in school transportation.⁷⁸ Mashaw and Harfst explain that this “movement’ had the usual emotional appeal of any group seeking to protect children” and was “armed with descriptions of gruesome accidents.”⁷⁹

There was just one problem for these activists. The National Highway Traffic Safety Administration (“NHTSA”) had studied the issue extensively and determined the costs outweighed the benefits.⁸⁰ At the time, the rules that Congress was considering adopting would only address thirty child fatalities.⁸¹ Meanwhile, the changes would increase the cost of school busses by twenty-five percent nationwide.⁸² Moreover, these measures actually offered to create perverse substitution risks. The “costs were so substantial that further measures might actually reduce school bus safety . . .” because districts would elect to keep older, unsafe buses on the road for longer.⁸³ Nevertheless, senators and representatives alike condemned the NHTSA for even engaging in cost-benefit analysis in the context of child safety, going so far as to threaten congressional investigation of the agency.⁸⁴

As Congress lurched toward adoption of the measures, Mashaw and Harfst explain that “it was obvious that regulatory officials had badly botched their

73. JERRY L. MASHAW & DAVID L. HARFST, *THE STRUGGLE FOR AUTO SAFETY* 141 (1990).

74. *See id.*

75. *Id.* (emphasis added).

76. *See id.* at 141–42.

77. *Id.*

78. *See id.* at 142.

79. *Id.*

80. *Id.*

81. *See id.*

82. *See id.* at 143.

83. *Id.*

84. *See id.* at 143–44.

assessment of the costs and benefits of school bus safety.”⁸⁵ But not for the reason that one might think. Their calculations were rational and reasonable, and their recommendations reflected careful analysis and weighing of the pros and cons.⁸⁶ According to Mashaw and Harfst, their mistake was that “[t]hey had confused economics with politics. In the political process and in the media, sober cost-benefit calculations are about as popular as rich, absentee slumlords.”⁸⁷ They had also failed to account for widespread risk over-perception among the public and its legislators when it came to child safety.⁸⁸

It would seem that risk misperception in this instance was also zero-sum. The over-perception of school bus risk was accompanied by an under-perception of passenger vehicle risk. “If Congress wanted to protect the lives of children, it would have done better to reenergize NHTSA’s lagging [regulation of passenger vehicles].”⁸⁹ As will be discussed later in this Article, “[e]ven modest safety enhancement[s] would [have] decrease[d] the risk of death or serious injury for tens of thousands of children”⁹⁰ There is no clearer showing of the deadly implications of risk misperception.

2. *Child Restraint Regulations in Commercial Flights*

Some child safety advocates have long lobbied for the FAA to adopt regulations requiring all children to wear some sort of restraint on commercial flights.⁹¹ These restrictions would require families to purchase additional tickets for infants.⁹² While advocates of the regulations over-perceive the risk of injury or death to unrestrained infants, they under-perceive the costs associated with implementing such a policy. By requiring families to purchase an additional seat for their infant, many of those families will be priced out of the market for air travel.⁹³ As an alternative, these less-wealthy families may choose a more economical, yet more dangerous, method of transportation: driving. The resulting deaths caused by the perverse incentive to take to the highways instead of the airways (*i.e.*, the substitution risk) would likely outweigh any lives saved by the restraint policy.⁹⁴

In November of 2001, the American Academy of Pediatrics (“AAP”) issued a policy statement advocating for a new FAA regulation that would require all children to be restrained.⁹⁵ Under existing regulations, children under the age

85. *Id.* at 144.

86. *See id.*

87. *Id.*

88. *See id.*

89. *Id.* at 146.

90. *Id.*

91. *See FAA Once Again Dances Around Mandatory Child Restraint Issue*, 8 AIR SAFETY WEEK, Oct. 3, 1994 (detailing previous attempts to mandate child restraints).

92. Thomas B. Newman, Brian D. Johnston & David C. Grossman, *Effects and Costs of Requiring Child-Restraint Systems for Young Children Traveling on Commercial Airplanes*, 157 ARCHIVES PEDIATRIC ADOLESCENT MED. 969, 969 (2003).

93. *Id.*

94. *Id.*

95. *See American Academy of Pediatrics, Restraint Use on Aircraft*, 108 PEDIATRICS 1218, 1218 (2001).

of two were allowed to be held in an adult's lap throughout the flight.⁹⁶ Historically, the FAA had declined to alter this rule because it would "result in more injuries and deaths to infants and toddlers because parents would not be willing to buy a ticket to reserve a seat for the infant and would opt to travel by car instead"⁹⁷ The AAP argued no data supported the FAA's claim.⁹⁸ Meanwhile, the AAP's own data recognized that the risk of flying in general was "exceedingly small."⁹⁹ At the time, it was "estimated that 4.6 million children younger than 2 years fly on US domestic airlines annually"¹⁰⁰ While the AAP's data supported the contention that unrestrained infants had a higher relative mortality risk than restrained adults, it could not determine "whether the higher risk of mortality for infants was attributable to lack of restraint use, fragility of infants, or both."¹⁰¹

In response to the AAP's proposal, pediatricians from the University of California, San Francisco and the University of Washington defended the FAA's reasons for declining to require the child restraints.¹⁰² They began by pointing out that the AAP policy statement "did not present any analysis of the numbers of lives that might be saved by [their proposed] policy or the policy's costs."¹⁰³ "Using available data on the risk of fatalities from air travel and the survivability of crashes and reasonable assumptions," they went on to supply the cost-benefit analysis that the AAP had omitted.¹⁰⁴ The doctors estimated the AAP's policy would prevent an average of 0.4 deaths per year.¹⁰⁵ Altering their base assumptions, they estimated the number could range from .05 to 1.6 deaths per year.¹⁰⁶ On the other hand, they found that the proposed policy would result in a net increase in deaths if just five to ten percent of families chose automobile travel instead of flying.¹⁰⁷ "Even if the policy led to no increase in car travel and cost only \$20 per round trip per young child, the cost per life saved would be about \$4.3 million per discounted life-year."¹⁰⁸ Ultimately, the FAA yielded to the science and sided against the AAP.¹⁰⁹

As with most studies of this kind, the authors openly admit they could not feasibly consider every single factor.¹¹⁰ However, they fundamentally disagreed with the AAP's "assertion that no data support the FAA's concern about travel

96. *Id.*

97. *Id.*

98. *See id.*

99. *Id.* at 1219.

100. *Id.*

101. *Id.*

102. Newman et al., *supra* note 92.

103. *Id.*

104. *Id.* at 972.

105. *Id.* at 969.

106. *Id.* at 970-71.

107. *Id.* at 971.

108. *Id.* at 973.

109. Press Release, Federal Aviation Administration, FAA Announces Decision on Child Safety Seats (Aug. 25, 2005), https://www.faa.gov/news/press_releases/news_story.cfm?contentKey=1966 [<https://perma.cc/97SW-AFPZ>].

110. Newman et al., *supra* note 92, at 973.

substitution and believe[d] that analyses of benefits and costs can inform policy decisions like this one”¹¹¹ Indeed, it is unsettling that the AAP would maintain there is no data supporting the contention that more lives would be lost as a result of FAA mandated child restraints given the FAA itself had “argued in a 1995 report to Congress that [child restraints] on aircraft would prevent a maximum of 5 child plane crash deaths per 10 years and would result in a net increase of 82 deaths per 10 years”¹¹² Unfortunately, by refusing to address the data and over-perceiving the relative risk posed by unrestrained infant air travel, the AAP advocated for a policy that might have accomplished the very thing it sought to avoid. The crucial failing on the part of the AAP is not that it failed to weigh the different sources of risk, rather it failed altogether to seriously consider the substitution risk posed by increased driving.

3. *School Shootings*

The national discourse over school shootings is one marred by dramatic risk over-perception. Even though a student has better odds of being struck by lightning than dying in a school shooting, the narrative of the school massacre dominates the discussion over gun violence.¹¹³ And understandably so—nobody wants to be perceived as an apologist for the deaths of innocent children. The harsh reality, however, is that there are more pressing matters in the context of gun violence than protecting schoolchildren.¹¹⁴ In a world of finite resources, political and monetary capital spent on protecting schools must be diverted from other worthy causes, such as preventing suicide or protecting the overwhelming majority of victims, Black Americans.¹¹⁵ For too many American schoolchildren, their time spent at home or walking to school is actually the most dangerous part of their day.¹¹⁶ Perceptions surrounding the risk of school shootings is a prime example of how over-perception results in an inefficient distribution of resources and exacts secondary costs. Additionally, understood in conjunction with the foregoing sections, this section suggests that humans can be at their most irrational when they perceive a risk to their children.

111. *Id.* at 969–70.

112. *Id.* at 969.

113. See Jason Bedrick, *How Common Are School Shootings?*, CATO INST.: CATO LIBERTY (Sept. 22, 2014, 4:47 PM), <https://www.cato.org/blog/how-common-are-school-shootings> [<https://perma.cc/Y7ST-H7SL>].

114. See *Gun Violence Statistics*, GIFFORDS L. CTR. <https://lawcenter.giffords.org/facts/gun-violence-statistics/> (last visited Jan. 16, 2022) [<https://perma.cc/S5ZB-XZYK>].

115. Gun suicides make up 61% of gun-related deaths in America. *Id.* Black men make up 52% of all gun homicide victims. *Id.*

116. See Alia Wong, *The Gun Violence That's a Bigger Threat to Kids than School Shootings*, ATLANTIC (Feb. 19, 2019), <https://www.theatlantic.com/family/archive/2019/02/gun-violence-children-actually-experience/582964/> [<https://perma.cc/NM9Z-WR2P>] (“Seldom do . . . fatalities happen on school campuses at all, in fact. While comprehensive data are limited, a 2017 study found that the majority—85 percent—of children 12 or younger who were shot to death from 2003 to 2013 were killed in a home. Roughly four in 10 kids aged 13 to 17 who were killed with a gun also died in a home; another four in 10 were killed in the streets. Meanwhile, nearly two in three of the country’s gun deaths (of all ages) are the result of suicide [P]ublic mass shootings make up less than 1 percent of firearm fatalities, according to separate reporting by The N.Y. Times.”).

The Columbine High School Massacre of 1999 was a watershed moment in American history.¹¹⁷ American schoolchildren forever occupy a post-Columbine era.¹¹⁸ “Previous school shootings were, for the most part, rash acts of violence and left few people dead. . . . Columbine inaugurated a new template for mass shootings in America: the spectacle murder.”¹¹⁹ Of the ten deadliest school shootings, seven have occurred post-Columbine.¹²⁰ Images of bloodied high school students fleeing from their Colorado classrooms with their arms raised have been supplemented in the national consciousness with the faces of little boys and girls from the peaceful Connecticut village of Newtown.¹²¹ “60% of teens say they are worried about a shooting occurring at their school.”¹²² Mass school shootings dominate the narrative of gun-control proponents and opponents alike.¹²³ Yet, notwithstanding the availability of post-Columbine school shootings, “the statistical likelihood of any given public school student being killed by a gun, in school, on any given day since [Columbine] was roughly 1 in 614,000,000.”¹²⁴ In fact, students are 246 times more likely to die by gun suicide, 156 times more likely to die in a community shooting, forty-two times more likely to die in a domestic violence shooting, and thirty-seven times more likely to die from an accidental shooting.¹²⁵ This begs the question: why do school shootings drive the gun-control narrative? The answer is risk over-perception due to the sensational, dreadful nature of the risk.

117. See Michael Luo, *Twenty Years After Columbine*, NEW YORKER, <https://www.newyorker.com/news/news-desk/twenty-years-after-columbine> (last visited Jan. 16, 2022) [https://perma.cc/UT6V-YXHX].

118. See Eric Mafdis, “It’s Better to Overreact”: School Officials’ Fear and Perceived Risk of Rampage Attacks and the Criminalization of American Public Schools, 24 CRITICAL CRIMINOLOGY 39, 40 (2016) (comparing the post-Columbine era to a post-9/11 era).

119. Luo, *supra* note 117.

120. See, e.g., *Number of Victims of School Shootings in the United States Between 1982 and November 2021*, STATISTA, <https://www.statista.com/statistics/476381/school-shootings-in-the-us-by-victim-count/> (last visited Jan. 16, 2022) [perma.cc/UJ38-47D7]; Meghan Keneally, *The 11 Mass Deadly School Shootings that Have Happened Since Columbine*, ABC NEWS (Apr. 19, 2019, 8:28 AM), <https://abcnews.go.com/US/11-mass-deadly-school-shootings-happened-columbine/story?id=62494128> [https://perma.cc/34TN-94S9]; Bonnie Berkowitz & Chris Alcantara, *The Terrible Numbers that Grow with Each Mass Shooting*, WASH. POST (May 12, 2021), <https://www.washingtonpost.com/graphics/2018/national/mass-shootings-in-america/> [https://perma.cc/J7GL-VT9D].

121. See, e.g., Michael Ray, *Sandy Hook Elementary School Shooting*, BRITANNICA (Sept. 21, 2021), <https://www.britannica.com/event/Sandy-Hook-Elementary-School-shooting> [https://perma.cc/FPE4-HXC5]. [

122. GIFFORDS L. CTR., THE TRUTH ABOUT SCHOOL SHOOTINGS 3 (2019), <https://www.giffords.org/wp-content/uploads/2019/02/The-Truth-About-School-Shootings-Report.pdf> [https://perma.cc/VRP2-YYK9].

123. See, e.g., Emma Newburger, *Biden Calls for Congress to Pass Stricter Gun Laws on Anniversary of Parkland Mass Shooting*, CNBC (Feb. 14, 2021, 4:19 PM), <https://www.cnbc.com/2021/02/14/biden-calls-on-congress-to-reform-gun-laws-on-anniversary-of-parkland-shooting.html> [https://perma.cc/VMH7-R3TH]; AJ Willingham, *At Its First Meeting After Parkland, the NRA Draws Attention to Mass Shootings*, CNN, <https://www.cnn.com/interactive/2018/05/politics/nra-convention-trnd-cnnphotos/> (last visited Jan. 16, 2022) [https://perma.cc/Z2GQ-WJHJ].

124. David Ropeik, *School Shootings are Extraordinarily Rare. Why Is Fear of them Driving Policy?*, WASH. POST (Mar. 8, 2018), https://www.washingtonpost.com/outlook/school-shootings-are-extraordinarily-rare-why-is-fear-of-them-driving-policy/2018/03/08/f4ead9f2-2247-11e8-94da-ebf9d112159c_story.html [https://perma.cc/M5D2-5U4D].

125. GIFFORDS L. CTR., *supra* note 122, at 7.

If a hypothetical poll were to ask whether schools should be safer, the pollster would be hard-pressed to find a naysayer.¹²⁶ If the poll were to ask, however, whether already safe schools should be safer at the cost of educational quality and students' civil liberties, the pollster might observe different results.¹²⁷ While the latter question represents the reality on the ground in schools across America, students, parents, and administrators primarily ask the former.¹²⁸ By adopting a zero-tolerance mindset where it is "better to overreact," these groups fundamentally over-perceive the risk of school shootings.¹²⁹ Furthermore, they turn a blind eye to the harmful effects of their overreaction.¹³⁰

This misperception is not victimless. In an empirical study of school administrators, University of Washington professor Eric Mafdis found support for what many researchers have dubbed "the Columbine Effect."¹³¹ He observed that when "the genuinely high potential cost of school rampage fused with the perception of high probability, . . . school rampages came to be viewed as a risk that . . . must be avoided *at nearly any cost*."¹³² This zero tolerance mindset emphasizes "surveillance, securitization, and criminalization rather than more ameliorative forms of prevention, such as restorative justice."¹³³ He contends that these "zero tolerance policies and enhanced security practices . . . are disproportionately used to surveil and punish students of color in urban areas."¹³⁴ Moreover, they "are routinely applied to stigmatize and penalize students for relatively petty crimes like drug use, disorderly conduct, and vandalism, not violence."¹³⁵ "In this process, significant concerns about students' civil liberties and schools' limited financial resources were broadly deemed as subordinate to the primary goal of school safety."¹³⁶

There is a reason obviously guilty criminal defendants are guaranteed procedural protections.¹³⁷ Sure, it might increase public safety on the front end to eliminate such protections, but it exacts back-end costs to civil liberties and civil

126. See, e.g., Emily Swanson, Carolyn Thompson & Hannah Fingerhut, *AP-NORC Poll: Most Believe Schools Have Become Less Safe*, AP NEWS (Apr. 16, 2019), <https://apnews.com/article/north-america-us-news-ap-top-news-bullying-shootings-39a6676a68ca4e81bc22253bb1e84eeb> [<https://perma.cc/ARU2-K6XS>].

127. See Mafdis, *supra* note 118, at 51.

128. See *id.*

129. See *id.* at 49 (explaining how administrators have responded to school shootings by taking a zero-tolerance, hypervigilance approach to policing schools).

130. See *id.*

131. *Id.* at 42.

132. *Id.* at 49.

133. *Id.*

134. *Id.* at 51 (citing Pamela Fenning & Jennifer Rose, *Overrepresentation of African American Students in Exclusionary Discipline: The Role of School Policy*, 42 URB. EDUC. 536; Katherine Irwin, Janet Davidson & Amanda Hall-Sanchez, *The Race to Punish in American Schools: Class and Race Predictors of Punitive School-Crime Control*, 21 CRITICAL CRIMINOLOGY 47 (2013)).

135. *Id.* (citing AARON KUPCHIK, *HOMEROOM SECURITY: SCHOOL DISCIPLINE IN AN AGE OF FEAR* (2010)).

136. *Id.* at 49.

137. See ANTONIN SCALIA, *A MATTER OF INTERPRETATION: FEDERAL COURTS AND THE LAW* 25 (1997) ("Long live formalism. It is what makes a government a government of laws and not men.")

participation.¹³⁸ Stop-and-frisk *might* make life safer for some, but it conflicts with fundamental American values.¹³⁹ The same principles should apply to safety in schools and to those who have not yet been vested with any political rights.

Students' civil liberties are not the only victims of the over-perception of school shooting risk.¹⁴⁰ According to Professor Mafdis' study, administrators viewed the quality of education at their school as another unfortunate sacrificial lamb that must yield to safety concerns despite the infinitesimally small risk probability.¹⁴¹ Ironically, the very measures taken by administrators to make students feel safer are destructive of that end.¹⁴² "[T]he expansion of zero-tolerance policies and school security measures, have been linked to higher levels of fear and perceived disorder among students."¹⁴³ In turn, these higher levels of fear directly correlate to poor academic achievement among students.¹⁴⁴

It is not better to overreact. "Better safe than sorry" is an oversimplification and is often untrue. Nor is it better to underreact. Rather, it is better to react appropriately—the Goldilocks concept of what is "just right." Of course, this is easier said than done. In the context of school shootings, however, reactions do not even come close to reflecting statistical realities.¹⁴⁵ Overreaction is a mental crutch that interferes with any rational discussion or debate over school safety or gun violence. Until the national discourse reflects the fact that "schools are one of the safest places in the United States,"¹⁴⁶ prescriptive measures will be unable to adequately address the issues of school shootings and gun violence in general.¹⁴⁷ Moreover, those measures will continue to exact backend social costs.

4. *A Modern Analogue: SARS-CoV-2 (COVID-19)*

The mixture of panic and ostriching that gripped the nation immediately following the 2019-2020 outbreak of the novel coronavirus (COVID-19) is a paradigmatic example of systemic risk misperception. Nobody, even the

138. See e.g., Joel Rose, *Mike Bloomberg Can't Shake the Legacy of Stop-and-Frisk Policing in New York*, NPR (Feb. 25, 2020, 4:18 PM), <https://www.npr.org/2020/02/25/809368292/the-legacy-of-stop-and-frisk-policing-in-michael-bloombergs-new-york> [<https://perma.cc/3LY9-GSKZ>] (detailing then-presidential candidate Mike Bloomberg's apology for stop-and-frisk).

139. See *id.*

140. See Mafdis, *supra* note 118, at 45.

141. See *id.* ("The notion that safety and security, as opposed to education, would be the top priority of principals at schools in low crime middle class suburban areas is a fairly new development, and likely one seldom present before the influence of Columbine.")

142. See Benjamin W. Fisher, *Students' Perceptions of Safety at School After Sandy Hook*, 16 J. SCH. VIOLENCE 349, 357 (2017).

143. *Id.*

144. *Id.*

145. See Mafdis, *supra* note 118, at 47.

146. Erin K. Nekvasil, Dewey G. Cornell & Francis L. Huang, *Prevalence and Offense Characteristics of Multiple Casualty Homicides: Are Schools at Higher Risk than Other Locations?*, 5 PSYCH. VIOLENCE 236, 241 (2015).

147. *Id.* at 242.

experts,¹⁴⁸ got it right initially. Many, including the authors, significantly underestimated the risk posed by this virus.¹⁴⁹ Others exhibited extreme and irrational coping behaviors in their overestimation of the risk.¹⁵⁰ COVID-19 “might just be the perfect case study for understanding how errors in risk perception lead us astray. In short, coronavirus shows that we still suck at assessing risk.”¹⁵¹

Toward the end of 2019, reports of an uptick in pneumonia cases began to trickle out of Wuhan, China.¹⁵² By the new year, Chinese officials suspected that a novel coronavirus had jumped species from the wild animals sold in the Huanan Wet Market to their human captors.¹⁵³ As infections and information began to spread to the United States, what *Politico* commentators, Sudeep Reddy and Victoria Guida, dubbed “The Great Coronavirus Panic of 2020” set in.¹⁵⁴ As they described it, “America is losing its collective mind over coronavirus, and nobody really knows whether it’s justified or not.”¹⁵⁵ The seeds of this confusion began with a lie.

Presidents lie.¹⁵⁶ All the time.¹⁵⁷ Some of these lies are necessary; even moral. For example, FDR lied about being non-interventionist as he silently prepared for WWII.¹⁵⁸ But some of these lies are unconscionable; even impeachable.¹⁵⁹ For example, Nixon and Clinton came under threat of impeachment for obstructing justice through false statements.¹⁶⁰ “On January 28th of [2020], before the virus was on anyone’s radar, the national security advisor, Robert O’Brien, told [President Trump], ‘This virus will be the biggest national security

148. See Ja’han Jones, *Surgeon General Jerome Adams Tries to Walk Back Past Bad Mask Advice*, HUFFPOST (July 13, 2020), https://www.huffpost.com/entry/surgeon-general-jerome-adams-defends-face-masks-coronavirus_n_5f0b62cec5b63a72c3436d4e?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xlLmNvbS8&guce_referrer_sig=AQAAAGTEvdugO-m7OXdVF5xPmXb_CvG5OQQ_LC2SEa8yxkWT39BvRVD12afHeqHDBdbjOchcb092CG30NHA25X5wuSvv_9B7CRKU3uWwZOB-1UIKGSYDHC63DvM4815HKJufd5UuSRxZl08cbN6dVwvNO3TKUI267mYksbV5za1E-X7_ [https://perma.cc/KFU6-JBMJ].

149. Alison Bernstein, *Coronavirus Shows We Still Suck at Assessing Risk*, SCIMOMS (Mar. 14, 2020), <https://scimoms.com/coronavirus-risk/> [https://perma.cc/5G3G-9Y3N].

150. *Id.*

151. *Id.*

152. *Coronavirus Outbreak Timeline Fast Facts*, CNN (Aug. 23, 2020, 10:23 AM), <https://www.cnn.com/2020/02/06/health/wuhan-coronavirus-timeline-fast-facts/index.html> [https://perma.cc/R6SX-QFB3].

153. *Wuhan Bans Eating Wild Animals as Coronavirus Drives a Crackdown in China*, CBS NEWS (May 21, 2020, 8:51 AM), <https://www.cbsnews.com/news/wuhan-china-coronavirus-bans-eating-wild-animals-breeding-wet-markets/> [https://perma.cc/QBQ7-BDAE] (“The coronavirus that causes COVID-19 is widely believed to have passed from bats to people, possibly via another species, before spreading worldwide.”).

154. Sudeep Reddy & Victoria Guida, *The Great Coronavirus Panic of 2020*, POLITICO (Mar. 9, 2020, 8:00 AM), <https://www.politico.com/newsletters/morning-money/2020/03/09/the-great-coronavirus-panic-of-2020-785941> [perma.cc/7DSK-3MG6].

155. *Id.*

156. See e.g., Michael Blake, *From Washington to Trump, All Presidents Have Told Lies (But Only Some Have Told Them for the Right Reasons)*, CONVERSATION (Sept. 17, 2020) <https://theconversation.com/from-washington-to-trump-all-presidents-have-told-lies-but-only-some-have-told-them-for-the-right-reasons-145995> [perma.cc/64WZ-QKKT].

157. *See id.*

158. *Id.*

159. CHARLES L. BLACK, JR. & PHILIP BOBBITT, *IMPEACHMENT: A HANDBOOK* 81 (2018).

160. *Id.* at 79.

threat you face in your presidency.”¹⁶¹ By February 7, 2020, Trump told Bob Woodward that the virus “goes through air” and was “more deadly than . . . even your strenuous flus.”¹⁶² He estimated that the virus was five times more deadly than the flu.¹⁶³

President Trump then faced a choice: tell the American people the truth about the risk posed by the virus or lie to them. He chose to lie. Until the end of March 2020, Trump publicly maintained that the virus was no worse than the flu.¹⁶⁴ Around that time, he told Bob Woodward, “I wanted to always play it down. I still like playing it down because I don’t want to create a panic.”¹⁶⁵ As we argue in Part V, the answer to potential risk misperception is not to obfuscate or mislead. Misinformation begets misperception. Rather, the American public, equipped with accurate information, and the tools to process that information, can become much more accurate risk-perceivers. President Trump fundamentally misunderstood the nature of risk misperception and missed an opportunity to marshal what could have been an unforgettable moment of American resilience. And the panic still came.

As far as human nature is concerned, with panic comes irrationality.¹⁶⁶ Fearing both the virus and a government-mandated quarantine, consumers congregated outside of Costcos, Walmarts, and other grocers to hoard supplies.¹⁶⁷ Notwithstanding the massive risk of community spread, heedless and panicked consumers mobbed businesses overwhelmingly in search of one single creature comfort: toilet paper.¹⁶⁸ Some even came to fisticuffs over it.¹⁶⁹ Of course, toilet paper is not the only example of irrational hoarding behavior. People purchased

161. Scott Pelley, *Donald Trump's Conversations with Bob Woodward About Coronavirus, Black Lives Matter and Nuclear War*, CBS NEWS (Sept. 13, 2020), <https://www.cbsnews.com/news/donald-trump-bob-woodward-rage-60-minutes-2020-09-13/> [perma.cc/666D-YZU3].

162. *Id.*

163. Jamie Gangel & Elizabeth Stuart, “Pretty Cool. Right?” *Unfiltered Moments from Trump's 18 Interviews with Bob Woodward*, CNN (Sept. 9, 2020), <https://www.cnn.com/2020/09/09/politics/trump-bob-woodward-interviews/index.html> [perma.cc/WK8S-B28S].

164. Tommy Beer, *All the Times Trump Compared Covid-19 to the Flu, Even After He Knew Covid-19 Was Far More Deadly*, FORBES (Sept. 10, 2020), <https://www.forbes.com/sites/tommybeer/2020/09/10/all-the-times-trump-compared-covid-19-to-the-flu-even-after-he-knew-covid-19-was-far-more-deadly/?sh=1efc17f5f9d2> [https://perma.cc/S9VW-4BK3].

165. Tamara Keith, *Trump Says He Prevented Panic on Pandemic, That's Not His Usual Approach*, NPR (Sept. 12, 2020), <https://www.npr.org/2020/09/12/912081447/trump-says-he-prevented-panic-on-pandemic-thats-not-his-usual-approach> [perma.cc/VES2-SS92].

166. See, e.g., Jeffrey Kluger, *In the Wake of the Coronavirus, Here's Why Americans Are Hoarding Toilet Paper*, TIME (Mar. 14, 2020, 3:55 PM), <https://time.com/5803273/hoarding-toilet-paper/> [https://perma.cc/Z8MV-XTE3].

167. *Id.*

168. See, e.g., *id.*; Richard Hall, *Coronavirus: Why People Are Panic Buying Toilet Paper, According to a Pandemic Expert*, INDEPENDENT (Mar. 15, 2020, 8:58 PM), <https://www.independent.co.uk/news/world/americas/coronavirus-toilet-paper-panic-buying-covid-19-uk-australia-a9403351.html> [https://perma.cc/3Z5T-XGJM].

169. See, e.g., David Blank, *Family Members Get into a Fight When One Accuses the Other of Hiding Toilet Paper*, CNN, (Apr. 8, 2020, 10:47 PM) <https://www.cnn.com/2020/04/08/us/toilet-paper-family-fight-arrest-trnd/index.html> [https://perma.cc/64JR-B8EM]; Lee Brown, *Women Fight over Toilet Paper During Coronavirus Panic Buying in Australia*, N.Y. POST (Mar. 8, 2020, 5:04 PM), <https://nypost.com/2020/03/08/women-fight-over-toilet-paper-during-coronavirus-panic-buying-in-australia/> [https://perma.cc/54TR-7AE3].

stocks of bottled water, as if preparing for an earthquake or hurricane.¹⁷⁰ There was absolutely no reason to stock up on bottled water.¹⁷¹ Both the Environmental Protection Agency and the Centers for Disease Control and Prevention (“CDC”) had announced that normal disinfection processes for tap water suffice to kill any virus that causes COVID-19.¹⁷² Furthermore, unlike in the case of an earthquake or hurricane, government services such as water sanitation and delivery were not at risk of shutting down.¹⁷³

Consumers also began hoarding gallons of hand sanitizer.¹⁷⁴ CNN reported that in some places “desperation for the stuff [was] rising to the level of thievery.”¹⁷⁵ Capitalizing on consumer irrationality, price gougers sold their stores of hand sanitizer to willing purchasers at exorbitant rates.¹⁷⁶ The internet exploded with do-it-yourself hand sanitizer recipes.¹⁷⁷ One New Jersey 7-Eleven owner sold a homemade concoction that caused chemical burns to several children.¹⁷⁸ All the while, information was readily available that handwashing was far superior to hand sanitizer use.¹⁷⁹ Yet there was no corresponding run on hand soap. Here is where the contradiction becomes apparent: consumers stocked up on staple goods for the home in preparation for government-mandated quarantine but also stocked up on hand sanitizer as if they would be in public for extended

170. See Jefferson Graham, *Amid Coronavirus Buying, Amazon Sold out of Bottled Water and Toilet Paper, Too*, USA TODAY (Mar. 16, 2020, 11:04 AM), <https://www.usatoday.com/story/tech/2020/03/15/amazon-toilet-paper-water-household-items/5055632002/> [https://perma.cc/3Z9F-9P9R].

171. Tracy Quinn, *COVID-19: Why Most Don't Need to Stockpile Bottled Water*, NRDC (Mar. 30, 2020), <https://www.nrdc.org/experts/tracy-quinn/covid-19-why-most-dont-need-stockpile-bottled-water> [https://perma.cc/T7GH-RL9Z].

172. See *Water and COVID-19 FAQs*, CTNS. FOR DISEASE CONTROL & PREVENTION (Apr. 23, 2020), <https://www.cdc.gov/coronavirus/2019-ncov/php/water.html> [https://perma.cc/WS5C-ZU9J]; *Coronavirus and Drinking Water and Wastewater*, ENV'T PROT. AGENCY, <https://www.epa.gov/coronavirus/coronavirus-and-drinking-water-and-wastewater> (last visited Jan. 16, 2022) [https://perma.cc/VK8M-KTCB].

173. ENV'T PROT. AGENCY, *supra* note 172.

174. Ford Vox, *Why We Can't Find Hand Sanitizer*, CNN (Mar. 11, 2020, 4:49 PM), <https://www.cnn.com/2020/03/11/opinions/hand-sanitizer-coronavirus-opinion-vox/index.html> [https://perma.cc/2NXD-TYR4].

175. *Id.*

176. See *id.*

177. See Alicia Lee, *Don't Try to Make Your Own Hand Sanitizer Just Because There's a Shortage from Coronavirus*, CNN (Mar. 3, 2020, 12:55 PM), <https://www.cnn.com/2020/03/03/health/coronavirus-diy-hand-sanitizer-trnd/index.html> [https://perma.cc/EG84-6SNP].

178. See Leah Asmelash, *Police Seize Likely Homemade Sanitizer from a 7-Eleven After a Young Boy Was Allegedly Burned by It*, CNN (Mar. 11, 2020, 3:36 PM), <https://www.cnn.com/2020/03/11/us/7-eleven-new-jersey-sanitizer-burn-trnd/index.html> [https://perma.cc/6L3A-HGM5]; see also Anna Medaris Miller, *A Pharmacy Tried to Help People Make Their Own Hand Sanitizer Because of Coronavirus-Related Shortages, but It Posted the Wrong Recipe*, INSIDER (Mar. 6, 2020, 9:30 AM), <https://www.businessinsider.com/pharmacy-posted-wrong-recipe-how-to-make-hand-sanitizer-2020-3> [https://perma.cc/G8M3-HCNA] (describing mis-posting of recipe for homemade hand sanitizer during COVID-19 shortages).

179. *Show Me the Science—When & How to Use Hand Sanitizer in Community Settings*, CTNS. FOR DISEASE CONTROL & PREVENTION: HANDWASHING, <https://www.cdc.gov/handwashing/show-me-the-science-hand-sanitizer.html> (last visited Jan. 16, 2022) [https://perma.cc/Q6N5-L2JM] (“CDC recommends washing hands with soap and water whenever possible because handwashing reduces the amounts of all types of germs and chemicals on hands. But if soap and water are not available, using a hand sanitizer with at least 60% alcohol can help you avoid getting sick”); see also Ferris Jabr, *Why Soap Works*, N.Y. TIMES (Mar. 13, 2020), <https://www.nytimes.com/2020/03/13/health/soap-coronavirus-handwashing-germs.html> [https://perma.cc/BJ4N-SMWQ] (explaining how soap and hand sanitizer interact with germs).

periods of time with no access to soap and water. Unable to assess, sort, or prioritize risks, consumers did the only thing left: buy everything and prepare for anything. This dichotomy demonstrates the shortcomings of human risk perception.

This kind of hoarding behavior and the resulting shortages led to a suboptimal distribution of goods and services in society, somewhat akin to a tragedy of the commons.¹⁸⁰ Nowhere was this clearer than with the hoarding of surgical masks. “With coronavirus popping up in the United States, some . . . beg[a]n buying face masks as a form of protection”¹⁸¹ However, in the early days of the outbreak, these masks were desperately needed in hospitals.¹⁸² For example, one “intensive-care nurse in Illinois was told to make a single-use mask last for five days.”¹⁸³ One hospital “had started storing dirty masks in plastic containers to use again later with different patients.”¹⁸⁴ Another Washington doctor, who was “trying to make her small stock last, [was] spraying each mask with alcohol after use, until it br[oke] down.”¹⁸⁵ In the early days of the COVID-19 outbreak, it seemed irrationality was the rule not the exception.¹⁸⁶

But hoarding behaviors are not the only example of irrational thinking surrounding the COVID-19 pandemic. Some completely ignored the risk by putting their head in the sand or actively downplaying the risk.¹⁸⁷ After governments and businesses began requiring masks in public, there were many who flat out refused to comply.¹⁸⁸ Many COVID-19 deniers, some who believed the pandemic was a

180. “The tragedy of the commons is an economics problem in which every individual has an incentive to consume a resource, but at the expense of every other individual -- with no way to exclude anyone from consuming. . . . [I]t results in harmful over-consumption[,] . . . under investment[,] and ultimately [total] depletion of the resource.” *Tragedy of the Commons*, INVESTOPEDIA (Oct. 23, 2020), <https://www.investopedia.com/terms/t/tragedy-of-the-commons.asp> [<https://perma.cc/9GGD-RW8H>].

181. Leah Asmelash, *The Surgeon General Wants Americans to Stop Buying Face Masks*, CNN: HEALTH (Mar. 2, 2020, 9:38 AM), <https://www.cnn.com/2020/02/29/health/face-masks-coronavirus-surgeon-general-trnd/index.html> [<https://perma.cc/L5E8-NWD6>]; Jerome M. Adams (@Surgeon_General), TWITTER (Feb. 29, 2020, 4:08 AM), https://web.archive.org/web/20200302115642/https://twitter.com/Surgeon_General [<https://perma.cc/RS3F-GM86>].

182. Mariel Padilla, *‘It Feels Like a War Zone’: Doctors and Nurses Plead for Masks on Social Media*, N.Y. TIMES (Mar. 22, 2020), <https://www.nytimes.com/2020/03/19/us/hospitals-coronavirus-ppe-shortage.html> [<https://perma.cc/5F6V-VB4L>].

183. *Id.*

184. *Id.*

185. *Id.*

186. See *Coronavirus Myths, Rumors, and Misinformation*, JOHNS HOPKINS MED. (June 30, 2020), <https://www.hopkinsmedicine.org/coronavirus/articles/coronavirus-myths-rumors-misinformation.html> [<https://perma.cc/CJB2-RZNG>] (chronicling the healthcare myths that circulated in the early days of the outbreak). For a study linking social media use to misinformation and subsequent risk misperception, see Aengus Bridgman et al., *The Causes and Consequences of COVID-19 Misperceptions: Understanding the Role of News and Social Media*, 1 SPECIAL ISSUE COVID-19 & MISINFORMATION 1, 2–6 (2020).

187. See, e.g., Nexstar Media Wire, *14 in Texas Family Get COVID-19 After Virus Denier’s Party; 1 Left Dead and Another on Life Support*, FOX 8 NEWS (July 31, 2020, 5:06 AM), <https://fox8.com/news/coronavirus/14-in-texas-family-get-covid-19-after-virus-deniers-party-1-left-dead-and-another-on-life-support/> [<https://perma.cc/8D3D-7SDZ>].

188. Paul Ruehl, *Coronavirus: There Really Are Mask Deniers out There. I Had to Spend a Weekend with Them*, USA TODAY (July 27, 2020, 9:49 AM), <https://www.usatoday.com/story/opinion/voices/2020/07/26/coronavirus-covid-19-wear-mask-prevention-virus-column/5494984002/> [<https://perma.cc/F9XX-PTTQ>].

conspiracy against the Trump campaign, would go on the contract the virus themselves.¹⁸⁹ Relatedly, perceptions regarding the risk of COVID-19, a natural disaster, was strongly correlated with political affiliation.¹⁹⁰ In one poll forty percent of Republicans felt the death count was inflated while only seven percent of Democrats agreed.¹⁹¹ Another poll revealed that Democrats were 12.9% more likely to get vaccinated against COVID-19 than their counterparts.¹⁹² In a rational world, one's political affiliations would be as relevant to assessing the risk of a virus as it is to assessing the probability that Punxsutawney Phil will see his shadow in a given year.

Governments and institutions also exhibited signs of irrational thought-processes early in the outbreak. It became taboo to discuss the value of a statistical life ("VSL").¹⁹³ Phrases like "[w]e cannot let the cure be worse than the problem itself," unobjectionable as a matter of logic, quickly became politically controversial.¹⁹⁴ In a statement to the press, New York Governor Andrew Cuomo responded to concerns of small business owners that the prophylactic measures would destroy their livelihoods.¹⁹⁵ He stated that "[his] judgment is, do whatever is necessary to contain this virus, and then we will manage the consequences afterwards."¹⁹⁶ Nevada Governor Steve Sisolak put it more bluntly when he said, "You can't put a value on human life."¹⁹⁷ Likewise, a March 2020 study from the Imperial College COVID-19 Response Team recognized the importance of understanding the secondary "ethical and economic implications" of prophylactic measures.¹⁹⁸ However, the team ultimately decided considerations of such factors were outside the scope of its study when recommending "population-

189. See, e.g., *supra* note 187; Ashley Collman, *A Man Who Thought the Coronavirus Was a 'Scamdemic' Wrote a Powerful Essay Warning Against Virus Deniers After He Hosted a Party and Got His Entire Family Sick*, INSIDER (July 28, 2020, 6:51 AM), <https://www.businessinsider.com/coronavirus-texas-conservative-thought-hoax-before-infection-2020-7> [<https://perma.cc/5GTF-MSRP>].

190. *Republicans, Democrats Move Even Further Apart in Coronavirus Concerns*, PEW RSCH. CTR. (June 25, 2020), <https://www.pewresearch.org/politics/2020/06/25/republicans-democrats-move-even-further-apart-in-coronavirus-concerns/> [<https://perma.cc/6VMY-Y75Q>].

191. Margaret Talev, *Axios-Ipsos Coronavirus Index, Week 8: Second-Guessing the Death Toll*, AXIOS (May 5, 2020), <https://www.axios.com/axios-ipsos-coronavirus-week-8-5a1947d5-9850-4e58-9583-9b617e6fdclb.html> [<https://perma.cc/Y7TL-CF7Q>].

192. Jennifer Kates, Jennifer Tolbert & Kendal Orgera, *The Red/Blue Divide in COVID-19 Vaccination Rates*, Kaiser Family Foundation (Sept. 14, 2020), <https://www.kff.org/policy-watch/the-red-blue-divide-in-covid-19-vaccination-rates/> [perma.cc/FFM4-WYNZ].

193. See John Sadler, *"Can't Put a Value on Human Life": Sisolak Mulls Options in Managing Virus Spread*, LAS VEGAS SUN (July 9, 2020, 12:25 AM), <https://lasvegassun.com/news/2020/jul/09/cant-put-value-human-life-sisolak-virus-options/> [<https://perma.cc/2J4H-7Q7Y>].

194. Brett Samuels & Rebecca Klar, *Trump: "We Can't Let the Cure Be Worse than the Problem Itself"*, HILL (Mar. 23, 2020, 8:11 AM), <https://thehill.com/homenews/administration/488965-trump-hints-at-changes-to-restrictions-we-cant-let-the-cure-be-worse> [<https://perma.cc/E3LJ-379A>].

195. Bloomberg Markets and Finance, *Most NY Complaints Over Bars Being Closed, Gov. Cuomo Says*, YOUTUBE (Mar. 17, 2020), <https://www.youtube.com/watch?v=nZvNEjB-urA> [<https://perma.cc/N3QW-CUP4>].

196. *Id.*

197. Sadler, *supra* note 193.

198. NEIL M. FERGUSON ET AL., IMPERIAL COLL. COVID-19 RESPONSE TEAM, IMPACT OF NON-PHARMACEUTICAL INTERVENTIONS (NPIs) TO REDUCE COVID-19 MORTALITY AND HEALTHCARE DEMAND 4 (Mar. 16, 2020), <https://www.imperial.ac.uk/media/imperial-college/medicine/sph/ide/gida-fellowships/Imperial-College-COVID19-NPI-modelling-16-03-2020.pdf> [<https://perma.cc/3YUP-P8CW>].

wide social distancing combined with home isolation of cases and school and university closure” on and off for “18 months or more.”¹⁹⁹

Failing or refusing to consider the secondary loss of life caused by prophylactic measures is a kind of finite, short-term thinking that is dangerous.²⁰⁰ Measures such as shelter-in-place contributed to the worst annualized drop in Gross Domestic Product on record, “even outstripping the Great Depression in its scale.”²⁰¹ As a rule of thumb, some experts maintain that for every one percent increase in unemployment, 40,000 people die.²⁰² While the true level of mortality caused by unemployment and recession is disputed,²⁰³ mortality is not the only factor policymakers should consider. For every life taken by unemployment and economic depression, several more are destroyed.²⁰⁴ People lose livelihoods, homes, pensions, savings, marriages, and more.²⁰⁵ Failure to perceive and incorporate these substitute sources of risk in the prophylactic decision-making process had potential to magnify rather than minimize the effects of the virus.

Most recently, New Jersey Governor Phil Murphy issued a tweet celebrating the first long-term care resident vaccination in the state.²⁰⁶ That individual was a 103-year-old woman.²⁰⁷ At the time the vaccine was in short supply and essential workers, disproportionately people of color, more than half her age

199. *Id.* at 15.

200. See Scott Wallsten, Thomas M. Lenard & Kip Viscusi, “Kip Viscusi on the Value of a Statistical Life and Coronavirus” (*Two Think Minimum*), TECH. POL’Y INST. (April 30, 2020), <https://techpolicyinstitute.org/2020/04/30/kip-viscusi-on-the-value-of-a-statistical-life-and-coronavirus-two-think-minimum/> [<https://perma.cc/CGN3-D67P>] (quoting Kip Viscusi, the father of statistical life evaluation, discussing prophylactic measures: “If we’re really saving a million lives through social distancing, multiply that by \$10 million a life. You’re talking about \$10 trillion in terms of benefits. That’s a lot of benefits . . . but sooner or later we’re going to have to be phasing down and the government’s going to have to start picking their shots.”).

201. Matthew Brown, *Fact Check: U.S. GDP Drop in 2020’s Second Quarter Is the Worst in Modern History*, USA TODAY (Aug. 10, 2020, 9:40 AM), <https://www.usatoday.com/story/news/factcheck/2020/08/08/fact-check-u-s-quarterly-gdp-drop-worst-modern-history/5569089002/> [<https://perma.cc/X67P-GR8W>].

202. For an informative discussion on this figure, see More or Less, *Fact Checking the Big Short*, BBC, at 4:05 (Mar. 4, 2016), <https://www.bbc.co.uk/sounds/play/p03kpvk2> [<https://perma.cc/369V-D64J>]; see also *Rising Unemployment Causes Higher Death Rates, Yale Researcher Shows*, YALENEWS (May 23, 2002), <https://news.yale.edu/2002/05/23/rising-unemployment-causes-higher-death-rates-new-study-yale-researcher-shows> [<https://perma.cc/5K3U-M3GB>]; *The Social Costs of Unemployment: Hearing Before the Joint Econ. Comm.*, 96th Cong. 1 (1979).

203. Alex McKechnie, *How Is It Possible that Joblessness Could Kill You, but Recessions Could Be Good for Your Health?*, DREXELNOW (July 24, 2014), <https://drexel.edu/now/archive/2014/July/Unemployment-Study/> [<https://perma.cc/DA65-V6HF>].

204. *See id.*

205. Wallsten et al., *supra* note 200 (“If you’re imposing a huge economic cost, there’s also a health loss associated with that. So health is on both sides of the analysis.”).

206. Phil Murphy (@GovMurphy), TWITTER (Dec. 28, 2020, 8:26 AM), https://twitter.com/GovMurphy/status/1343564072722325504?ref_src=twsrc%5Etfw%7Ctwcamp%5Etweetembed%7Ctwterm%5E1343564072722325504%7Ctwgr%5E%7Ctwcon%5E%5Es1_&ref_url=https%3A%2F%2Fwww.nbcpiladelphia.com%2Fnews%2Fcoronavirus%2Fphil-murphy-coronavirus-new-jersey-vaccines%2F2648348%2F [<https://perma.cc/AGV4-2CLA>].

207. *Id.*

were dying.²⁰⁸ As a society, we should question whether this vaccination was truly a cause for celebration.²⁰⁹ Difficult decisions require difficult discussions.

It is not inhumane or immoral to make decisions based on the value of a statistical life²¹⁰ or the value of a quality-adjusted-life-year (“QALY”).²¹¹ Quite the opposite, it shows a concern for all human lives, not just the most visible ones. The fact of the matter is that governments and agencies have been putting a value on human life for decades, and society has collectively benefited as a result.²¹² Moreover, we individually put a price on life all the time when we purchase life insurance, sacrifice safety for price, or take unnecessary risks.²¹³ While VSL analysis overwhelmingly supported shelter-in-place and other quarantine measures, inevitably the costs of those measures will outstrip the benefits.²¹⁴ Decisionmakers must be prepared to deal with that eventuality by engaging in VSL and QALY analyses. Additionally, QALY analysis would have forced New Jersey health officials to compare the value of gaining a few more years for a 103-year-old against potentially saving the life of a 40-something-year-old essential worker with comorbidities resulting in part from their membership in an underprivileged class. Decisionmakers cannot shy away from these difficult realities because of a discomfort with valuing life.

The purpose of this section has not been to minimize or trivialize the risk posed to society by the COVID-19 outbreak. The virus clearly represents a substantial source of risk, and dealing in counterfactuals presents difficulties. However, irrational purchasing behavior and decisional procedures perfectly highlight the pervasiveness of risk misperception in our society. The price society pays for this misperception could compound the costs exacted by the virus alone.

208. See Samantha Artiga, Latoya Hill & Sweta Haldar, *COVID-19 Cases and Deaths by Race/Ethnicity: Current Data and Changes Over Time*, KFF (Oct. 8, 2021), <https://www.kff.org/racial-equity-and-health-policy/issue-brief/covid-19-cases-and-deaths-by-race-ethnicity-current-data-and-changes-over-time/> [https://perma.cc/X6TA-7BSJ]; Celine McNicholas & Margaret Poydock, *Who are Essential Workers?*, ECON POLICY INST. (May 19, 2021), <https://www.epi.org/blog/who-are-essential-workers-a-comprehensive-look-at-their-wages-demographics-and-unionization-rates/> [https://perma.cc/A2BG-8FBN].

209. See, e.g., Abby Goodnough & Jan Hoffman, *The Elderly vs. Essential Workers: Who Should Get the Coronavirus Vaccine First?*, N.Y. TIMES (July 21, 2021), <https://www.nytimes.com/2020/12/05/health/covid-vaccine-first.html> [https://perma.cc/BUX4-GXR3]; Kylie Quinn, *Why We Should Prioritise Older People When We Get a COVID Vaccine*, CONVERSATION (Nov. 15, 2020, 1:53 PM), <https://theconversation.com/why-we-should-prioritise-older-people-when-we-get-a-covid-vaccine-148432> [https://perma.cc/HT2X-BMHY].

210. See sources cited *supra* note 209.

211. See Luis Prieto & José A Sacristán, *Problems and Solutions in Calculating Quality-Adjusted Life Years (QALYs)*, 1 HEALTH & QUALITY LIFE OUTCOMES 1, 1 (2003) (“Since health is a function of length of life and quality of life, the QALY was developed as an attempt to combine the value of these attributes into a single index number. The QALY calculation is simple: the change in utility value induced by the treatment is multiplied by the duration of the treatment effect to provide the number of QALYs gained.”).

212. See Wallsten et al., *supra* note 200 (“[T]ypically about once every year or once every two years, the press discovers, oh my god, they’re valuing lives and does a big stir in terms of the controversy. And then it settles down when they hear how big the number is. So when they find out that their lives are being valued at a quite high number, people get less upset.”).

213. See *Lives vs. the Economy*, NPR (Apr. 15, 2020, 4:21 PM), <https://www.npr.org/transcripts/835571843> [https://perma.cc/QJ3J-YBN6].

214. See Wallsten et al., *supra* note 200.

III. PSYCHOLOGICAL RISK PERCEPTION: WHY HUMANS MISPERCEIVE TECHNOLOGY

There are several psychological factors that contribute to risk misperception in humans. People rely on a mixture of cognitive crutches, heuristics, and emotional appraisals to navigate the risks of everyday life.²¹⁵ A brief mental exercise demonstrates one of these cognitive shortcuts. Take a moment and picture a bird in your mind. Chances are you pictured a sparrow, robin, or crow instead of a long-wattled umbrellabird or an albatross. But why did your brain, without any conscious thought, select the bird that it did? Why does the baseball player refuse to wash his lucky socks?²¹⁶ Why do Americans perceive Black men as more dangerous than white men?²¹⁷

The answer to these questions lies in the mental shortcuts and biases our brain engages in every single day.²¹⁸ In some cases, they are actually rather successful in assisting humans to process informational inputs quickly.²¹⁹ In the course of everyday life, one is more likely to encounter a sparrow or a robin, and faith in a lucky pair of socks can sometimes lead to a better outing. But these heuristics and biases are fallible.²²⁰ When you inject complexity into mental processes, such as processing race in America, these mental shortcuts often operate as devastating shortcomings.²²¹ They can cause humans to act irrationally and systematically misperceive risk.²²² As the world humans inhabit continues to increase in complexity, one can expect risk misperception to worsen.²²³

215. See *The Psychology of Risk Perception*, HARV. MENTAL HEALTH LETTER 6 (June 2011), https://www.health.harvard.edu/newsletter_article/the-psychology-of-risk-perception [<https://perma.cc/K9ZB-3H8Q>]; see also Tversky & Kahneman, *supra* note 4; Calandrillo, *supra* note 8.

216. See Seattle Mariners, 2011—*Lucky Charm*, YOUTUBE (Nov. 9, 2015), <https://www.youtube.com/watch?v=s4ayLdsJyw0&list=PLX0QiAf6mS6AR5Ogcm7WpiY-9LmL1iQO&index=122> [<https://perma.cc/3XY6-GL3J>].

217. See John Paul Wilson, Kurt Hugenberg & Nicholas O. Rule, *Racial Bias in Judgments of Physical Size and Formidability: From Size to Threat*, 113 J. PERSONALITY & SOC. PSYCH. 59, 74 (2017) (“Non-Black perceivers overestimated young Black men as taller, heavier, stronger, more muscular, and more capable of causing physical harm than young White men.”). Nowhere was this unfortunate bias more prevalent than in the disparate responses by law enforcement to Black Lives Matter protestors in the Capitol and majority-white Trump supporters terrorizing the seat of government. See Nicole Chavez, *Rioters Breached US Capitol Security on Wednesday. This Was the Police Response When It Was Black Protesters on DC Streets Last Year*, CNN (Jan. 10, 2021, 11:30 PM), <https://www.cnn.com/2021/01/07/us/police-response-black-lives-matter-protest-us-capitol/index.html> [<https://perma.cc/CFT8-MKMP>].

218. See Cass R. Sunstein, *Hazardous Heuristics*, 70 U. CHI. L. REV. 751, 751 (2003).

219. *Id.*

220. *Id.*

221. See Wilson et al., *supra* note 217, at 74 (“Critically, these size and harm perceptions predicted the extent to which perceivers saw force as justified against hypothetical suspects of crime.”).

222. See Tversky & Kahneman, *supra* note 4, at 1131.

223. There are “emerging views of decision making which indicate that decision making is based often on experiential ‘gut’ feelings rather than rational analysis.” Nancy Rhodes & Kelly Pivik, *Age and Gender Differences in Risky Driving: The Roles of Positive Affect and Risk Perception*, 43 ACCIDENT ANALYSIS & PREVENTION 923, 929 (2011). “[T]hese simple gut-level decisions that are encouraged by evolution appear to make people stupid in the modern world under unpredictable circumstances, and they encourage unhealthy risk taking rather than discourage it.” Valerie F. Reyna & Frank Farley, *Risk and Rationality in Adolescent Decision Making: Implications for Theory, Practice, and Public Policy*, 7 PSYCH. SCI. PUB. INT. 1, 4 (2006) (emphasis added).

This Article does not, and cannot, survey all of the different heuristics and biases that might affect risk misperception. The purpose, rather, of this Part is to identify a select few that have an inextricably intertwined connection to certain immutable characteristics of emerging technology, causing a general aversion to such technology in humans. In short, the below heuristics and biases are the driving forces behind systemic technological risk misperception. Compounding the issue, these mental shortcuts are themselves interconnected. Humans often combine heuristics and stack inference upon inference to paint different layers of a risk portrait.²²⁴ Only by identifying and understanding the cognitive and psychological factors that contribute to misperception, can humans then begin the process of reducing their impact on decision-making processes.

A. *The Precautionary Principle as an Overarching Backdrop to Regulatory Decision-making*

The Precautionary Principle operates as the decisional canvas upon which humans employ their heuristic and cognitive shortcuts to paint a portrait of the risks they face in life.²²⁵ With the post-industrial “emergence of increasingly unpredictable, uncertain, and unquantifiable but possibly catastrophic risks . . . ,” societies began to formally incorporate the Precautionary Principle into their decisional processes.²²⁶ There is no singular definition of the Precautionary Principle; rather, it occupies a spectrum ranging from its weak form to its strong form.²²⁷ At one end, “[t]he most cautious and weak versions suggest, quite sensibly, that a lack of decisive evidence of harm should not be grounds for refusing to regulate.”²²⁸ At the strong end, “regulation is required whenever there is a possible risk to health, safety, or the environment, even if the supporting evidence is speculative and even if the economic costs of regulation are high.”²²⁹ From these polemical definitions, the parameters of the precautionary continuum can be deduced: (1) the burden of proving the absence or presence of risk; (2) who bears that burden; (3) the scale and probability of the potential harm; (4) whether regulation is required or merely encouraged; and (5) the scale of the regulatory remediation.²³⁰

As the World Commission on the Ethics of Scientific Knowledge & Technology has noted, “the [Precautionary Principle] is a strategy to cope with scientific uncertainties in the assessment and management of risks.”²³¹ It is inherently

224. See Tversky & Kahneman, *supra* note 4, at 1131.

225. Cass R. Sunstein, *Beyond the Precautionary Principle*, 151 U. PA. L. REV. 1003, 1043 (2003).

226. WORLD COMM’N ON ETHICS OF SCI. KNOWLEDGE AND TECHNOLOGY, THE PRECAUTIONARY PRINCIPLE, UNESCO 7 (Mar. 2005), <https://www.eubios.info/UNESCO/precprin.pdf> [<https://perma.cc/6YRF-HN95>] [hereinafter COMEST, THE PRECAUTIONARY PRINCIPLE].

227. For a discussion of common elements amongst the different forms of the Precautionary Principle, see *id.* at 13–14.

228. Sunstein, *supra* note 225, at 1012.

229. *Id.* at 1018.

230. See *id.* at 1014 (citing Richard B. Stewart, *Environmental Regulatory Decision Making under Uncertainty*, in 20 RESEARCH IN LAW AND ECONOMICS 71, 78 (Timothy Swanson ed., 2002)).

231. COMEST, THE PRECAUTIONARY PRINCIPLE, *supra* note 226, at 8.

conservative, creating a rebuttable presumption in favor of the status quo. Its adoption has “marked a shift from *post-damage control* (civil liability as a curative tool) to the level of a *pre-damage control* (anticipatory measures) of risks.”²³² Although sources trace the origin of its modern form to the 1970s, the Precautionary Principle is really a regulatory endorsement of more colloquial thinking evident in age-old adages such as “better safe than sorry.”²³³

Examples of the Precautionary Principle in regulatory decision-making are everywhere. It has become nearly ubiquitous in international environmental regulation.²³⁴ Given the scientifically uncertain nature of the dangers posed by climate change and pollution, many environmental conventions incorporate some form of the Precautionary Principle.²³⁵ The Precautionary Principle helps explain why millions of law abiding citizens are subjected to full-body scans at airport across the country every single day.²³⁶ It is the same principle that influenced Dr. Kelsey’s decision to reject inconclusive data regarding the safety of thalidomide.²³⁷ It is also the same principle that spurs overreaction to the low risk of school shootings.²³⁸ Like any tool of decision-making, the Precautionary Principle must be wielded with precision.

Professor Cass Sunstein, a long-time critic of the Precautionary Principle and preeminent American expert on behavioral economics, has “suggested that the weak versions of the Precautionary Principle are unobjectionable and important.”²³⁹ It states a “truism” that combats the kind of decision-making that would require an overwhelming showing of harm before taking action to mitigate risk.²⁴⁰ He warns against trivializing this function, citing a poll revealing one-fifth of Americans believe no costly action should be taken against global warming until we are assured of its actuality.²⁴¹ In other words, the weak form of the

232. *Id.* at 7.

233. *See id.* at 9; Sunstein, *supra* note 225, at 1004.

234. Sunstein, *supra* note 225, at 1005, 1005 n.6.

235. *See, e.g., Second International Conference on the Protection of the North Sea: Ministerial Declaration Calling for Reduction of Pollution*, 27 INT’L LEGAL MATERIALS 835, 838 (1988) (“Accepting that, in order to protect the North Sea from possibly damaging effects of the most dangerous substances, a precautionary approach is necessary which may require action to control inputs of such substances even before a causal link has been established by absolutely clear scientific evidence.”); United Nations Conf. on Env’t & Dev., *Rio Declaration on Env’t and Dev.*, 31 INT’L LEGAL MATERIALS 874, 879 (1992). (“In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”); Comm’n of the Eur. Cmty., *Comm’n from the Comm’n on the Precautionary Principle*, EUR. UNION 1, 7 (2000) (The precautionary principle applies “where scientific information is insufficient, inconclusive, or uncertain and where there are indications that the possible effects on the environment, or human, animal or plant health may be potentially dangerous and inconsistent with the chosen level of protection.”).

236. *See* Jay Wagner, *TSA Year in Review: A Record Setting 2018*, TRANSP. SEC. ADMIN. (Feb. 7, 2019), <https://www.tsa.gov/blog/2019/02/07/tsa-year-review-record-setting-2018> [<https://perma.cc/Q5NU-L9AY>].

237. *See supra* Section II.A.1.

238. *See supra* Section II.B.3.

239. Sunstein, *supra*, note 225, at 1016.

240. *Id.*

241. *Id.* at 1016–17.

Precautionary Principle is useful in combatting the kind of decision-making that would require an absolute certainty of harm to trigger a regulatory intervention.

In its strong form, however, Professor Sunstein argues that the Precautionary Principle is paralyzing and ultimately useless as a tool of decision-making.²⁴² “In some cases, regulation eliminates the ‘opportunity benefits’ of a process or activity, and thus causes preventable deaths.”²⁴³ This phenomenon was evident in the example of FAA-mandated child restraints discussed in Part II. In that case, regulation would have reduced one source of risk (child injuries on airplanes) but given rise to a substitute source of risk (increased motor vehicle travel). “The point is . . . [that] in its strongest form, [the Precautionary Principle] is offended by regulation as well as by nonregulation.”²⁴⁴ “This is a common situation, for opportunity benefits and substitute risks are the rule, not the exception.”²⁴⁵

Take, for example, the case of nuclear arsenals. The global stockpile of nuclear arms, ninety percent of which is held by the U.S. and Russia, is enough to end human life several times over.²⁴⁶ The mere existence of these weapons creates a risk of nuclear terrorism or even nuclear holocaust.²⁴⁷ Relying on a strong Precautionary Principle, several members of the medical community have called for the total abolition of nuclear weapons.²⁴⁸ Going even further, one group has declared nuclear proliferation to “be among the most urgent of all global public health priorities.”²⁴⁹ As Professor Sunstein cautions, however, a faithful Precautionary Principle analysis must cut both ways.²⁵⁰ The existence of nuclear weapons has contributed to an unprecedented nuclear peace among world superpowers.²⁵¹ If war is merely “a continuation of political intercourse, carried on with other means,” then politics for its own sake must always stop short of nuclear war.²⁵² Put differently, while an abolition of these weapons might reduce the risk of nuclear catastrophe, a substitute risk of conventional world war would arise. For mutually assured destruction to serve its deterrent

242. *Id.* at 1035.

243. *Id.* at 1023.

244. *Id.* at 1024.

245. *Id.* at 1025.

246. See Kelley Christensen, *More Harm than Good Assessing the Nuclear Arsenal Tipping Point*, MICH. TECH (June 13, 2018, 9:01 AM), <https://www.mtu.edu/news/stories/2018/june/more-harm-than-good-assessing-the-nuclear-arsenal-tipping-point.html> [<https://perma.cc/PV38-KQ2W>].

247. See *id.* (“Playing out a hypothetical scenario, the researchers explain that if the U.S. used 100 nuclear weapons against China’s most populous cities, initial blasts would likely kill more than 30 million people.”).

248. See, e.g., *Our Mission*, INT’L PHYSICIANS PREVENTION NUCLEAR WAR, <https://www.ipnw.org/programs/nuclear-weapons-abolition/abolition-of-nuclear-weapons-campaign-material-and-research> (last visited Jan. 16, 2022) [<https://perma.cc/M44W-W45L>] (calling for the abolition of nuclear weapons).

249. See, e.g., Ira Helfand, Lachlan Farrow & Jaya Tiwari, *Nuclear Terrorism*, 324 BRITISH MED. J. 356, 358 (2002).

250. Sunstein, *supra* note 225, at 1054–58.

251. Cf. Robert Rauchhaus, *Evaluating the Nuclear Peace Hypothesis: A Quantitative Approach*, 53 J. CONFLICT RESOLUTION 258 (2009).

252. CARL VON CLAUSEWITZ, ON WAR 87 (Michael E. Howard trans., Peter Paret ed., 1989).

purpose, it must be exactly that: assured.²⁵³ Therefore, the strong Precautionary Principle would also seem to counsel in *favor* of a nuclear triad possessing enough redundancies and weapons to destroy the world several times over. Consequently, a faithful application of the strong Precautionary Principle is paralyzing in this situation because it cautions against *both* choices. In other words, even if one agreed that it is *always* better to be safe than sorry, rarely is it clear what is safe and what is sorry.

Sunstein's critique of the Precautionary Principle is nuanced. Again, in its weak form, it is unobjectionable.²⁵⁴ The absence of a causal link should not always preclude regulatory intervention. In its strong form, it is paralytic and thus cannot be relied upon.²⁵⁵ Notwithstanding the paralytic effects, however, it still has "widespread appeal."²⁵⁶ Herein lies the key to Professor Sunstein's critique: how can groups, like the physicians above, continue to embrace the strong Precautionary Principle when it cautions against *both* regulatory intervention *and* nonintervention? The answer lies in the fact that individuals "can regard themselves as 'precautionary' only if they blind themselves to many aspects of risk-related situations and focus on a narrow subset of what is at stake."²⁵⁷ This blindness or selective risk awareness is possible because of cognitive biases.²⁵⁸ In situations where the strong Precautionary Principle should be paralyzing because of the existence of substitute risks, humans, subconsciously relying on cognitive biases, selectively apply the Precautionary Principle to some sources of risk while completely ignoring others.²⁵⁹ "Simply as a logical matter, no society can be highly precautionary with respect to all risks."²⁶⁰

The Precautionary Principle (and the cognitive biases that inform its application) is magnified in the context of emerging technologies. The strong form Precautionary Principle should almost always be paralytic in this context. On the one hand, it would require government regulation of any emerging technology that might pose a risk to health or safety. Since the nature and scope of risks posed by a new piece of technology often suffer from a significant degree of uncertainty, the Precautionary Principle could be invoked in favor of regulating nearly every emerging technology. On the other hand, emerging technologies offer potential opportunity benefits. Technology saves lives. Consequently, the Precautionary Principle would caution against any government interference that

253. See *WARGAMES* (MGM Studios Inc. 1983) (In the classic '80s flick *WARGAMES*, Mathew Broderick's character "trained" a computer by having it repeatedly play tic-tac-toe in order to make it realize that launching a nuclear attack guaranteed mutual destruction with no winner (and the newly educated computer therefore aborted the attack)); see also Ben Gilbert, *Elon Musk Says He's Terrified of AI Taking over the World and Most Scared of Google's DeepMind AI Project*, *INSIDER* (July 27, 2020, 11:49 AM), <https://www.businessinsider.com/elon-musk-maureen-dowd-ai-google-deepmind-wargames-2020-7> [<https://perma.cc/U96U-6PW8>] (comparing Google AI to *WARGAMES*).

254. Sunstein, *supra* note 225, at 1016.

255. *Id.* at 1035.

256. *Id.* at 1018.

257. Cass R. Sunstein, *Precautions Against What? The Availability Heuristic and Cross-Cultural Risk Perception*, 57 *ALA. L. REV.* 75, 77 (2005).

258. See Sunstein, *supra* note 225, at 1036.

259. See *id.* at 1029.

260. *Id.*

might inhibit the development of lifesaving technologies. Thus “it [should] stand[] as an obstacle to regulation and nonregulation, and to everything in between.”²⁶¹ The remainder of this section, however, demonstrates how the cognitive biases that inform applications of the strong Precautionary Principle selectively amplify the perceived risks posed by emerging technology in a particularized manner, tipping the decisional scales in favor of regulation. That is, cognitive biases, working through the Precautionary Principle, consistently manifest as a bias against emerging technologies, resulting in suboptimal regulatory decision-making.

B. Neophobia: Fear of the Unknown Versus Dread of the Unfamiliar

It is easy to see how a human penchant for fearing unknown risks could influence the selective application of the Precautionary Principle. The Precautionary Principle is an attempt to account for scientific uncertainties. A fear, or even discomfort, associated with uncertainty could lead one to over-perceive any threat associated with that uncertainty.²⁶² This cognitive bias is also exhibited in common proverbs, such as “better the devil you know than the devil you don’t.” In the context of emerging technologies, fear of the unknown takes on a different, amplified meaning. The risks posed by emerging technologies are likely to be overperceived because, not only are they unknown or uncertain, they are unfamiliar and alien.²⁶³ In other words, “familiarity may breed contempt: common actions and activities are often not perceived as especially risky compared with the unfamiliar or the novel.”²⁶⁴ Thus, the very nature of emerging technologies results in a particularized kind of phobia: technophobia—a subset of neophobia.²⁶⁵ As an example, while the risk associated with a tornado or hurricane may be uncertain or unknown, we accept that these kinds of natural disasters are somewhat familiar to us, even if we aren’t directly affected by them. So-called “murder hornets,” on the other hand, engender a more dreadful kind of fear because they are alien and thus are not easily comparable to other, more familiar, natural disasters.²⁶⁶ Consequently, the selective application of the Precautionary Principle to emerging technologies is influenced not only by a fear of the unknown but by a dread of the unfamiliar.

Neophobia is well-documented. A risk perception study in Korea revealed that individuals over-perceived the risk posed by the 2002 SARS outbreak relative to the risk posed by influenza because of the unfamiliarity of the SARS risk

261. *Id.* at 1028.

262. *Id.* at 1036.

263. Martina Rauc et al., *The Influence of Feelings While Driving Regular Cars on the Perception and Acceptance of Self-Driving Cars*, 39 RISK ANALYSIS 358, 359, 361 (2019) (“For example, objectively risky activities such as alcohol consumption or driving, which are perceived as non-dreadful and familiar, are also perceived as not very risky by the public.”).

264. *Id.*

265. See Khasawneh, *supra* note 2, at 98.

266. See, e.g., Anthony Laudato, *Invasion! The Threat from Asian Giant Hornets*, CBS NEWS (July 26, 2020, 9:07 AM), <https://www.cbsnews.com/news/invasion-the-threat-from-asian-giant-hornets/> [<https://perma.cc/3C7R-YTPQ>].

factors.²⁶⁷ One Canadian study of sexual behavior found that individuals were more likely to downplay the risks of unprotected sex with a hypothetical new partner who they *perceived* as more “familiar,” even where familiarity provided no “information about the sexual health history for any of the hypothetical partners.”²⁶⁸ This study indicates that it is not only familiarity in the objective sense, but in the subjective as well, that determines risk perceptions.²⁶⁹ This suggests that the brain can be lulled into feelings of familiarity even in the absence of true familiarity. Other studies have noted that perceptions of familiarity regarding an ethnic cuisine are negatively correlated with perceptions of risk posed by that cuisine.²⁷⁰ As some of these observers have explained,²⁷¹ concomitant to a fear of the unfamiliar is the mere-exposure effect, a “well-established finding that people evaluate a stimulus more positively after repeated exposure to that stimulus.”²⁷²

Technophobia as a form of neophobia is likewise well-documented.²⁷³ Much of the research surrounding this phenomenon was inspired by a wave of computer-phobia in the 1980s when the age of personal computers dawned.²⁷⁴ It can be defined as “an irrational fear and/or anxiety that individuals form as a response to a new stimulus that comes in the form of a technology”²⁷⁵ From a logical standpoint, “the adoption of novel products [or technology] is typically associated with risk taking and uncertainty because accepting novelty implies leaving the realm of the familiar.”²⁷⁶ A literature review of empirical research regarding the impact of technophobia on business concluded that “the introduction of technological changes can provoke emotional and cognitive reactions. This fear and anxiety may manifest itself in the form of a phobia-induced by

267. See Seonghoon Hong & Alan Collins, *Societal Responses to Familiar Versus Unfamiliar Risk: Comparisons of Influenza and SARS in Korea*, 26 RISK ANALYSIS 1247, 1254–55 (2006).

268. Shayna Sparling & Ken Cramer, *Choosing the Danger We Think We Know: Men and Women's Faulty Perceptions of Sexually Transmitted Infection Risk with Familiar and Unfamiliar New Partners*, 24 CANADIAN J. HUM. SEXUALITY 237, 241 (2015).

269. See *id.*

270. See, e.g., Hyewon Youn & Jong-Hyeong Kim, *Is Unfamiliarity a Double-Edged Sword for Ethnic Restaurants?*, 68 INT'L J. HOSP. MGMT. 23, 24–25 (2018); Ja Young Choe & Mi Sook Cho, *Food Neophobia and Willingness to Try Non-Traditional Foods for Koreans*, 22 FOOD QUALITY & PREFERENCE 671, 676 (2011).

271. See Sparling & Cramer, *supra* note 268, at 241; Choe & Cho, *supra* note 270, at 676.

272. Pieter Van Dessel, Gaëtan Mertens, Colin Tucker Smith & Jan De Houwer, *The Mere Exposure Instruction Effect: Mere Exposure Instructions Influence Liking*, 64 EXPERIMENTAL PSYCH. 299, 299 (2017). See generally Robert B. Zajonc, *Attitudinal Effects of Mere Exposure*, 9 J. PERSONALITY & SOC. PSYCH. 1, 1 (1968). Cf. D. W. Rajecki, *Zajonc, Cockroaches, and Chickens, c. 1965–1975: A Characterization and Contextualization*, 2 EMOTION REV. 320, 326 (2010); Thomas D.G. Burgess II & Stephen M. Sales, *Attitudinal Effects of “Mere Exposure”: A Reevaluation*, 7 J. EXPERIMENTAL SOC. PSYCH. 461, 462 (1971).

273. See Adrienne LaFrance, *When People Feared Computers*, ATLANTIC (Mar. 30, 2015), <https://www.theatlantic.com/technology/archive/2015/03/when-people-feared-computers/388919/> [https://perma.cc/636L-A66M].

274. *Id.*

275. Khasawneh, *supra* note 2, at 98.

276. Peter H. Feindt & P. Marijn Poortvliet, *Consumer Reactions to Unfamiliar Technologies: Mental and Social Formation of Perceptions and Attitudes Toward Nano and GM Products*, 23 J. RISK RSCH. 475, 478 (2020).

technology; technophobia.”²⁷⁷ In turn, that phobia “might push employees to avoid the new technology.”²⁷⁸ Moreover, “technophobia d[oes] not fade away with time. In fact, new technologies bring new and unique facets of technophobia”²⁷⁹

Technophobia’s influence on risk perception and decision-making is costly. Indeed, looking only at its effects on the workplace, it has been “estimated that technophobia might be responsible for no less than \$4.2 billion[] in wages, in the United States alone.”²⁸⁰ Further research suggests that aversion to unfamiliar technology, a heuristic in its own right, is informed by other heuristics.²⁸¹ In effect, the absence of familiarity results in a blank canvas of sorts, which, out of discomfort, humans subconsciously seek to fill with other heuristics. Turning to some of these other heuristics, it is clear how they comingle and compound one another to bias individuals against unfamiliar technology.

C. *The Availability Heuristic*

When sorting through unknown or unfamiliar risks, humans rely on the availability heuristic to manufacture risk probabilities.²⁸² The brain attempts to produce a proxy estimate of the probability of an event occurring or the frequency of a class based on the ease with which prior examples can be recalled from stored recollections.²⁸³ For example, the reason an individual might think of a crow or a sparrow when asked to picture a bird is likely because those examples are the ones frequently encountered, and thus are the most available for the brain to recall. “The availability heuristic illuminates the operation of the Precautionary Principle, by showing why some hazards will be on-screen and why others will be neglected.”²⁸⁴ It helps explain why the Precautionary Principle is invoked against emerging technologies when instead it should be paralytic due to substitute costs.

The availability heuristic can operate as a convenient means of estimating and navigating the risks of everyday life.²⁸⁵ “[It] is an ecologically valid clue for the judgment of frequency because, in general, frequent events are easier to recall or imagine than infrequent ones.”²⁸⁶ In this sense, it would appear that the availability heuristic is at odds with the foregoing discussion of unfamiliar risk. In

277. Odai Y. Khasawneh, *Technophobia Without Borders: The Influence of Technophobia and Emotional Intelligence on Technology Acceptance and the Moderating Influence of Organizational Climate*, 88 *COMPUTS. HUM. BEHAV.* 210, 210 (2018) (citing Marjorie A. Cambre & Desmond L. Cook, *Computer Anxiety: Definitions, Measurement, and Correlates*, 1 *J. EDUC. COMPUTING RSCH.* 37 (1985)).

278. Khasawneh, *supra* note 2, at 94.

279. *Id.* at 98.

280. *Id.* at 93. (citing Victoria B. Elder, Ella P. Gardner & Stephen R. Ruth, *Gender and Age in Technostress: Effects on White-Collar Productivity*, 3 *GOV'T. FIN. REV.* 17 (1987)).

281. See Feindt & Poortvliet, *supra* note 276, at 476.

282. See Amos Tversky & Daniel Kahneman, *Availability: A Heuristic for Judging Frequency and Probability*, 5 *COGNITIVE PSYCH.* 207, 208 (1973).

283. See *id.*

284. Sunstein, *supra* note 257, at 87.

285. Tversky & Kahneman, *supra* note 282, at 208.

286. *Id.* at 209.

general, one might expect that familiar risks would be overestimated by the availability heuristic since they are the most available, whereas infrequent and unfamiliar risks would be underestimated because they are unavailable. “However, availability is also affected by various factors which are unrelated to actual frequency. . . . [S]uch factors will affect the perceived frequency of classes and the subjective probability of events.”²⁸⁷ These manipulative factors are especially prevalent in the context of emerging technologies. When they are allowed to bias human perception, “the availability heuristic can lead to serious errors in terms of both excessive fear and neglect.”²⁸⁸

Any number of factors which affect memory recall can lead to a biased application of the availability heuristic.²⁸⁹ The most obvious factors are salience and vividness.²⁹⁰ They contribute to availability because the more salient or vivid an experience, object, or story is, the more likely it is to trigger and capture attentional resources in the brain and for longer periods of time.²⁹¹ “Greater time in thought means more rehearsal, and more rehearsal means greater memorial availability.”²⁹² In the context of tobacco regulation, graphic warning labels incorporating salient and vivid depictions of the adverse consequences of tobacco consumption have been shown to result in better recall of the warning messages.²⁹³

The underlying nature of emerging technologies renders them particularly susceptible to a biased application of the availability heuristic. In particular, “[c]ontextual factors such as . . . novelty . . . or media coverage increase the salience of an event.”²⁹⁴ Demonstrating the interrelated nature of different cognitive biases in risk assessment, novelty and unfamiliarity contribute to availability because new and unique objects or events are likely to capture attentional resources.²⁹⁵ As previously discussed, emerging technologies are, by definition, novel and unfamiliar.²⁹⁶

With respect to media coverage, “[a]vailability, produced by ‘a particularly vivid case or new finding that receives considerable media attention,’ play[s] a

287. *Id.*

288. Sunstein, *supra* note 257, at 88.

289. *See id.* at 77.

290. *See id.* (“If a particular incident is cognitively ‘available’—both vivid and salient—then people will have a heightened fear of the risk in question.”).

291. *See* Valerio Santangelo, *Forced to Remember: When Memory Is Biased by Salient Information*, 283 BEHAV. BRAIN RSCH. 1, 4 (2015).

292. RICHARD NISBETT & LEE ROSS, HUMAN INFERENCE: STRATEGIES AND SHORTCOMINGS OF SOCIAL JUDGMENT 55 (1980) (“Thus, more vivid information is likely to be more available not merely because it is more interesting and hence likely to be stored. More vivid information normally will prompt more rehearsal and more elaborate and effective encoding processes, both of which should improve later availability.”).

293. *See* An-Li Wang, Zhenhao Shi, Victoria P. Fairchild, Catherine A. Aronowitz & Daniel D. Langleben, *Emotional Salience of the Image Component Facilitates Recall of the Text of Cigarette Warning Labels*, 29 EUR. J. PUB. HEALTH 153, 156 (2018).

294. Olivier Dessaint & Adrien Matray, *Do Managers Overreact to Salient Risks? Evidence from Hurricane Strikes*, 126 J. FIN. ECON. 97, 98 (2017).

295. *See id.*

296. *See supra* Section III.B.

major role in . . . leaps in public concern.”²⁹⁷ Emerging technologies are particularly affected by media coverage because they are subject to the Gartner Hype Cycle.²⁹⁸ “Gartner’s Hype Cycle . . . characterizes the typical progression of an emerging technology from overenthusiasm through a period of disillusionment to an eventual understanding”²⁹⁹ The period of disillusionment often occurs “[b]ecause the technology does not live up to . . . the media’s overinflated expectations, [and] it is rapidly discredited. Some of the early trials end in highly publicized failures. Media interest wanes, except for a few cautionary tales.”³⁰⁰ While the technology usually recovers from early struggles, negativity bias—in which “bad information is processed more thoroughly than good”—helps explain why individuals perceive negative media hype as more salient than positive hype.³⁰¹

297. See Sunstein, *supra* note 257, at 90.

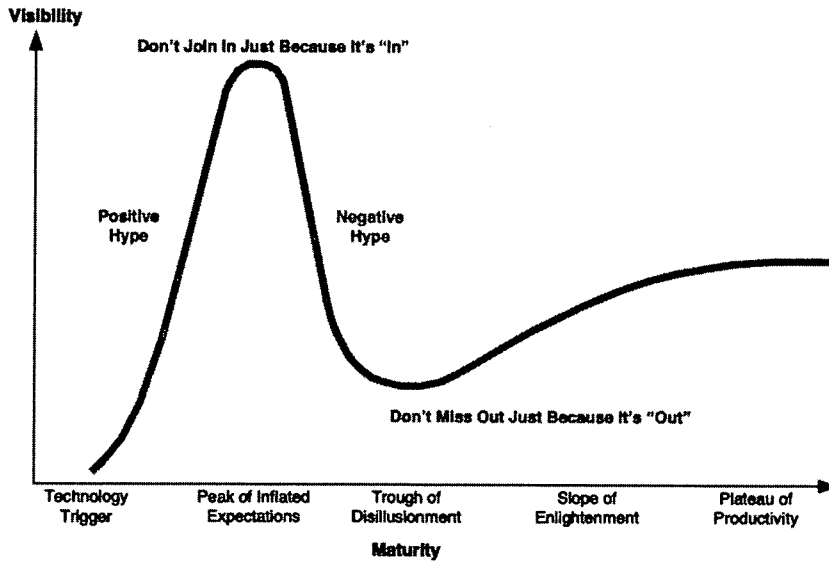
298. See ALEXANDER LINDEN & JACKIE FENN, UNDERSTANDING GARTNER’S HYPE CYCLES: STRATEGIC ANALYSIS REPORT, GARTNER RSCH. 5 (2003), <http://www.ask-force.org/web/Discourse/Linden-HypeCycle-2003.pdf> [<https://perma.cc/CL3X-JUYB>].

299. *Id.*

300. *Id.* at 8.

301. Roy F. Baumeister, Ellen Bratslavsky, Catrin Finkenauer & Kathleen D. Vohs, *Bad Is Stronger than Good*, 5 REV. GEN. PSYCH. 323, 323 (2001). Media sensationalization of “murder hornets” offers a prime example of negative media hype and public reactions to it. See, e.g., Spencer K. Monckton, *How British Columbia and Washington State Are Stopping the Spread of Asian Giant Hornets*, CONVERSATION (July 8, 2020, 11:50 AM), <https://theconversation.com/how-british-columbia-and-washington-state-are-stopping-the-spread-of-asian-giant-hornets-140518> [<https://perma.cc/6LH9-2DZ2>] (“Panic-stricken headlines about ‘murder hornets’ are thankfully mostly behind us. The nickname may have staying power, but it is certainly unearned.”); Natalie O’Neill, *What Happened to the Murder Hornets Expected to Wreak Havoc in the US?*, N.Y. POST (July 9, 2020, 2:50 PM), <https://nypost.com/2020/07/09/what-happened-to-the-murder-hornets-invading-the-us/> [<https://perma.cc/QE2Q-KAM6>] (“Unfortunately a lot of people are killing bumblebees thinking they are Asian giant hornets, . . . [t]hat’s doing more harm than good.”); Kaila Lafferty, *2,000+ Reports of Potential Asian Giant Hornets Sent to Washington Department of Agriculture*, KING 5 NEWS (July 23, 2020, 7:09 PM), <https://www.king5.com/article/tech/science/environment/asian-giant-over-2000-reports-of-potential-murder-hornet-sightings-submitted-to-the-department-of-agriculture/281-456f2dd9-4fac-46bc-9acf-6e14a422a7ef> [<https://perma.cc/238K-KDMF>] (“Almost all of [the 2,000+ sightings] turned out to be false reports.”).

FIGURE 1: THE HYPE CURVE



Source: Gartner Research (May 2003)

Finally, the nature of the substitute costs associated with regulating emerging technologies also renders them particularly susceptible to availability bias.³⁰²

Sometimes a certain risk, said to call for precautions, is cognitively available, whereas other risks, including the risks associated with regulation itself, are not. . . . In many cases where the precautionary principle seems to offer guidance, the reason is that some of the relevant risks are available while others are barely visible.³⁰³

For example, the brain can easily understand the causal link between mandatory infant restraints in airplanes and reduced injuries related to flying with infants.³⁰⁴ The causal pathway the brain must navigate, however, to establish a link between mandatory infant restraints on airplanes and increased traffic deaths requires several more inferential steps. Understanding the risks associated with overregulating or not adopting an emerging technology also requires more inferential steps because they come in the form of lost opportunity benefits; lives that could have been saved or improved. On the other hand, the costs associated with adopting an emerging technology are much more visible because they represent a departure from the status quo.

Novelty, media hype, and cost visibility represent only a few of the routes through which the availability heuristic can skew perceptions against an emerging technology in distinct and particularized modes.³⁰⁵ As shown below, there are numerous other interrelated cognitive biases that affect the availability heuristic and the Precautionary Principle.

302. Cf. Sunstein, *supra* note 225, at 1043.

303. *Id.*

304. See *supra* Section II.B.2.

305. See Dessaint & Matray, *supra* note 294, at 98.

D. Informational Access

Decision-makers are only as good as the information they possess. When an emerging technology threatens to disrupt an industry,³⁰⁶ preexisting industry players often face the threat of significant pecuniary losses.³⁰⁷ Understandably, these self-interested parties respond by discrediting or obstructing the emerging technology.³⁰⁸ Modern corporate structures and increased fidelity to the shareholder have contributed to this zealous safeguarding of market share and profitability, even at the cost of human life.³⁰⁹ Some of these defense tactics include the usual and effective lobbying and political spending that influence high level decision-making.³¹⁰ However, in a democratic society filled with individual decisionmakers, industry manipulation of the accessibility, pace, and content of information in order to distort public perceptions of risk can be just as effective at preventing market disruption.³¹¹

As a general proposition, established market players are likely to react negatively to any developments, tech-related or otherwise, that threaten their bottom lines. The tobacco industry's response to the discovery of a conclusive link between its products and various cancers is a prime example of the depths to which corporations will stoop to protect profitable products.³¹² In addition to the typical lobbying and politicking, the tobacco industry engaged in informational warfare

306. “Disruptive technology can be defined as ‘. . . a technology that changes the bases of competition by changing the performance metrics along which firms compete.’” Munan Li, Alan L. Porter & Arho Suominen, *Insights into Relationships Between Disruptive Technology/Innovation and Emerging Technology: A Bibliometric Perspective*, 129 *TECH. FORECASTING & SOC. CHANGE* 285, 286 (2018) (quoting J.L. Bower & C.M. Christenson, *Disruptive Technologies: Catching the Wave*, 73 *HARV. BUS. REV.* 43, 43–53 (1995)).

307. Two readily available examples of industry leaders suffering losses as a result of emerging technology include BlackBerry, Ltd. and Kodak, Inc.; see Sam Gustin, *The Fatal Mistake that Doomed BlackBerry*, *TIME* (Sept. 24, 2013), <https://business.time.com/2013/09/24/the-fatal-mistake-that-doomed-blackberry/> [<https://perma.cc/83J2-XVT2>]; Chunka Mui, *How Kodak Failed*, *FORBES* (Jan. 18, 2012, 9:56 AM), <https://www.forbes.com/sites/chunkamui/2012/01/18/how-kodak-failed/#6ea4a7516f27> [<https://perma.cc/85RL-WWTK>].

308. See, e.g., Yussuf Saloojee & Elif Dagli, *Tobacco Industry Tactics for Resisting Public Policy on Health*, 78 *BULL. WORLD HEALTH ORG.* 902, 902–03 (2000); Samantha L. Thomas, Jennifer David, Melanie Randle, Mike Daube & Kate Senior, *Gambling Advocacy: Lessons from Tobacco, Alcohol and Junk Food*, 40 *AUSTRALIAN & N.Z. J. PUB. HEALTH* 211, 211 (2016).

309. See Saloojee & Dagli, *supra* note 308, at 902 (2000). (“Questioned about the ethics of targeting the world’s poor, a manager at [a major tobacco company] replied: ‘It would be stupid to ignore a growing market. I can’t answer the moral dilemma. We are in the business of pleasing our shareholders.’”); see also SIMON SINEK, *THE INFINITE GAME* 70–90 (2019) (discussing the negative effects of shareholder primacy).

310. Just how effective industry lobbying and political donations are has been studied extensively in the context of the leadup to the 2008 Financial Crisis. See generally Atif Mian, Amir Sufi & Francesco Trebbi, *The Political Economy of the Subprime Mortgage Credit Expansion*, 8 *Q. J. POL. SCI.* 373 (2013) (examining the effectiveness of special interest lobbying in the buildup to the subprime mortgage crisis); Deniz Igan, Prachi Mishra & Thierry Tresselt, *A Fistful of Dollars: Lobbying and the Financial Crisis*, 26 *NBER MACROECONOMICS ANN.* 195 (2012) (analyzing the effect of lobbying effort on lenders’ stock returns).

311. See, e.g., Saloojee & Dagli, *supra* note 308, at 903 (describing tobacco manufacturers that “have engaged in a vigorous effort to silence critics distort science, influence public opinion, control public policy, and coordinate their strategy on litigation”).

312. See *id.*

on a scale the business world had never seen.³¹³ In response to the carcinogenic discovery, the industry launched a campaign to suppress negative research.³¹⁴ Furthermore, it established a research front in the form of the Tobacco Industry Research Council.³¹⁵ “Instead of supporting genuine scientific research into the problems, it spent millions of dollars publicizing research purporting to prove that tobacco did not cause cancer.”³¹⁶ Following decades of misinformation and obfuscation—and unnecessary deaths—public perception of risk eventually caught up with reality.³¹⁷ Even still, the industry persisted in its disinformation campaign when the risk posed by second-hand smoke was later revealed.³¹⁸ These tactics continue to this day.³¹⁹ Importantly, the “industry’s strategy does not require winning the debates it manufactures. It is enough to foster and perpetuate the illusion of controversy in order to muddy the waters around scientific findings that threaten the industry.”³²⁰ In other words, the mere implantation of a seed of doubt regarding risk levels can be enough to delay accurate public perception of risk by decades. Taking note, other businesses—including fast food restaurants, alcohol producers, and casinos—have launched similar disinformation campaigns with comparable success.³²¹

With respect to emerging technologies, the American automobile industry has waged similar disinformation campaigns against new products proven to increase motor vehicle safety.³²² The decades-long battle over seatbelts and airbags represent a paradigmatic example.³²³ In his revolutionary book, *Unsafe at Any Speed*, Ralph Nader accused the American auto industry of ignoring technology that increased safety.³²⁴ Worried that an accurate assessment of the risk posed by their cars would hurt their bottom line, the big auto companies fomented disinformation.³²⁵ Like the tobacco industry, the American auto industry established several research and safety foundations whose real purpose was to deflect public risk perception away from dangerous design towards dangerous drivers.³²⁶ They

313. See WORLD HEALTH ORG., TOBACCO INDUSTRY INTERFERENCE WITH TOBACCO CONTROL 4–5 (2008), <https://www.who.int/publications/i/item/9789241597340> [<https://perma.cc/4UFN-ANFM>] [hereinafter WHO, *Tobacco Report*]; Saloojee & Dagli, *supra* note 308, at 903.

314. See WHO, *Tobacco Report*, *supra* note 313, at 10.

315. Saloojee & Dagli, *supra* note 308, at 903.

316. *Id.*

317. See *id.*

318. See *id.* at 903–04.

319. See WHO, *Tobacco Report*, *supra* note 313, at 10.

320. Saloojee & Elif Dagli, *supra* note 308, at 903.

321. See Thomas et al., *supra* note 308, at 211.

322. Clyde Haberman, *Lessons from the Past for a Future in Smart Cars*, N.Y. TIMES (Sept. 14, 2014), <https://www.nytimes.com/2014/09/15/us/lessons-from-the-past-for-a-future-in-smart-cars.html> [<https://perma.cc/5SEZ-KKCM>].

323. *Id.*

324. *Id.*; see also The New York Times, *Searching for the Crashless Car*, YOUTUBE (Sept. 15, 2014), <https://www.youtube.com/watch?v=qxuqBdiQtRw&t=6s> [<https://perma.cc/FHE4-GVVQ>] [hereinafter New York Times, *Crashless Car*].

325. See Frank W. Geels & Caetano C.R. Penna, *Societal Problems and Industry Reorientation: Elaborating the Dialectic Issue LifeCycle (DILC) Model and a Case Study of Car Safety in the USA (1900–1995)*, 44 RSCH. POL’Y 67, 78 (2015).

326. See *id.* at 76 (discussing the Automobile Safety Foundation, the NSC, etc.).

pumped out information claiming consumers did not want increased safety and inaccurate assessments of the costs associated with safety measures.³²⁷ They even went as far as to threaten Mr. Nader and dissenting manufacturers who sought to innovate in the field of auto safety.³²⁸ Even after it became clear to the big auto companies that public perception of risk would inevitably catch up with reality, they persisted in publicly stifling safety innovation while privately developing the technology themselves.³²⁹ Following decades of disinformation and unnecessary death, car manufacturers have performed a complete about-face, competing to win the title of safest car on the road.³³⁰

Another paradigmatic example of information manipulation is the National Football League's ("NFL") suppression of cutting-edge concussion research.³³¹ Bennet Omalu, portrayed by actor Will Smith in the film *Concussion*,³³² famously discovered the neurodegenerative disease chronic traumatic encephalopathy ("CTE")—originally thought to be confined to boxers—in NFL players.³³³ Naïvely, Dr. Omalu "thought NFL doctors would be pleased when they [learned of his discovery]."³³⁴ However, like the tobacco and auto industries, the NFL had its own counter-research arm, the Mild Traumatic Brain Injury committee.³³⁵ Though none of its leading members were neuropathologists, they did their best to discredit Dr. Omalu's work and his reputation.³³⁶ In communications with academics, reporters, and the public, the NFL dismissed his work as "speculative," "flawed," and "not appropriate science."³³⁷ Moreover, they "'publish[ed] an unprecedented series of papers, several of which were rejected by peer reviewers and editors and later disavowed even by some of their own authors."³³⁸ Once the NFL realized they could no longer deny the undeniable, they began to

327. New York Times, *Crashless Car*, *supra* note 324; *see also* Geels & Penna, *supra* note 325, at 79.

328. Haberman, *supra* note 322 ("General Motors, then the dominant car manufacturer, reacted to Mr. Nader's charges with the far-from-brilliant tactic of spying on him and trying to lure him into compromising positions.").

329. *See* Geels & Penna, *supra* note 325, at 78.

330. *See id.* at 69; *see also* 2021 *Top Safety Picks*, INS. INST. FOR HIGHWAY SAFETY, <https://www.iihs.org/ratings/top-safety-picks> (last visited Jan. 16, 2022) [<https://perma.cc/YNR3-9MBY>]. The automotive industry has also waged information warfare against technology that could make cars safer for the environment, and ultimately, human life. The industries resistance to the catalytic converter is a representative example. *See* Steven Cohen, *The 'Can't-Do' Approach of the American Auto Industry*, HUFFPOST (Mar. 27, 2017, 7:48 AM), https://www.huffpost.com/entry/the-cant-do-approach-of-the-american-auto-industry_b_58d8fb3de4b0f633072b3979 [<https://perma.cc/JYR6-C6CJ>].

331. *See* Jeanne Marie Laskas, *Bennet Omalu, Concussions, and the NFL: How One Doctor Changed Football Forever*, GQ (Sept. 14, 2009) <https://www.gq.com/story/nfl-players-brain-dementia-study-memory-concussions> [<https://perma.cc/6GTS-N54V>].

332. *See* CONCUSSION (Columbia Pictures 2015); *see also* Laskas, *supra* note 331.

333. *See generally* Bennet I. Omalu et al., *Chronic Traumatic Encephalopathy in a National Football League Player*, 57 NEUROSURGERY 128 (2005).

334. Laskas, *supra* note 331.

335. *Id.*

336. *See id.*

337. *Id.*

338. *See The NFL Tried to Intimidate Scientists Studying the Link Between Pro Football and Traumatic Brain Injury*, UNION CONCERNED SCIENTISTS (Oct. 11, 2017), <https://www.ucsusa.org/resources/nfl-tried-intimidate-scientists-studying-link-between-pro-football-and-traumatic-brain> [<https://perma.cc/S48K-4A55>] (quoting MARK FAINARU-WADA & STEVE FAINARU, LEAGUE OF DENIAL 6 (2013)).

suppress the undeniable.³³⁹ A 2016 congressional study accused the NFL of “work[ing] to improperly influence . . . government research, trying to steer [a] study toward a doctor with ties to the league”³⁴⁰ After the NFL realized it could not influence the study, it pulled the funds it had promised.³⁴¹ Sadly, while the NFL was busy obfuscating and sowing the seeds of doubt, a generation of young children signed up for youth football completely unaware of just what they were signing up for.³⁴² Of his groundbreaking research, Dr. Omalu had the following to say: “There are times I wish I never [did it]. It has dragged me into worldly affairs I do not want to be associated with. Human meanness, wickedness, and selfishness. *People trying to cover up, to control how information is released.*”³⁴³

Whether motivated by corporate greed, fiduciary duty to the shareholder, or the structure of executive compensation, the ability of industry players to wage informational warfare against emerging technologies has a significant impact on public perception of associated risks.³⁴⁴ Even giant tech companies that once cut their teeth on innovation are exhibiting similar defensive behaviors.³⁴⁵ They have been accused of suppressing and stifling emerging technologies by taking advantage of mergers and acquisitions, borderline copyright infringement, and disproportionate economies of scale (e.g., Facebook’s strong-armed acquisition³⁴⁶

339. *Id.*

340. John Branch, *N.F.L. Tried to Influence Concussion Research, Congressional Study Finds*, N.Y. TIMES (May 23, 2016), <https://www.nytimes.com/2016/05/24/sports/football/nfl-tried-to-influence-concussion-research-congressional-study-finds.html> [<https://perma.cc/ZHR4-TEBQ>].

341. *See id.*

342. Laskas, *supra* note 331 (“You realize you can blow out your knee, you can even break your neck and become paralyzed. Those are all known risks. But you don’t sign up to become a brain-damaged young adult.”).

343. *Id.* (emphasis added).

344. It is important to note that industry is not the only source capable of information manipulation. The example of anti-vaccination propaganda demonstrates how any group threatened by an emerging piece of technology can sow the seeds of doubt in the face of overwhelming evidence. *See generally* 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 (2012); Azhar Hussain, Syed Ali, Madiha Ahmen & Sheharyar Hussain, *The Anti-Vaccination Movement: A Regression in Modern Medicine*, CUREUS, July 3, 2018, at 1; Matthew Motta, Steven Sylvester & Timothy Callaghan, *Why Vaccine Opponents Think They Know More than Medical Experts*, TEX. MED. ASS’N (Oct. 24, 2019), <https://www.texmed.org/Template.aspx?id=48227> [<https://perma.cc/HYZ4-TSKV>]. However, this section primarily focuses on industry manipulation because that form of manipulation affects emerging technology in a more particularized manner.

345. *See* Alexis C. Madrigal, *Silicon Valley Abandons the Culture that Made It the Envy of the World*, ATLANTIC (Jan. 15, 2020), <https://www.theatlantic.com/technology/archive/2020/01/why-silicon-valley-and-big-tech-dont-innovate-anymore/604969/> [<https://perma.cc/KDNS-WVUA>].

346. *See* Tyler Sonnemaker, *New Text Messages Show Kevin Systrom Worried About Mark Zuckerberg Going into ‘Destroy Mode’ If He Didn’t Sell to Facebook*, INSIDER (July 29, 2020, 6:05 PM), <https://www.businessinsider.com/instagram-cofounder-feared-zuckerberg-destroy-mode-facebook-acquisition-texts-2020-7> [<https://perma.cc/4WX4-9A95>] (“Facebook’s acquisition of Instagram has since come under scrutiny from regulators and politicians who argue it amounted to anti-competitive practices.”).

of Instagram and Amazon's undercutting³⁴⁷ of competitor prices).³⁴⁸ Like the tobacco and automotive industries, big tech has also demonstrated a willingness to manipulate the information the public receives.³⁴⁹ The fact that big tech companies—once themselves champions of disruptive technology—are now themselves stifling innovation lends credence to the notion that emerging technology is particularly susceptible to risk misperception caused by industry manipulation of information.

E. Control

As emerging technology promises to make life increasingly automated, it also becomes exposed to another particularized form of cognitive bias. While much of the fear associated with automation is economic,³⁵⁰ those fears are inextricably bound to a technophobic fear of losing control.³⁵¹ Fear of losing

347. See Taylor Hatmaker & Devin Coldewey, *Secret Documents from US Antitrust Probe Reveal Big Tech's Plot to Control or Crush the Competition*, TECHCRUNCH (July 31, 2020, 1:07 PM), <https://tinyurl.com/2926s353> [<https://perma.cc/Y99G-BJ6J>] (“Aggressive price cutting by [Amazon] forced the [competition] out of business, allowing it to be snapped up and integrated.”).

348. See, e.g., Angus Loten, *Large Tech Companies Prepare for Acquisition Spree*, WALL ST. J. (May 21, 2020, 5:30 AM), <https://www.wsj.com/articles/large-tech-companies-prepare-for-acquisition-spree-11590053401> [<https://perma.cc/P88M-MVAL>]; Christopher Mims, *Not Even a Pandemic Can Slow Down the Biggest Tech Giants*, WALL ST. J. (May 23, 2020, 1:37 PM), <https://www.wsj.com/articles/not-even-a-pandemic-can-slow-down-the-biggest-tech-giants-11590206412> [<https://perma.cc/B8MS-MVC7>]; *American Tech Giants Are Making Life Tough for Startups*, ECONOMIST (June 2, 2018), <https://www.economist.com/business/2018/06/02/american-tech-giants-are-making-life-tough-for-startups> [<https://perma.cc/4DXY-D4K4>]; Jack Kelly, *Big Tech Continues to Get Bigger While Smaller Rivals Are Withering Away*, FORBES (Apr. 15, 2020, 12:41 PM), <https://www.forbes.com/sites/jackkelly/2020/04/15/big-tech-continues-to-get-bigger-while-others-are-withering-away/#2959c51e7fd2> [<https://perma.cc/ES4B-QFZM>].

349. See, e.g., Alan Patricof, *The Big Tech Companies Are Smothering Small Start-Ups*, FIN. TIMES (Apr. 10, 2019), <https://www.ft.com/content/dcaf8f16-5ae2-11e9-840c-530737425559> [<https://perma.cc/CDY5-4M6S>]; Rodrigo Ochigame, *The Invention of “Ethical AI,”* INTERCEPT (Dec. 20, 2019, 12:19 PM), <https://the-intercept.com/2019/12/20/mit-ethical-ai-artificial-intelligence/> [<https://perma.cc/7G7L-UDFE>]; Cathy O’Neil, *Big-Data Algorithms Are Manipulating Us All*, WIRED (Oct. 18, 2016, 7:00 AM), <https://www.wired.com/2016/10/big-data-algorithms-manipulating-us/> [<https://perma.cc/H6YC-CRX3>]; Kirsten Grind, Sam Schechner, Robert McMillan & John West, *How Google Interferes with Its Search Algorithms and Changes Your Results*, WALL ST. J. (Nov. 15, 2019, 8:15 AM), <https://www.wsj.com/articles/how-google-interferes-with-its-search-algorithms-and-changes-your-results-11573823753> [<https://perma.cc/VK9W-V7AE>].

350. The potential of this economic fear of automation to magnify perceived risks associated with emerging technology should not be dismissed. A 2018 Pew Research Center poll reveals a high proportion of individuals fear job automation will result in significant unemployment and widen the gap between the rich and the poor. See Richard Wike & Bruce Stokes, *In Advanced and Emerging Economies Alike, Worries About Job Automation*, PEW RSCH. CTR. (Sept. 13, 2018), <https://www.pewresearch.org/global/2018/09/13/in-advanced-and-emerging-economies-alike-worries-about-job-automation/> [<https://perma.cc/7GWE-XQLX>]. Moreover, the public seems more concerned with the negative aspects of automation than the positive aspects. *Id.* One can expect this focus on the negative downsides of job automation to adversely skew perceptions of risk.

351. See Terry Goodrich, *More than a Third of Study Participants Fear Technology that Could Lead to Job Loss More than They Do Romantic Rejection, Public Speaking and Police Brutality*, BAYLOR U. (Mar. 21, 2017), <https://www.baylor.edu/mediacommunications/news.php?action=story&story=178582> [<https://perma.cc/2RK3-59ZX>].

control, just like any phobia, can inflate a decisionmaker's perception of associated risks.³⁵²

In general, humans experience feelings of anxiety, fear, and helplessness when they perceive a lack of control over their environment.³⁵³ In one study, subjects were more likely to under-perceive the discomfort associated with a painful stimulus when they were provided with illusions of control over that stimulus.³⁵⁴ Those who fear flying consistently rate lack of control as significant source of their phobia.³⁵⁵

In the context of automation and artificial intelligence ("AI"), pop culture hits such as *I, Robot*, *the Matrix*, and Stanley Kubrick's cult classic *2001: A Space Odyssey* are provocative and arousing precisely because they each tap into a human discomfort with surrendering control to technology.³⁵⁶ Philosophers have made careers out of proselytizing Singularitarianism, the notion that humans will lose control of AI through an exponentially accelerating chain reaction of machine learning.³⁵⁷ A simple internet search reveals a plethora of resources aimed at counseling employees through their automation-induced technophobia.³⁵⁸ Intuitively speaking, it is easy to imagine that this anxiety associated with ceding control to automation and artificial intelligence would alter the manner in which humans perceive and interreact with emerging technologies, resulting in a misapplication of the Precautionary Principle against that technology.

But it is not just that a fear of losing control influences how a decisionmaker might apply the strong Precautionary Principle. It also influences whether an individual will engage in the fallacy of the strong Precautionary Principle in the first place.³⁵⁹ Indeed, the paralytic nature of the strong Precautionary Principle

352. See *The Psychology of Risk Perception*, *supra* note 215; see also Viscusi, *Valuing Risk of Death from Terrorism and Natural Disasters*, *supra* note 8, at 211 ("Terrorism risks involve a substantial element of dread. They are also involuntary risks outside the individual's control. The dramatic nature of the 9/11 attacks surely contributes to the vivid character of the risks, which may be influential as well.").

353. See Susan Mineka & Kelly A. Kelly, *The Relationship Between Anxiety, Lack of Control and Loss of Control*, in *STRESS, PERSONAL CONTROL AND HEALTH* 163, 171–78 (Andrew Steptoe & Ad Appels eds., 1989). For an extensive discussion of the fear of losing control, see generally *STRESS PERSONAL CONTROL AND HEALTH* (Andrew Steptoe & Ad Appels eds., 1989), *supra*.

354. See Kenneth S. Bowers, *Pain, Anxiety, and Perceived Control*, 32 *J. CONSULTING & CLINICAL PSYCH.* 596, 600–01 (1968).

355. See Frank H. Wilhelm & Walton T. Roth, *Clinical Characteristics of Flight Phobia*, 11 *J. ANXIETY DISORDERS* 241, 257 (1997); Lucas van Gerwen, *Sociodemographic and Clinical Characteristics of People Who Self-Refer for Treatment for Their Fear of Flying*, in *PSYCHOLOGICAL PERSPECTIVES ON FEAR OF FLYING* 1, 9 (Robert Bor & Lucas van Gerwen eds., 2003).

356. See Ezio Di Nucci & Filippo Santoni de Sio, *Who's Afraid of Robots? Fear of Automation and the Ideal of Direct Control* (2014) (unpublished manuscript).

357. Albert R. Antosca, *Singularitarianism and the New Millennium: Techno-Theology in the Transhumanist Age of Re-Enchantment* 105–06 (Apr. 2018) (Ph.D. dissertation, Salve Regina University); see also Collin Braun, *The Mortals: A Comparative Analysis of Christianity and Singularitarianism on the Subject of Eternal Life* 8 (2011) (Ph.D. dissertation, Claremont Graduate University).

358. See, e.g., *How Techno-Phobia Can Harm Your Business*, *MEDIUM* (Aug. 23, 2017), <https://medium.com/@Etech7/how-techno-phobia-can-harm-your-business-bd2576f0af32> [<https://perma.cc/5G7C-Y4TB>].

359. Cf. Lane Wallace, *The Illusion of Control*, *ATLANTIC* (May 26, 2010), <https://www.theatlantic.com/technology/archive/2010/05/the-illusion-of-control/57294/> [<https://perma.cc/DPR2-8QMQ>].

itself produces the anxious feeling of losing control.³⁶⁰ Like a cat to a warm beam of sunlight, humans subconsciously seek out comforting illusions of control as a means of cocooning themselves from the realities of indeterminacy.³⁶¹ This is part of the reason people engage in irrational hoarding behaviors (e.g., toilet paper shortages as a response to COVID-19) in response to uncontrollable stimuli, such as natural disasters.³⁶² When an analysis under the Precautionary Principle offers no advice because it is paralyzing—as is so often the case with emerging technology—the resulting decisional limbo can produce feelings of anxiety.³⁶³ Because no decision is definitively advised, there is no control to be had. This is a form of cognitive dissonance in which the Precautionary Principle supports both action and inaction.³⁶⁴ “The existence of dissonance, being psychologically uncomfortable, motivates the person to reduce the dissonance and leads to *avoidance of information* likely to increase the dissonance. The greater the magnitude of the dissonance, the greater is the pressure to reduce dissonance.”³⁶⁵ Consequently, in the face of dissonance caused by a paralytic Precautionary Principle, humans, seeking illusions of control, will not only contrive a precautionary answer when the principle offers none, but they will likely choose the option that will *itself* provide them with the greatest illusion of control. That is, regulation, creating a proverbial double whammy.

F. Age

In general, as humans age they become more risk averse.³⁶⁶ That is, they tend to inflate the risks they perceive.³⁶⁷ There are numerous reasons for this phenomenon. Some are inherent to aging itself.³⁶⁸ For example, humans generally experience a spike in economic risk aversion around the typical age of retirement, “probably reflect[ing] the shift toward fixed income assets after retirement.”³⁶⁹ Moreover, as physical health and motor function begin to decline, everyday tasks, such as crossing the street or taking a shower, become more

360. *Id.* (detailing the discomfort that can arise when quantitative analysis breaks down).

361. See Ellen J. Langer, *The Illusion of Control*, 32 J. PERSONALITY & SOC. PSYCH. 311, 325 (1975).

362. See Colleen Kirk & Kena Johnson, *Panic Buying Amid Covid-19 Fears*, N.Y. INST. TECH. (Apr. 2, 2020), https://www.nyit.edu/box/features/panic_buying_amid_covid_19_fears [<https://perma.cc/CV8J-T8FH>].

363. *Cf. Wallace, supra* note 359.

364. Cognitive Dissonance can be defined as the “psychological conflict resulting from incongruous beliefs and attitudes held simultaneously.” *Cognitive Dissonance*, MERRIAM-WEBSTER, <https://www.merriam-webster.com/dictionary/cognitive%20dissonance> (last visited Jan. 17, 2022) [<https://perma.cc/PC9F-7G4Q>].

365. Eddie Harmon-Jones & Judson Mills, *An Introduction to Cognitive Dissonance Theory and an Overview of Current Perspectives on the Theory*, in *COGNITIVE DISSONANCE: REEXAMINING A PIVOTAL THEORY IN PSYCHOLOGY* 1, 3 (Eddie Harmon-Jones ed., 2019) (emphasis added).

366. This is not *always* the case. For example, studies suggest that the elderly are equally likely to engage in risky behaviors such as gambling and unsafe sex. See Emily M. Bonem, Phoebe C. Ellsworth & Richard Gonzalez, *Age Differences in Risk: Perceptions, Intentions and Domains*, J. BEHAV. DECISION MAKING 1 (2015) (“[A]ge differences in risk preferences may vary across [different risk] domains and may result from differing motivations.”).

367. *See id.*

368. See William B. Riley Jr. & K. Victor Chow, *Asset Allocation and Individual Risk Aversion*, 48 FIN. ANALYTICS J. 32, 32 (1992).

369. *Id.*; see also Rhodes & Pivik, *supra* note 223.

risky.³⁷⁰ In that sense, increased risk perception and aversion amongst the elderly are justified by the fact that life does indeed become riskier as one ages. These factors inherent to aging, however, cannot completely account for the drastic increase in risk perception that aging adults often experience. These factors, themselves external to human cognition, nonetheless inform a broader cognitive attitude that the world is riskier than it actually is; particularly so in relation to emerging technology.³⁷¹ This is unfortunate considering the fact that emerging technology promises to make life much less risky and much more comfortable and enjoyable for senior citizens.³⁷² It is also concerning because the average age of democratic decisionmakers in the U.S. is set to increase as “[t]he aging of baby boomers means that within just a couple decades, older people are projected to outnumber children for the first time in U.S. history.”³⁷³

If risk aversion among senior citizens were entirely rational, one would expect a perfect correlation between an increase in an actual aging-related risk and the aversion towards that risk. However, studies measuring increased aversion to non-aging-related risks demonstrate that this phenomenon cannot be explained solely by an actual increase in risks facing the elderly.³⁷⁴ One such study sought to build upon prior research indicating that information processing speed and other important variables, such as working memory, necessary for complex decision-making deteriorate in humans as they age.³⁷⁵ “[Their] findings confirmed the notion . . . that older adults demonstrate risk aversion in the risky choice context in which risk-seeking would be a more effective strategy . . .” as a result of this cognitive decline.³⁷⁶ One of the ways that older adults subconsciously compensate for this loss in cognition is “through selective engagement in cognitive resources. Older adults may conserve resources . . . limiting both the quantity and complexity of the information to which they attend.”³⁷⁷ In other words, older adults possess a generalized aversion to risk.

370. See Bonem, et al., *supra* note 366, at 1; see also Martin Halek & Joseph G. Eisenhauer, *Demography of Risk Aversion*, 68 J. RISK & INS. 1, 10 (2001). (finding evidence that “suggests that being age 65 or older significantly increases one’s [economic] risk aversion by 95.19 percent to 114.15 percent”).

371. *Why Some Older People Are Rejecting Digital Technologies*, SCI. DAILY (Mar. 12, 2018), <https://www.sciencedaily.com/releases/2018/03/180312091715.htm> [<https://perma.cc/RDH8-B53E>].

372. Eleftheria Vaportzis, Maria Giatsi Clausen & Alan J. Gow, *Older Adults Perceptions of Technology and Barriers to Interacting with Tablet Computers: A Focus Group Study*, 8 FRONTIERS PSYCH. 1, 1 (2017).

373. *Older People Projected to Outnumber Children for First Time in U.S. History*, U.S. CENSUS BUREAU (Oct. 8, 2019), <https://www.census.gov/newsroom/press-releases/2018/cb18-41-population-projections.html> [<https://perma.cc/RVX4-9VWJ>] (internal quotations removed).

374. See, e.g., Debra E. Henninger, David J. Madden & Scott A. Huettel, *Processing Speed and Memory Mediate Age-Related Differences in Decision Making*, 25 PSYCH. & AGING 262, 262 (2010); James F. Cavanagh et al., *Individual Differences in Risky Decision-Making Among Seniors Reflect Increased Reward Sensitivity*, 6 FRONTIERS NEUROSCIENCE 1, 1 (2012); Jonathan J. Rolison, Stacey Wood & Yaniv Hanoach, *Risky Decision Making in Younger and Older Adults: The Role of Learning*, 27 PSYCH. & AGING 129, 129 (2012).

375. See Maciej Kościelniak, Klara Rydzewska & Grzegorz Sedek, *Effects of Age and Initial Risk Perception on Balloon Analog Risk Task: The Mediating Role of Processing Speed and Need for Cognitive Closure*, 7 FRONTIERS PSYCH., Apr. 2016, at 8.

376. *Id.*

377. *Id.* at 3.

The implications of this generalized aversion for emerging technology are crystal clear. Analyzing the risks associated with complex emerging technologies requires dedicating a significant amount of cognitive resources towards processing intricate information.³⁷⁸ As has been explained, understanding the risks associated with a piece of technology is cognitively easier than understanding the substitute costs that regulation would bring about. A generalized risk aversion resulting from a decline in cognitive resources would undoubtedly affect perceptions of emerging technology in a negative manner.

This aversion to risk in general is amplified by a particularized aversion to new technology in older adults. As the brain ages, it becomes less neuroplastic.³⁷⁹ When this occurs, individuals begin to lose the ability to adapt to new stimuli and learn new cognitive and motor skills.³⁸⁰ As the old adage suggests, “you can’t teach an old dog new tricks.”³⁸¹ While this is, of course, an overstatement, any child who has had to re-explain how the television remote functions to a parent or grandparent is well-acquainted with this phenomenon. This reduced ability to adapt to new technology results in anxiety, which, in turn, causes a technophobic aversion.³⁸² This irrational phobia serves only to increase the risk aversion older adults feel towards emerging technology, thus inflating perceptions of risk.

IV. THE CONSEQUENCES OF TECHNOLOGICAL RISK MISPERCEPTION

As explained in Part III, technological risk misperception is a distinctive form of misperception because humans are systematically predisposed to over-perceiving the risks associated with a new piece of technology. The consequences and costs of technological risk perceptions are also unique because they come in the form of lost benefits and opportunities: lives not saved, lives not improved, profits not made.³⁸³ The insidious costs associated with a blind allegiance to the status quo are often not cognitively available to decisionmakers

378. *See id.* at 2.

379. *See id.* (“The scientific literature indicates a clear and marked monotonic decrease in basic fluid cognitive abilities (such as processing speed, working memory capacity, and fluid intelligence) from early adulthood through middle age to old age, and this is responsible for decreased performance in various cognitive tasks.”) (internal citations omitted).

380. *See* Lisa Pauwels, Sima Chalavi & Stephan P. Swinnen, *Aging and Brain Plasticity*, 10 *AGING* 1789, 1790 (2018); Denise C. Park & Gérard N. Bischof, *The Aging Mind: Neuroplasticity in Response to Cognitive Training*, 15 *DIALOGUES CLIN. NEUROSCIENCE* 109, 109 (2013).

381. *See* Pauwels et al., *supra* note 380.

382. *See* Dina Di Giacomo, Jessica Ranieri, Meny D’Amico, Federica Guerra & Domenico Passafiume, *Psychological Barriers to Digital Living in Older Adults: Computer Anxiety as Predictive Mechanism for Technophobia*, 9 *BEHAV. SCIS.* 96, 100 (2019); Galit Nimrod, *Technophobia Among Older Internet Users*, 44 *EDUC. GERONTOLOGY* 148, 157–59 (2018); Mairéad Hogan, *Age Differences in Technophobia: An Irish Study*, in *INFORMATION SYSTEMS DEVELOPMENT* 117, 127 (Chris Barry, Kieran Conboy, Michael Lang, Gregory Wojtkowski, & Wita Wojtkowski eds., 2009).

383. *See* Steve Calandrillo, Jason Oh & Ari Webb, *Deadly Drones? Why FAA Regulations Miss the Mark on Drone Safety*, 23 *STAN. TECH L. REV.* 182, 185 (2020).

because, as Ike and Tina Turner put it, “you can’t miss nothing that you never had.”³⁸⁴

When technological risk misperception leads decisionmakers to shun emerging technology in favor of maintaining the status quo, the world collectively suffers as a result.³⁸⁵ Three contemporary examples of technological risk misperception—drones, self-driving cars, and artificial intelligence—demonstrate the prohibitive yet subtle costs associated with technological risk misperception.

A. *The Costs of Fearing Drones*

There is no dispute that unmanned aerial vehicles, better known as drones, will revolutionize the human experience for the better.³⁸⁶ They have a proven ability to save lives and deliver necessary goods and services to vulnerable and remote demographics.³⁸⁷ Yet Americans fear them.³⁸⁸ This irrational fear has led to an irrational response. Rather than reflecting a commonsense weighing of the costs and benefits associated with drone technology, the American regulatory response to this promising new technology is a story of systemic risk misperception.³⁸⁹ The result is a reduction of overall social welfare and a stifling of technological advancement.³⁹⁰

It was not always the case that drone regulation was informed by irrational fear. There was a time when FAA drone “guidelines were lenient, for . . . the agency’s main purpose was to regulate manned passenger aircraft”³⁹¹

384. IKE & TINA TURNER, *YOU CAN’T MISS NOTHING THAT YOU NEVER HAD* (Sonja Records 1964).

385. See Calandrillo et al., *supra* note 383, at 185.

386. See, e.g., *Drone Technology Uses and Applications for Commercial, Industrial and Military Drones in 2020 and the Future*, INSIDER (Jan. 12, 2021, 10:15 AM), <https://www.businessinsider.com/drone-technology-uses-applications> [<https://perma.cc/QJ2L-WZ7F>]; Daisy Carrington & Jenny Soffel, *15 Ways Drones Will Change Your Life*, CNN (Nov. 18, 2013, 5:23 AM), <https://www.cnn.com/2013/11/03/business/meet-your-friendly-neighborhood-drones/index.html> [<https://perma.cc/JMB8-W3BN>] (detailing how drone technology will revolutionize human existence).

387. See, e.g., Nina Strohlic, *The Surprising Ways Drones Are Saving Lives*, NAT’L GEOGRAPHIC, <https://www.nationalgeographic.com/magazine/2017/06/explore-drones-for-good/> (last visited Jan. 16, 2022) [<https://perma.cc/38ZA-4SM8>]; Jack Karsten & Darrel M. West, *How Emergency Responders Are Using Drones to Save Lives*, BROOKINGS (Dec. 4, 2018), <https://www.brookings.edu/blog/techtank/2018/12/04/how-emergency-responders-are-using-drones-to-save-lives/> [<https://perma.cc/NN3X-WAS6>]; see also Alex Williams, *The Drones Were Made for This Moment*, N.Y. TIMES (May 23, 2020) <https://www.nytimes.com/2020/05/23/style/drones-coronavirus.html> [<https://perma.cc/NN3X-WAS6>] (describing how drones rose to the vital challenge of unmanned delivery of essential goods and services during the Covid-19 outbreak).

388. See David Nassar, *New Poll Reveals Americans’ High Hopes For—But High Fears of—Drones*, HAWTHORN GRP. (Dec. 5, 2019), <https://www.hawthorngrp.com/press-release/drone-poll/> [<https://perma.cc/4KY6-4N4M>] (finding an overwhelming majority of Americans believe that drone use will become prevalent but a similarly overwhelming majority fear such an eventuality). Notably, age plays a significant role in predicting aversion to drone technology. See Paul Hitlin, *8% of Americans Say They Own a Drone, While More than Half Have Seen One in Operation*, PEW RSCH. CTR. (Dec. 19, 2017), <https://www.pewresearch.org/fact-tank/2017/12/19/8-of-americans-say-they-own-a-drone-while-more-than-half-have-seen-one-in-operation/> [<https://perma.cc/8GVX-AA9E>] (“Older Americans often have substantially more negative—and less permissive—attitudes toward drones than do younger adults.”).

389. Calandrillo et al., *supra* note 383, at 233.

390. *Id.* at 230.

391. *Id.* at 185.

Unfortunately, this “American honeymoon with drone technology” came crashing down in the 2000s when rising public fears put pressure on the FAA to adopt an aggressive regulatory stance.³⁹² To be sure, drones are a tool capable of abuse just like any other.³⁹³ In that sense, no one can deny that they do represent a source of risk.³⁹⁴ However, because the FAA’s misguided regulations respond to public fears, as opposed to actual risk factors, they accomplish little in the way of mitigation.³⁹⁵

The FAA has issued restrictive commercial drone regulations that have stifled sector growth and pushed innovation abroad.³⁹⁶ The FAA “prohibits commercial drones from flying at night, above 400 feet, faster than 100 miles per hour, or over crowds of people.”³⁹⁷ Furthermore, the combined vehicle and cargo weight cannot exceed fifty-five pounds.³⁹⁸ But the most prohibitive of FAA regulations “provides for ‘line of sight’ operating requirements . . . [that] eliminate nearly all practical applications of the emerging technology.”³⁹⁹ Lastly, the FAA has implemented registration requirements aimed at deterring criminal uses of drones.⁴⁰⁰ The FAA can waive some of the minor regulations; however, these waivers are typically inadequate for most immediate drone applications.⁴⁰¹

The starting place for any rational discussion of drone regulation is the fact that, in stark contrast to other means of transporting goods and services, there have been *zero* reported deaths caused by drone related accidents in the United States.⁴⁰² The costly line-of-sight regulation does little to increase public safety. Nominally speaking, it is meant to “reduce collisions by requiring operators to see their drone directly . . .”⁴⁰³ While this requirement might offer some logical appeal to the layman, it is ultimately not grounded in rational thought.⁴⁰⁴ “Drone operation through a live camera feed provides drone operators with a clearer visual of their drones to better see and avoid obstacles in a drone’s path.”⁴⁰⁵ Moreover, advancements in collision-avoidance technology have obviated the need for an operator to keep a drone within his or her visual line of sight.⁴⁰⁶ In other

392. *Id.* at 186.

393. *See id.* at 227.

394. *Id.* at 222–29 (highlighting risks to public safety, national security, and personal privacy).

395. *See id.* at 227.

396. *See id.* at 187 (many large American drone developers have moved their operations abroad).

397. *Id.* at 191.

398. *See id.*

399. *Id.* (“In simple English, that means that drones cannot fly past their pilot’s visual line of view, which is usually not more than a few hundred yards. Alternatively, an observer must visually observe the drone at all times with unaided sight (e.g., no binoculars) if the pilot uses ‘First-Person View’ (FPV) or similar technology. (FPV technology would otherwise allow the pilot to operate a drone miles beyond her visual line of sight by utilizing a camera in the drone’s cockpit to transmit a video image back to the operator’s position.)”)

400. *See id.* at 193–94.

401. *See id.* at 192 (explaining that the FAA cannot waive restrictions related to visual line of sight, operating over crowds, and operating during daylight hours).

402. *See id.* at 224.

403. *Id.* at 230.

404. *Id.*

405. *Id.* at 232.

406. *See id.* at 231–32.

words, the FAA is trying to address a problem that technology has already solved.

The FAA's registration requirements also miss the mark. As a practical matter, criminals and terrorists are unlikely to register their drones, and the FAA lacks a robust enforcement mechanism to make them do so.⁴⁰⁷ Even worse, in an attempt to deter and catch those few bad actors who would use drone technology to violate the privacy of others, the FAA has created a substitute risk with respect to lawful drone operators.⁴⁰⁸ "[I]nformation provided through drone registration will be public, which means names and home addresses of drone pilots—as young as thirteen years old—are public information."⁴⁰⁹ In short, the FAA has exposed lawful operators to the very risk they seek to mitigate with their regulations.

So, why do these ineffective, outmoded regulatory measures persist? The answer is "based [i]n systemic risk-misperception, exaggerating fear over reality."⁴¹⁰ According to the National Academies of Sciences, Engineering and Medicine, an attitude of zero-tolerance for risk has taken hold of FAA regulators.⁴¹¹ But, as Professor Sunstein has made clear, in a climate of substitute risks and benefits, zero-tolerance is a fallacy.⁴¹² "It is evident that the FAA's focus concentrates far more on the risks of integrating drones into the national airspace rather than on the benefits that drones provide (or, more importantly, the *opportunity costs* of not utilizing modern technology)."⁴¹³ Put in more familiar terms, by applying a strong Precautionary Principle to the risks posed by drone implementation, regulators have turned a blind eye towards the benefits and opportunities that have been lost as a result of their decisions.

The costs associated with not innovating in the field of drone technology are massive.⁴¹⁴ Drones have beneficial applications in a wide array of industries, ranging from medicine to law enforcement and from conservation to tourism.⁴¹⁵ Unfortunately, FAA's archaic regulations impede many of these applications.⁴¹⁶ In response, major tech companies are moving their drone programs abroad.⁴¹⁷ Google has moved its drone delivery program to Australia.⁴¹⁸ Amazon has moved similar programs to Canada and the United Kingdom.⁴¹⁹ "[T]his *lost opportunity* means that foreign nations—instead of America—are benefiting from

407. *See id.* at 243–45.

408. *Id.* at 244.

409. *Id.* at 242–43.

410. *Id.* at 233.

411. *See* NAT'L ACADS. SCI., ENGINEERING & MED., *ASSESSING THE RISKS OF UNMANNED AIRCRAFT SYS. (UAS) INTO THE NATIONAL AIRSPACE SYSTEM 2* (2018).

412. *See* Sunstein, *supra* note 225, at 1028.

413. Calandrillo et al., *supra* note 383, at 212.

414. *Id.* at 212–13.

415. *See id.* at 194–222 (highlighting just some of the applications and benefits of drone technology currently has to offer).

416. *See id.* at 238.

417. *See id.* at 235.

418. *Id.*

419. *See id.* at 236–37.

technological advancements, new jobs, and an economic upswing.”⁴²⁰ Foreign nations, “see[ing] an opportunity to capture a market that the FAA is complicit in crippling inside the United States,” have moved quickly to clear the way for more drone innovation.⁴²¹

But the costs exacted by technological risk misperception are not limited to economic ones.⁴²² There are direct human costs as well.⁴²³ Drone technology has been used in other countries to “deliver emergency equipment and supplies to the world’s hard-to-reach areas.”⁴²⁴ Drones have also been used by search and rescue officials to save lives in remote areas or after natural disasters.⁴²⁵ Consequently, thanks to drone technology, deaths that were once tragic are now tragically preventable. “Simply put, the FAA’s line-of-sight regulation costs lives. No patient should die because their lifesaving treatment is stuck in traffic.”⁴²⁶

Drone regulation in America “is a cautionary tale of how well-intended laws and policies aimed at enhancing safety can silently cost lives rather than protect them.”⁴²⁷ It is also a tale of how our brains contribute to systemic risk misperception by amplifying some risks far above reward. Drone regulation underscores the importance of combatting systemic technological risk misperception as well as the tired and fallacious regulatory attitude of better safe than sorry.

B. *The Costs of Fearing Autonomous Vehicles*

While the previous example largely focused on regulators, the example of autonomous vehicles largely turns on public perceptions of risk, thus highlighting the duality of risk misperception in America. Every three years, as many Americans are killed on the roads “as were killed in all of the country’s wars since World War II.”⁴²⁸ Consequently, over the course of one’s life, driving represents a significant source of risk. Yet Americans do not to treat it that way.⁴²⁹ Rarely do we stop to consider whether it might be our last day on earth when we start our engines as a police officer might when she starts her day—even though the risk of death is comparable.⁴³⁰ Some fear flying over driving even though the

420. *Id.* at 235 (emphasis added).

421. *Id.* at 237.

422. *See id.* at 210.

423. *See id.* at 211–12.

424. *Id.* (explaining that drones have been used to deliver blood transfusions and laboratory samples).

425. *See id.* at 210–11 (describing how drones have been used to locate and recover hundreds of victims).

426. *Id.* at 212.

427. *Id.* at 185.

428. Haberman, *supra* note 322.

429. *See* Viscusi, *Valuing Risk of Death from Terrorism and Natural Disasters*, *supra* note 8, at 211 (“Despite the highly focused nature of past terrorism-related fatalities, terrorism deaths are valued as highly as are fatalities associated with motor-vehicle accidents, which are much more diffusely distributed”).

430. There are around 800,000 sworn law enforcement officers in the United States. *See, e.g.*, U.S. DEP’T OF JUST., NCJ 249681, NATIONAL SOURCES OF LAW ENFORCEMENT EMPLOYMENT DATA (2016), <https://bjs.ojp.gov/content/pub/pdf/nsleed.pdf> [<https://perma.cc/AM73-7SVR>]; *Law Enforcement Facts*, NAT’L LAW ENFORCEMENT MEM’L FUND, <https://nleomf.org/facts-figures/law-enforcement-facts> [<https://perma.cc/NC C9-7Y2F>] (last visited Jan. 17, 2022). In 2019, eighty-nine officers were killed in the line of duty (almost half of

latter is far more dangerous.⁴³¹ In short, many Americans downplay the risks associated with driving and underestimate the imperative for a revolution in safety technology. Deaths and injuries on the highways are seen as tragic and unfortunate by the public when they should be viewed as completely preventable. This systemic risk misperception has stalled implementation of the one technology that offers an all-encompassing solution: automation.⁴³²

The human toll associated with maintaining the status quo and failing to develop and implement self-driving cars is staggering.⁴³³ According to the NHTSA, 36,560 people were killed in traffic crashes in 2018 alone.⁴³⁴ The CDC estimates 2 million more are injured each year.⁴³⁵ The economic costs are also sobering.⁴³⁶ “[F]or crashes that occurred in 2017, the cost of medical care and productivity losses associated with occupant injuries and deaths from motor vehicle traffic crashes exceeded \$75 billion.”⁴³⁷ Human error is responsible for around ninety percent of all automobile crashes.⁴³⁸ In other words, drivers as a class represent one of the most dangerous groups in America. Understandably, proponents of self-driving cars seek to remove human error from the equation, much like airplane manufacturers have done with great success.⁴³⁹

Knowing the high price Americans pay on the roadways each year, one would expect the public to embrace and support any technology that promises to reduce that burden. Sadly, however, motorists have often required convincing before adopting new safety technology.⁴⁴⁰ In the context of automated cars, a major roadblock developers face is convincing motorists to hand the keys over to a computer.⁴⁴¹ In one survey of perceived opportunity cost, researchers found

those deaths were themselves driving related), meaning about one in every 9000 officers are killed in the line of duty each year. See Press Release, Fed. Bureau of Investigation, FBI Releases 2019 Statistics on Law Enforcement Officers Killed in the Line of Duty (May 4, 2020), <https://www.fbi.gov/news/pressrel/press-releases/fbi-releases-2019-statistics-on-law-enforcement-officers-killed-in-the-line-of-duty> [<https://perma.cc/WS3C-X5ES>]. The U.S. population is around 328.2 million. *Quick Facts*, U.S. CENSUS BUREAU, <https://www.census.gov/quick-facts/fact/table/US/PST045219> (last visited Jan. 16, 2022) [<https://perma.cc/KB7R-BUB7>]. Assuming all Americans are members of the risk population, the risk of motor vehicle death each year is also around one in 9000. See *Odds of Dying*, NAT’L SAFETY COUNCIL, <https://injuryfacts.nsc.org/all-injuries/preventable-death-overview/odds-of-dying/data-details/> (last visited Jan. 16, 2022) [<https://perma.cc/DN44-GEK7>].

431. See Blalock et al., *supra* note 9, at 1717.

432. See, e.g., Raue et al., *supra* note 263, at 2.

433. *Traffic Deaths Decreased in 2018, but Still 36,560 People Died*, NAT’L HIGHWAY TRAFFIC SAFETY ADMIN., <https://www.nhtsa.gov/traffic-deaths-2018> (last visited Jan. 16, 2022) [<https://perma.cc/T8DS-GP5K>].

434. *Id.*

435. *Motor Vehicle Crash Deaths*, CTRS. FOR DISEASE CONTROL & PREVENTION, <https://www.cdc.gov/vitalsigns/motor-vehicle-safety/index.html> (last visited Jan. 16, 2022) [<https://perma.cc/S39G-4JYS>].

436. *Costs Data and Prevention Policies, Motor Vehicle Safety*, CTRS. FOR DISEASE CONTROL & PREVENTION, <https://www.cdc.gov/motorvehiclesafety/costs/index.html> (last visited Jan. 16, 2022) [<https://perma.cc/7JR4-66FC>].

437. *Id.*

438. See Haberman, *supra* note 322; see also Raue et al., *supra* note 263 (estimating it at 94%).

439. See, e.g., Raue et al., *supra* note 263, at 2.

440. See Haberman, *supra* note 322.

441. See *id.*; see also Jingya Gao, Andisheh Ranjbari & Don MacKenzie, *Would Being Driven by Others Affect the Value of Travel Time? Ridehailing as an Analogy for Automated Vehicles*, 46 *TRANSP.* 2103, 2104 (2019) (“[T]he overall sustainability effects of ridehailing and vehicle automation will depend strongly on

that individuals valued time spent in a self-driving Uber as more costly than an identical normal Uber and even more costly than driving themselves.⁴⁴² This suggests “a lack of familiarity and comfort with driverless technology at present.”⁴⁴³

Heuristics and cognitive biases that drive technological risk misperception offer a partial yet substantial explanation for why consumers need convincing. One study of public perceptions of self-driving technology concluded that the “change in status quo—from an active driver to a passive driver—may be perceived as a loss among those who value the feeling of control when driving.”⁴⁴⁴ Reports of individuals sleeping behind the wheel of their Teslas are “disturbing” and “unsettling” precisely because they represent a departure from the familiar status quo to the unfamiliar.⁴⁴⁵ It is worth noting that, despite the salience of these reports, fatalities since Tesla released its autopilot product in 2014 have been exceedingly rare.⁴⁴⁶ The fear of losing control also helps “explain higher risk and lower benefit perception of self-driving cars.”⁴⁴⁷ The study concluded that “[g]iving up control may, in fact, be one of the major barriers to the adoption of self-driving cars.”⁴⁴⁸

Unfamiliarity, it seems, is also accompanied by ignorance.⁴⁴⁹ The same study found “evidence that . . . [p]eople who had greater experience with vehicle automation technologies had lower risk and higher benefit perceptions as well as

travelers’ behavioral responses to the technology, particularly how it affects their perceived value of in-vehicle time.”); see also Darrell M. West, *Brookings Survey Finds Only 21 Percent Willing to Ride in a Self-Driving Car*, BROOKINGS (July 23, 2018), <https://www.brookings.edu/blog/techtank/2018/07/23/brookings-survey-finds-only-21-percent-willing-to-ride-in-a-self-driving-car/> [<https://perma.cc/8BQY-LQK3>] (“When asked in a survey undertaken by researchers at the Brookings Institution how likely they are to ride in a self-driving car, only 21 percent of adult internet users said they are inclined to do so . . .”).

442. See Gao et al., *supra* note 441, at 2114.

443. *Id.* at 2103.

444. Raue, *supra* note 263, at 368.

445. See, e.g., Christopher Brito, *Disturbing Video Shows Driver Apparently Asleep in Moving Tesla on Highway*, CBS NEWS (Sept. 10, 2019, 7:27 AM), <https://www.cbsnews.com/news/tesla-driver-asleep-at-the-wheel-disturbing-video-shows-driver-apparently-asleep-in-moving-tesla-on-highway/> [<https://perma.cc/6HE7-93W9>]; Aaron Holmes, *Watch These Unsettling Videos of All the Times Tesla Autopilot Drivers were Caught Asleep at the Wheel in 2019*, INSIDER (Dec. 2, 2019, 11:48 AM), <https://www.businessinsider.com/drivers-sleeping-in-tesla-cars-autopilot-asleep-while-driving-videos-2019-12> [<https://perma.cc/MMY8-9DJ4>]; Peter C. Baker, *I Think This Guy Is, Like, Passed out in His Tesla*, N.Y. TIMES (Nov. 27, 2019), <https://www.nytimes.com/2019/11/27/magazine/tesla-autopilot-sleeping.html> [<https://perma.cc/E9QP-LTNV>]. One German court went so far as to ban Tesla’s use of the word autonomous because it felt that word amounted to false advertisement. See Jack Ewing, *German Court Says Tesla Self-Driving Claims Are Misleading*, N.Y. TIMES (July 14, 2020), <https://www.nytimes.com/2020/07/14/business/tesla-autopilot-germany.html> [<https://perma.cc/2ARK-NRAJ>].

446. Only 10 individuals have died as a direct result of Tesla’s autopilot function. See TESLA DEATHS, <https://www.tesladeaths.com/> (last visited Jan. 16, 2022) [<https://perma.cc/9SPF-FSKA>] (tracking global deaths related to Tesla vehicles and explaining its tracking decisions); see also Elon Musk (@elonmusk), TWITTER (May 14, 2018), <https://twitter.com/elonmusk/status/996131586469842945> [<https://perma.cc/FRN5-3DYN>] (“It’s super messed up that a Tesla crash resulting in a broken ankle is front page news and the ~ 40,000 people who died in US auto accidents alone in past year get almost no coverage.”).

447. Raue et al., *supra* note 263, at 368.

448. *Id.* at 369.

449. *Id.* at 368.

higher trust ratings of self-driving cars”⁴⁵⁰ Without this experience and knowledge, individuals rely on their heuristics to fill the decisional void, which typically disfavor emerging technologies.⁴⁵¹ In addition to lack of information there is an issue of disinformation. The publication of rare but retainable negative media hype means that the availability heuristic reinforces already inflated perceptions of risk. Those who had heard stories of accidents involving self-driving cars—such as the tragic and highly-publicized death of a Tempe woman—“reported lower trust levels in self-driving cars.”⁴⁵² A single negative story has the power to implant a seed of doubt in the public and derail years of progress.⁴⁵³

Self-driving cars represent a paradigm of technological risk misperception. Factors inherent in the technology itself and inherent in human behavior operate to inflate risks and obscure benefits.⁴⁵⁴ While many American drivers are unsure about whether they can ever trust a self-driving car with their family’s safety, if they understood their existing vehicle to be the ticking time bomb it represents, they might begin to wonder if they can afford not to.

C. *What’s Next? The Costs of Fearing Artificial Intelligence*

As explained in Section III.E on losing control, American pop culture has a macabre fascination with artificial intelligence-induced dystopias and doomsdays.⁴⁵⁵ This is likely because it taps into the powerful human discomfort with losing control. The two preceding examples of systemic technological risk misperception may be harbingers of what is in store for developers of AI. Ironically, one of the most vocal proponents of automated vehicles, Tesla CEO Elon Musk,

450. *Id.*

451. Tversky & Kahneman, *supra* note 4, at 1131.

452. Raue et al, *supra* note 263, at 368. Elaine Herzberg was struck and killed by a self-driving Uber after she appeared suddenly from the side of the road in the dark. See *Uber in Fatal Crash Had Safety Flaws Say US Investigators*, BBC (Nov. 6, 2019), <https://www.bbc.com/news/business-50312340> [<https://perma.cc/MCU9-AY4V>]. The human driver hired to watch over the automated system had taken her eyes off the road at the moment of impact. *Id.* Many experts, including the police felt that no human driver could have avoided the collision. See Aarian Marshall, *The Uber Crash Won’t Be the Last Shocking Self-Driving Death*, WIRED (Mar. 31, 2018, 7:00 AM), <https://www.wired.com/story/uber-self-driving-crash-explanation-lidar-sensors/> [<https://perma.cc/SZWS-L5ZK>]. However, the reason the vehicle did not register Ms. Herzberg was because it was not programmed to account for the possibility of jaywalkers. See BBC, *supra* note 452. There are no innocent parties in this incident. Ms. Herzberg should not have been jaywalking. The human driver should not have been looking at her phone. And Uber programmers should have taken jaywalking into account. But to use this example to suggest that self-driving cars are untrustworthy or unsafe—as many publications have done—would irrationally hold self-driving cars to a higher standard than their human counterparts. Interestingly, it turns out that the most difficult part of designing and programming self-driving cars is trying to predict the irrational behavior of human beings. See Neal E. Boudette, *Despite High Hopes, Self-Driving Cars Are ‘Way in the Future,’* N.Y. TIMES (July 17, 2019), <https://www.nytimes.com/2019/07/17/business/self-driving-autonomous-cars.html> [<https://perma.cc/AT8X-BZWE>]. This means that human irrationality threatens not only public acceptance of the technology, but its feasibility as well.

453. See Raue et al., *supra* note 263, at 369.

454. See *id.*

455. See *supra* Section III.E.

is also one of the most vocal critics of AI technology.⁴⁵⁶ He has largely been dismissed by industry insiders as a fear-monger, alarmist, and doomsayer.⁴⁵⁷ While his “relatively extreme views on AI are shared by a small minority of AI researchers[, his] celebrity status means they’re heard by huge audiences and this frustrates people doing actual AI research.”⁴⁵⁸

When it comes to AI, Elon Musk is a walking contradiction. On the one hand, he believes that AI development represents possibly the greatest existential threat to human existence.⁴⁵⁹ On the other hand, “Musk’s AI investments have allowed him to stay close to the field he’s so afraid of.”⁴⁶⁰ He is automating vehicles, developing neural interfaces,⁴⁶¹ and has profited handsomely off of his AI investments (albeit on the pretense of precaution).⁴⁶² On the one hand, Musk thinks there is a good chance we *will become* slaves to our computers.⁴⁶³ On the other hand, he thinks there is a “one in billions chance” we are not *already* living in a simulation designed by a superintelligent entity.⁴⁶⁴ It would seem, then, that his fear-mongering is a precaution against a one in billions risk that superintelligence does not already exist.

Whether one understands Elon Musk as a symptom or source of public fears, it is clear that the emerging field of AI technology is at great risk of falling victim to systemic technological risk misperception. In a poll of Americans, fifty-three percent felt advancing the field was important, but the rest felt it was either unnecessary or potentially dangerous.⁴⁶⁵ Another survey found that “Americans, on average, expect that high-level machine intelligence will have a harmful impact on balance. Overall, thirty-four percent think that the technology will have

456. See Sam Shead, *Elon Musk has a Complex Relationship with the A.I. Community*, CNBC (May 13, 2020, 4:35 AM), <https://www.cnbc.com/2020/05/13/elon-musk-has-a-complex-relationship-with-the-ai-community.html> [<https://perma.cc/2Q26-4BRX>].

457. *Id.*

458. *Id.* (“As one of the most famous tech figures in the world, Musk’s alarmist views on AI can potentially reach millions of people.”).

459. See Elon Musk (@elonmusk), TWITTER (Sept. 4, 2017), <https://twitter.com/elonmusk/status/904633084309422080> [<https://perma.cc/E5WX-U69Q>]; Maureen Dowd, *Elon Musk’s Billion-Dollar Crusade to Stop the A.I. Apocalypse*, VANITY FAIR (March 26, 2017), <https://www.vanityfair.com/news/2017/03/elon-musk-billion-dollar-crusade-to-stop-ai-space-x> [<https://perma.cc/2WT5-QXME>].

460. Shead, *supra* note 456.

461. Anthony Cuthbertson, *Elon Musk Claims His Neuralink Chip Will Allow You to Stream Music Directly to Your Brain*, INDEPENDENT (July 21, 2020, 3:10 PM), <https://www.independent.co.uk/life-style/gadgets-and-tech/news/elon-musk-neuralink-brain-computer-chip-music-stream-a9627686.html> [<https://perma.cc/4SSW-3T5C>].

462. Gilbert, *supra* note 253 (“Musk was an early investor in DeepMind, which sold to Google in 2014 for over \$500 million, according to reports. He said in a 2017 interview that he made the move to keep an eye on burgeoning AI developments, not for a return on investment.”).

463. Jillian D’Onfro, *Elon Musk Thinks We Need Brain-Computers to Avoid Becoming ‘House Cats’ to Artificial Intelligence*, INSIDER (June 1, 2016, 11:03 PM), <https://www.businessinsider.com/elon-musk-on-neural-lace-2016-6> [<https://perma.cc/7H8J-4Y7R>].

464. Jason Koebler, *Elon Musk Says There’s a ‘One in Billions’ Chance Reality Is Not a Simulation*, VICE (June 2, 2016), 7:10 AM), https://www.vice.com/en_us/article/8q854v/elon-musk-simulated-universe-hypothesis [<https://perma.cc/ZW6Z-AMGK>].

465. See 60 Minutes/Vanity Fair Poll: Artificial Intelligence, 60 MINUTES (Mar. 28, 2016), <https://www.cbsnews.com/news/60-minutes-vanity-fair-poll-artificial-intelligence/> [<https://perma.cc/AD2G-2T9R>] (describing that 4% of the Americans polled felt AI would anger God).

a harmful impact; in particular, twelve percent said it could be extremely bad, *leading to possible human extinction*.⁴⁶⁶ It seems many Americans are also somewhat uninformed about the wide array of applications and benefits AI technology has to offer. Fifty-three percent said they would use an intelligent robot for day-to-day chores.⁴⁶⁷ Freeing Americans from their menial tasks represents one of the more inconsequential benefits of AI technology.⁴⁶⁸ In response to fears—some rational and some irrational—about the consequences of AI, many are calling for increased regulation of its development.⁴⁶⁹ Congress⁴⁷⁰ and the White House⁴⁷¹ have expressed interest in responding to these fears. Whether the regulatory response reflects irrational fears, as with drones and self-driving cars, or rational fears, only time will tell. Given AI's potential to completely revolutionize the human experience for the better,⁴⁷² the lost opportunities that could arise from misperception of the associated risks should give pause to overzealous regulators.

The foregoing examples of systemic technological risk misperception demonstrate the insidious nature of the consequences such misperception brings. It is difficult to comprehend lost opportunities. Because the causes and consequences of systemic risk misperception are so difficult to comprehend, remedying those issues is equally challenging.

IV. PERCEIVING REALITY: HOW TO COMBAT SYSTEMIC TECHNOLOGICAL RISK MISPERCEPTION

Any discussion about remedying systemic technological risk misperception in American decision-making must account for the political realities of our system of government. Generally speaking, there are two overlapping levels of decision-making in American politics: (1) high-level government decision-making conducted by politicians and regulators and (2) democratic decision-making conducted by individuals voting with their ballots, their feet, and their wallets. A

466. BAobao ZHANG & ALLAN DAFOE, *ARTIFICIAL INTELLIGENCE: AMERICAN ATTITUDES AND TRENDS IN HIGH-LEVEL MACHINE INTELLIGENCE*, CTR. FOR GOVERNANCE AI § 6.4 (2019), <https://governanceai.github.io/US-Public-Opinion-Report-Jan-2019/high-level-machine-intelligence.html#subsecharmood> [<https://perma.cc/5FS4-JXN7>] (emphasis added).

467. See 60 Minutes/*Vanity Fair Poll: Artificial Intelligence*, *supra* note 465.

468. For an account of potential benefits and applications of AI technology, see, for example, Taarini K. Dang, *AI Transforming the World*, FORBES (Feb 24, 2019, 8:22 PM), <https://www.forbes.com/sites/cognitive-world/2019/02/24/ai-transforming-the-world/#30b80ed94f03> [<https://perma.cc/Y54W-VYXB>]; Katherine Gammon, *5 Ways AI Will Change the World by 2050*, USC TROJAN FAMILY (2017), <https://news.usc.edu/trojan-family/five-ways-ai-will-change-the-world-by-2050/> [<https://perma.cc/4SDP-JZBT>]; Darrell M. West & John R. Allen, *How Artificial Intelligence Is Transforming the World*, BROOKINGS (Apr. 24, 2018), <https://www.brookings.edu/research/how-artificial-intelligence-is-transforming-the-world/> [<https://perma.cc/FZ5U-Y8Y3>].

469. See Arjun Kharpal, *Big Tech's Calls for More Regulation Offers a Chance for Them to Increase Their Power*, CNBC, <https://www.cnbc.com/2020/01/28/big-techs-calls-for-ai-regulation-could-lead-to-more-power.html> (Jan. 28, 2020, 1:21 AM), [<https://perma.cc/7UQ4-KY7B>].

470. See generally *Regulation of Artificial Intelligence*, LIBR. CONG. (Jan. 2019), <https://tile.loc.gov/storage-services/service/l1/l1glrd/2019668143/2019668143.pdf> [<https://perma.cc/9LA7-AEKD>] (“In the 115th Congress, thirty-nine bills have been introduced that have the phrase “artificial intelligence” in the text of the bill.”).

471. See Exec. Order No. 13859, 84 Fed. Reg. 3967, (Feb. 11, 2019).

472. West & Allen, *supra* note 468.

remedial scheme aimed at combatting systemic risk misperception must address both levels of decision-making in order to create meaningful change. Systematic problems require systemic solutions.

A problem with multiple sources, such as systemic technological risk misperception, has multiple solutions. We do not profess to possess a magic elixir to cure human beings of our biases. However, we pause here to offer suggestions, insights, and areas for further research that could assist in insulating decision-making processes from the effects of systemic technological risk misperception.

A. *Addressing Risk Misperception in Government Decisionmakers*

1. *Reversing the War on Agency Expertise*

Expertise and objectivity should drive decision-making, particularly in the context of complex emerging technologies. The decision to adopt, delay, or regulate an emerging technology often involves dense informational processing, risk weighing, and deliberations that the average legislator, let alone the average voter, simply cannot perform.⁴⁷³ The existence of the administrative state—particularly independent agencies—is a recognition that a directly democratic process of decision-making is not always the most efficient, nor even the most desired, process when facing complex issues. Some believe, however, that the administrative state’s tenuous relationship with democracy is untenable and, worse, unconstitutional.⁴⁷⁴ They have made great strides towards injecting popular control into the administrative state at the expense of agency expertise and independence.⁴⁷⁵ To the contrary, however, the purpose of agency expertise is not to supplant democratic decision-making but to supplement it.⁴⁷⁶ In a *representative* democracy, expertise must be allowed to inform democratic decision-making.⁴⁷⁷ Given the natural biases of the polity at large highlighted in this Article, the trend of stripping discretion away from agency decisionmakers could have disastrous effects for emerging technology.

As Professor Sunstein has explained, “[i]f government follows the judgments of ordinary people, it will be risk averse in” the same way the people are.⁴⁷⁸ Decisionmakers “following popular views,” will incorporate the systemic biases of their constituents into their decisional processes.⁴⁷⁹ “The result will be

473. William D. Eggers, Mike Turley & Pankaj Kamleshkumar Kishnani, *The Future of Regulation: Principles for Regulating Emerging Technologies*, DELOITTE (June 19, 2018), <https://www2.deloitte.com/us/en/insights/industry/public-sector/future-of-regulation/regulating-emerging-technology.html> [https://perma.cc/UCQ7-SPZK].

474. See, e.g., PHILLIP HAMBURGER, IS ADMINISTRATIVE LAW UNLAWFUL? 1 (2014).

475. See, e.g., *Free Enter. Fund v. Pub. Co. Acct. Oversight Bd.*, 561 U.S. 477, 492 (2010) (stripping the Public Corporation Accounting Oversight Board of double-for cause removal protections); *Seila L. LLC v. Consumer Fin. Prot. Bureau*, 140 S. Ct. 2183, 2197 (2020) (stripping the CFPB’s chief of for-cause removal protection).

476. See Peter L. Strauss, *How the Administrative State Got to This Challenging Place*, 150 DAEDALUS 17, 17, 24 (2021).

477. See *id.*

478. Sunstein, *supra* note 225, at 1020.

479. *Id.*

to move regulation in the direction suggested by the [strong] precautionary principle.”⁴⁸⁰ This is not to say that the judgments of ordinary people are irrelevant or should be discounted. Quite the opposite, expertise should inform the judgments of ordinary people and the judgments of ordinary people should inform the experts.⁴⁸¹ A sensible balance must be struck.

Recent developments in administrative law and American politics threaten that balance.⁴⁸² The Supreme Court has attempted to increase democratic accountability in the administrative state by bolstering executive oversight at the expense of expertise and independence. In *Free Enterprise Fund v. Public Company Oversight Board*, the Court held that Congress could not provide members of a Securities and Exchange (“SEC”) board with for-cause removal protections because the SEC itself already had such protections.⁴⁸³ In other words, the Constitution can tolerate one layer of protection from executive interference with multi-member commissions, but not two. In *Seila Law v. Consumer Financial Protection Bureau*, the Court held that Congress’ choice to provide the Consumer Financial Protection Bureau’s (“CFPB”) sole director with the same removal protections was unconstitutional.⁴⁸⁴ Instead, the Court held that the CFPB’s chief had to be removable at will by the President.⁴⁸⁵ Lastly, In November of 2020, Justice Alito gave a highly controversial speech to the Federalist Society in which he questioned the wisdom of decision-making by experts.⁴⁸⁶ While these examples represent the most direct challenges to agency independence, they are part of a silent, creeping trend that would reduce the impact of agency experts on policymaking,⁴⁸⁷ and increase the influence of layman politicians.⁴⁸⁸

480. *Id.*

481. See Michael Schudson, *The Trouble with Experts—and Why Democracies Need Them*, 35 *THEORY & SOC’Y* 491, 492 (2006).

482. See, e.g., *Free Enter. Fund v. Pub. Co. Acct. Oversight Bd.*, 561 U.S. 477, 496 (2010); *Seila L. LLC v. Consumer Fin. Prot. Bureau*, 140 S. Ct. 2183, 2197 (2020).

483. See 561 U.S. at 492 (“We hold that the dual for-cause limitations on the removal of Board members contravene the Constitution’s separation of powers.”).

484. See 140 S. Ct. at 2197 (“We hold that the CFPB’s leadership by a single individual removable only for inefficiency, neglect, or malfeasance violates the separation of powers.”).

485. See *id.* at 2192 (“The agency may therefore continue to operate, but its Director, in light of our decision, must be removable by the President at will.”).

486. See The Federalist Society, *Address by Justice Samuel Alito [2020 National Lawyers Convention]*, YOUTUBE (Nov. 25, 2020), <https://www.youtube.com/watch?v=VMnukCVIZWQ> [<https://perma.cc/4TTG-KGNR>].

487. See, e.g., *Gundy v. United States*, 139 S. Ct. 2116, 2131 (2019) (Gorsuch, J., dissenting) (attempting to resurrect the nondelegation doctrine); *Kisor v. Wilke*, 139 S. Ct. 2400, 2409 (2019) (placing Auer deference on its deathbed potentially); *Oil States Energy Servs., v. Greene’s Energy Grp.*, 138 S. Ct. 1365, 1377 (2018) (holding the patent and trademark office could adjudicate inter partes review without violating Article III, but taking a narrow, originalist approach to non-Article III adjudication).

488. Interestingly, while opponents of the administrative state never fail to point out that the Framers and the ratifying generation had no conception of post-New Deal agencies, these opponents do fail to point out that the Framers expected a level of expertise to exist amongst politicians. See, e.g., Charles J. Cooper, *Confronting the Administrative State*, NAT’L AFFAIRS (Fall 2015), <https://www.nationalaffairs.com/publications/detail/confronting-the-administrative-state> [<https://perma.cc/RKQ5-F8SW>]. In his seminal book, Professor Akhil Amar explains how the entire structure of Article I, indeed the entire system of *representative* democracy, was designed

While we offer no opinion as to whether the robust executive oversight the Court envisions for the administrative state is constitutionally mandated, we do think that the simultaneous rise in populism should give the Supreme Court pause when considering arguments of public policy. With the rise of populism, “knowledge of every kind is also under attack. Parents argue with their child’s doctor over the safety of vaccines. Famous athletes speculate that the world might actually be flat. . . .”⁴⁸⁹ Some politicians “portray experts as untrustworthy and contemptuous elites out to subvert the will of ordinary Americans.”⁴⁹⁰ As a result, “[a] significant number of laypeople now believe, for no reason but self-affirmation, that they know better than experts in almost every field.”⁴⁹¹ Even during the COVID-19 pandemic, where the voice of experts, like Dr. Anthony Fauci, should have been paramount, this war on expertise persisted—at the highest levels of government no less.⁴⁹²

For agencies to serve their “expertise” function, they cannot be constantly looking over their shoulders to the White House, wondering what it will think of their policy decisions. Moreover, if the Court continues down this path and a populist, or worse, a demagogue, occupies the Oval Office, civil servants will have no means of insulating their decision-making processes from the biases and misperceptions she will inevitably bring to bear on the regulators.⁴⁹³ The biases and heuristics identified in this Article demonstrate that expertise is needed now

to promote an expert class of legislators. AKHIL AMAR, *AMERICA’S CONSTITUTION: A BIOGRAPHY* 66–79 (2005). “Madison and other Federalists did indeed envision a House [and Senate] composed of enlightened lawmakers with extensive geographic reputations and *the ability to rise above ill-informed popular prejudices* when the need arose. Such enlightened statesmen would give the new republic more stability and wisdom in its dealings with foreign nations, and would add needed gravitas to domestic politics as well.” *Id.* at 79 (emphasis added). After the adoption of the Seventeenth Amendment, this underlying assumption of the Framers no longer holds to the same extent. *See id.* at 412–15. Consider, for example, the election of Senator Tommy Tuberville—whose only qualifications for office seem to be that he is a former SEC football coach, he is unaware what the three branches of government are, and is unclear as to which ideology America fought to eradicate in WWII. *See* Catie Edmondson, *Senator-elect Tommy Tuberville Flubs Basics of the Constitution, World War II and the 2000 Election*, N.Y. TIMES (Nov. 13, 2020), <https://www.nytimes.com/2020/11/13/us/tommy-tuberville-fact-check.html> [perma.cc/XV89-HJRM].

489. Tom Nichols, *How We Killed Expertise*, POLITICO (August/October 2017), <https://www.politico.com/magazine/story/2017/09/05/how-we-killed-expertise-215531> [https://perma.cc/9GJK-TXL5].

490. Ronald Brownstein, *Trump’s War on Expertise Is Only Intensifying*, ATLANTIC (Nov. 21, 2019), <https://www.theatlantic.com/politics/archive/2019/11/trump-attack-vindman-yovanovitch-hill/602383/> [https://perma.cc/3L58-T2UN].

491. Nichols, *supra* note 489.

492. *See* Scott Lehigh, *Time to End Populism’s War on Expertise*, BOS. GLOBE (Apr. 7, 2020, 9:55 PM), <https://www.bostonglobe.com/2020/04/07/opinion/time-end-populisms-war-expertise/> [https://perma.cc/6KKA-T8CL]; Mia Jankowicz, *Trump Attacked Fauci’s Advice and Boasted of Ignoring Government Experts in His Coronavirus Response*, INSIDER (July 9, 2020, 5:08 AM), <https://www.businessinsider.com/trump-attacks-fauci-boasts-of-ignoring-experts-on-coronavirus-2020-7> [https://perma.cc/3PWM-95BM]; Syon Bhanot, *Why Are People Ignoring Expert Warnings?—Psychological Reactance*, BEHAV. SCI. (Mar. 20, 2020), <https://behavioralscientist.org/why-are-people-ignoring-expert-warnings-psychological-reactance-coronavirus-covid-19/> [https://perma.cc/47NU-432K]; *see also* Tamar Lapin, *Anthony Fauci Says Family Needs Security over Death Threats, Continuing Harassment*, N.Y. POST (Aug. 5, 2020, 11:13 PM), <https://nypost.com/2020/08/05/fauci-says-he-and-his-daughters-need-security-over-death-threats/> [https://perma.cc/44SW-PCC5] (detailing death threats towards the Nation’s leading expert on the COVID-19 pandemic and his family).

493. Nichols, *supra* note 489.

more than ever to accurately assess the risks associated with emerging technology.

2. *Mandating Marginal Cost-Benefit Analysis and Risk-Risk Analysis*

By requiring regulators to employ marginal cost-benefit analysis and risk-risk analysis, we can minimize the influence of systemic technological risk misperception and ensure that substitution costs are not ignored in the decision-making process. Federal courts are grappling with the question of “whether agencies are required to engage in some form of cost-benefit analysis.”⁴⁹⁴ Congress is not always clear what is required of an agency when it issues a mandate.⁴⁹⁵ For their part, Presidents have issued guidance urging agencies to deploy some form of cost-benefit analysis.⁴⁹⁶ While this push to require cost-benefit analysis in regulatory decision-making is a necessary step in combatting systemic technological risk misperception, it is woefully inadequate on its own.⁴⁹⁷

Agencies must engage in the additional step of assessing *marginal* costs and benefits in addition to simple overall cost-benefit decision-making. *Marginal* decision-making “ask[s] not merely whether the benefits created by a given program exceed the costs imposed, but rather, whether the regulation maximizes the benefits *minus* the costs.”⁴⁹⁸ This analysis, which seeks to get the most regulatory bang per buck, can address what Justice Stephen Breyer once dubbed “The Last 10 Percent.”⁴⁹⁹ “At hazardous waste sites, for example, Breyer states that 90% or more of agency resources are spent to clean up the last 10% of the risk posed, whereas it takes only the first 10% of those resources to eliminate 90% of the total risk.”⁵⁰⁰ Generally speaking, the point where regulation should cease is where marginal costs equal marginal benefits.⁵⁰¹ If regulators go further than that, “for every additional dollar spent, society gets less than a dollar back in benefits.”⁵⁰² At this point, where marginal returns are negative, regulators should consider whether their time and money might have a larger impact somewhere else.

494. See Sunstein, *supra* note 257, at 2.

495. See *id.* at 3.

496. Exec. Order No. 12866, 58 Fed. Reg. 51,735 (Oct. 4, 1993) (“In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures . . . and qualitative measures of costs and benefits that are difficult to quantify, but nevertheless essential to consider. Further, in choosing among alternative regulatory approaches, agencies should select those approaches that maximize net benefits . . . , unless a statute requires another regulatory approach.”); see also Exec. Order No. 13,563, 76 Fed. Reg. 3821 (Jan. 18, 2011) (building upon Executive Order 12866).

497. See Cass Sunstein, *Cost-Benefit Analysis and Arbitrariness Review*, 41 HARV. ENV'T L. REV. 1, 6 (2017).

498. Calandrillo, *supra* note 8, at 991.

499. *Id.* (quoting STEPHEN BREYER, BREAKING THE VICIOUS CIRCLE: TOWARD EFFECTIVE RISK REGULATION 11–12 (Harvard U. Press 1993)).

500. *Id.* (citing STEPHEN BREYER, BREAKING THE VICIOUS CIRCLE: TOWARD EFFECTIVE RISK REGULATION 11–12 (Harvard U. Press 1993)).

501. See *id.* at 994.

502. *Id.* at 994.

In the context of emerging technology regulation, marginal cost-benefit analysis would prevent government from prohibitively regulating emerging technology. At some point regulators must ask: “Is it worth it to continue trying to improve the safety of this [promising technology] given the fact that we already have 99% of the risk eliminated . . . ?”⁵⁰³ By requiring agencies to consider whether more restrictive, costly regulation of emerging technology would yield an equal or higher benefit to society, we can ensure that the scope of regulation is optimal. It would allow agencies to ratchet up regulation to the point where public safety is maximized in proportion to cost while ensuring that technology developers are free to innovate at a reasonable and responsible pace.

In addition to marginal cost-benefit analysis, mandating risk-versus-risk analysis in agency decision-making would also reduce the influence of systemic technological risk misperception on decision-making. Risk-risk analysis would require agency decisionmakers to consider the substitution risks that a given restriction on technology would create as well as the lost benefits and opportunities that would result.⁵⁰⁴ In other words, regulators would be required to consider *all* the costs, not just the readily available ones. It is the simple, but overlooked, proposition that “[a]ll regulations should reduce current risks by a greater amount than the additional [unintended] risks they impose on society.”⁵⁰⁵ As this Article has repeatedly indicated, when it comes to regulating emerging technologies, substitution costs and lost opportunities are the rule—not the exception. When regulating in this field, risk-risk analysis would require regulators to consider the unintended risks and lost benefits that would occur when choosing to maintain the status quo over implementing a new piece of technology.

Whether it comes from congressional mandate, executive order, or judicial interpretation, agencies should be required to engage in both marginal cost-benefit analysis and risk-risk analysis. In addition to increasing efficiency and reducing arbitrariness across the administrative state, these important changes would provide the benefit of minimizing the impact of systemic technological risk misperception on agency decision-making.

3. *Structural Changes to Agencies*

Of course, merely directing agencies to engage in better cost-benefit analyses is not enough. A risk oversight function should exist somewhere in the administrative state to ensure that agencies are educated about complying with the aforementioned mandates. Generally speaking, agency oversight can be centralized, decentralized, or a combination thereof. Centralized review of agency action primarily occurs in the Office of Information and Regulatory Affairs

503. *Id.* at 991 (internal quotations removed).

504. *See id.* at 996–98 (discussing risk-risk analysis).

505. *Id.* at 998.

(“OIRA”),⁵⁰⁶ a division of the Office of Management and Budget (“OMB”),⁵⁰⁷ itself contained within the Executive Office of the President. Decentralized oversight comes in the form of officers housed within the different agencies that have oversight mandates.⁵⁰⁸ For example, the Foundations for Evidence-Based Policymaking Act of 2018 established, among other offices, a Chief Data Officer for every agency tasked with managing burgeoning government data.⁵⁰⁹ The two forms of oversight, however, are not mutually exclusive.⁵¹⁰ For example, the decentralized Chief Data Officer also serves as “agency liaison” to the centralized OMB.⁵¹¹

We propose the creation of a decentralized and centralized system to oversee agency risk analysis in order to combat misperception in decision-making. Congress could either establish a Chief Risk Officer in every relevant agency or expand the responsibilities of a preexisting officer, perhaps the Chief Information Officer or Chief Technology Officer. This officer would be tasked with educating agency officials on systemic technological risk misperception and identifying its manifestations in their respective agency’s actions. This officer would also ensure agency decisionmakers have conducted the proper marginal cost-benefit analysis and risk-risk analysis.

In conjunction with the creation of Chief Risk Officers, Congress could create a risk-taking agency or form a body within OIRA to liaise with the Chief Risk Officers. Just as OIRA already reviews significant regulatory actions for proper cost-benefit analysis,⁵¹² this specialized risk review body would be tasked with ensuring that agencies have considered substitution risks, marginal costs, and lost opportunities in their decision to restrict an emerging technology.

While these structural changes to agency review should only come after thorough debate and deliberation, we believe they would be an important step in the right direction to minimize the effects of systemic technological risk misperception.

4. *Fight Fire with Fire: How Tech Can Help Regulate Itself*

As demonstrated in the case of drone regulation, technology can sometimes be the answer to its own problems.⁵¹³ In addition to saving lives and improving

506. See *Information and Regulatory Affairs*, WHITE HOUSE, <https://www.whitehouse.gov/omb/information-regulatory-affairs/> (last visited Jan. 16, 2022) [<https://perma.cc/SS6D-XSP9>].

507. See *Office of Management and Budget*, WHITE HOUSE, <https://www.whitehouse.gov/omb/> (last visited Jan. 16, 2022) [<https://perma.cc/WYN3-QFAU>].

508. See e.g., Pub. L. No. 94-505, 90 Stat 2429 (1976) (establishing one of the earliest office of inspector general in the Department of Health, Education, and Welfare).

509. Foundations for Evidence-Based Policymaking Act of 2018, Pub. L. No. 115-435, § 3520, 132 Stat. 5529, 5541-42 (2019).

510. See, e.g., *id.* (describing decentralized Chief Data Officer).

511. *Id.*

512. *Modernizing Regulatory Review*, WHITE HOUSE (Jan. 21, 2021), <https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/20/modernizing-regulatory-review/> [<https://perma.cc/23PZ-YDZ7>].

513. See Calandrillo et al., *supra* note 383, at 187 (“This Article highlights the shortcomings of the FAA’s regulatory scheme, and proposes to fight fire with fire by using technology to solve technology’s own problems.”).

standards of living, emerging technology also offers the opportunity to improve regulatory decision-making by reducing or eliminating human error in risk assessment.

For example, researchers from China have already pieced together a theoretical framework for how artificial intelligence will revolutionize risk analysis.⁵¹⁴ The researchers explain that “[t]he traditional method of perceptual evaluation mainly relies on senior experts in related fields, and . . . the accumulation of years of experience in a certain field”⁵¹⁵ Through time, humans have also developed statistical modeling and computer simulation to assist in assessing risk.⁵¹⁶ This form of risk analysis, however, is labor- and resource-intensive and is still highly dependent on human assumptions and analysis, and thus, highly influenced by human bias.⁵¹⁷ “With the rapid development of computing science, new technologies such as big data and artificial intelligence have brought new ways for risk assessment . . . that is, scientific research in the era of big data will no longer require models and assumptions.”⁵¹⁸ Removing human error from risk analysis will allow for “high-precision ‘fast decision making’ in the future Artificial intelligence will promote the operation and management of human society into a new stage of civilization.”⁵¹⁹ If correct, the framework these researchers have laid out for AI decision-making promises to change the face of technology regulation as we know it.

AI has already shown promise in analyzing risk outside the regulatory context. As America’s infrastructure continues to deteriorate,⁵²⁰ it burgeons as a source of risk. Unfortunately, “estimating accidental risks in critical infrastructure involves a substantial effort and costs due to number of variables involved, complexity and lack of information.”⁵²¹ AI risk analysis, however, has been demonstrated to “improve the accuracy of risk assessment of critical infrastructure.”⁵²² AI methods have also shown promise in assisting experts in predicting and analyzing the risk of natural disaster.⁵²³ At this early stage, the applications for AI risk analysis appear bounded only by the human imagination. It is important to recognize that it could assist regulators in combatting systemic technological risk misperception in their decision-making.

514. See Shuya Bai, Danhui Feng & Oingfeng Dang, *Research and Application of Artificial Intelligence Technology in the Field of Risk Perception*, J. PHYSICS 1, 1 (2019).

515. *Id.* at 3.

516. *See id.*

517. *See id.*

518. *Id.*

519. *Id.* at 5.

520. See Mallory Simon and Rachel Clarke, *America’s Infrastructure Is Crumbling and These People Are Suffering Because of It*, CNN, <https://www.cnn.com/2019/06/17/us/crumbling-american-infrastructure/index.html> (June 21, 2019, 9:01 PM), [<https://perma.cc/U3EA-Y5JZ>].

521. Alexander Guzman, Choie Eugene, Shuichi Ishida & Atsushi Aoyama, *Artificial Intelligence Improving Safety and Risk Analysis: A Comparative Analysis for Critical Infrastructure*, 2016 IEEE INT’L CONF. INDUS. ENG’G & ENG’G MGMT. (IEEM) 471, 471 (2016).

522. *Id.* at 475.

523. See generally Seth Guikema, *Artificial Intelligence for Natural Hazard Risk Analysis: Potential, Challenges, and Research Needs*, 40 RISK ANALYSIS 1117 (2020).

B. Addressing Human Beings' Systemic Risk Misperception

1. Education

Education offers several avenues of combatting systemic technological risk misperception. First, research has shown that simply educating individuals about their biases and heuristics can go a long way in reducing misperceptions.⁵²⁴ Put differently, the first step in solving any problem is recognizing that there is one. Second, developers, regulators, and manufacturers can begin educating the public about the risks associated with avoiding a new piece of technology.⁵²⁵ Third, we can begin educating the next generation to process risk by removing them from risk-free environments and placing them in controlled-risk environments. As it turns out, the school of hard knocks might be the best place to learn accurate risk assessment.⁵²⁶ While these three recommendations are certainly not exhaustive, they would go a long way towards reducing systemic risk misperception of emerging technology.

The more we know about our biases and heuristics, the better we can identify when we are erroneously relying on them and correct our misperceptions.⁵²⁷ Mindfulness and awareness provide us with a means of “resisting the satisfying and simple answers and predictions that come with [cognitive biases] and engaging in the more unsettling process of doubting our categories and scripts and looking for the harder-to-see effects of context and situation.”⁵²⁸ These are “some of the better ways to reduce the biases that result from our automatic cognitive processes.”⁵²⁹ Taking this research to heart, the United States District Court for the Western District of Washington “proposed jury instructions . . . intended to alert the jury to the concept of unconscious bias and then to instruct the jury in a straightforward way not to use bias . . . in its evaluation . . . and in its decision-making.”⁵³⁰ The court also produced an unconscious bias juror video

524. See Adam Benforado & Jon Hanson, *The Great Attributional Divide: How Divergent Views of Human Behavior Are Shaping Legal Policy*, 57 EMORY L.J. 314, 334–36 (2008) (citing ELLEN J. LANGER, *MINDFULNESS* 61–79 (1989)).

525. See Sunstein, *supra* note 225, at 1034 (“The . . . problem is that risks that are now in the realm of uncertainty will often move, over time, into the realm of risk. Indeed, one of the principal goals of a well-functioning system of environmental protection is to acquire more information about potential hazards—information that includes an understanding of the probability of harm. In some circumstances, acquiring information is far better than responding to the worst-case scenario, at least when that response itself creates dangers in the realm of both uncertainty and risk.”).

526. Vox, *Why Safe Playgrounds Aren't Great for Kids*, YOUTUBE (Feb. 20, 2019), <https://www.youtube.com/watch?v=lztEnBFN5zU> [<https://perma.cc/KZ33-BMZU>].

527. See Benforado & Hanson, *supra* note 524, at 334–36. See generally HANS ROSLING WITH OLA ROSLING & ANNA ROSLING RÖNNLUND, *FACTFULNESS: TEN REASONS WE'RE WRONG ABOUT THE WORLD—AND WHY THINGS ARE BETTER THAN YOU THINK* (2018).

528. See Benforado & Hanson, *supra* note 524, at 335.

529. *Id.*

530. *Criminal Jury Instructions—Unconscious Bias*, U.S. DIST. CT. W. DIST. WASH., <https://www.wawd.uscourts.gov/sites/wawd/files/CriminalJuryInstructions-ImplicitBias.pdf> (last visited Jan. 16, 2022) [<https://perma.cc/W9LP-MNWD>].

that is “presented to jurors in every case.”⁵³¹ While mindfulness and awareness may seem overly simplistic, they should not be overlooked, particularly so in the context of emerging technology. If consumers are made more aware of their unconscious biases, they may be able to make better decisions about new technology.

After educating the public and consumers on how to process risk information in an unbiased manner, we should affirmatively provide them with that information.⁵³² In the aftermath of the 2008 Financial Crisis, many faulted predatory lending practices as precipitating the subprime mortgage crisis.⁵³³ Others have argued that consumers should bear some of the blame because they made poor decisions and irresponsibly took advantage of risk-laden lending practices.⁵³⁴ Whatever narrative one accepts, Congress was clearly concerned with the costs imposed by uninformed consumers and risk misperception when it established the Consumer Financial Protection Bureau.⁵³⁵ One of the CFPB’s primary mandates from Congress is to “arm people with the information, steps, and tools that they need to make smart financial decisions.”⁵³⁶ The application to systemic technological risk misperception is clear. In order to make smart decisions about emerging technology, the public and consumers must be equipped with accurate, unbiased information. Moreover, when one considers the fact that emerging technology as an industry is susceptible to information manipulation, access to information on associated risks is paramount. Whether it comes from government agencies, developers, or manufacturers, everyone has an interest in information.

Finally, while the desire to raise and educate our children in risk-free environments is understandable, this overprotectiveness can actually (ironically) operate as a disability for them later in life.⁵³⁷ Instead, we should treat children as what they really are: the next generation of American risk-takers. In a society where litigiousness is liturgical, American playgrounds have become oppressively boring and “safe”—with rubber everywhere and no tall structures.⁵³⁸ By comparison, the *skramellegepladsen*, also known as junk or adventure

531. *Unconscious Bias Juror Video*, U.S. DIST. CT. W. DIST. WASH., <https://www.wawd.uscourts.gov/jury/unconscious-bias> (last visited Jan. 16, 2022) [<https://perma.cc/SS9Z-P3D8>].

532. See Sunstein, *supra* note 225, at 1034.

533. See, e.g., FINANCIAL CRISIS INQUIRY COMMISSION, FIN. CRISIS INQUIRY REP., 389–90 (2011) (repeatedly citing predatory lending as a root source of toxic mortgages).

534. See *id.* at 447 (disagreeing with the commission’s stance on predatory lending practices. “[I]t also appears that many people who received high risk loans were predatory borrowers, or engaged in mortgage fraud, because they took advantage of low mortgage underwriting standards to benefit from mortgages they knew they could not pay unless rising housing prices enabled them to sell or refinance.”).

535. See H.R. REP. NO. 111-517, at 875 (2010) (Conf. Rep.) (“The Bureau will also include an Office for Financial Education . . .”).

536. *The Bureau*, CONSUMER FIN. PROT. BUREAU, <https://www.consumerfinance.gov/about-us/the-bureau/> (last visited Jan. 17, 2022) [<https://perma.cc/5GR8-SLJS>].

537. See Timothy D. Walker, *The Junk Playground of New York City*, ATLANTIC (Aug. 11, 2016), <https://www.theatlantic.com/education/archive/2016/08/the-junk-playground-of-new-york-city/495371/> [<https://perma.cc/A8YD-CN29>].

538. *Id.*

playgrounds, reintroduces limited risk into child play areas.⁵³⁹ Measures include: “erecting handmade play equipment like 20-ft. climbing towers; leaving intact gorse bushes that are quite spiky; supervising children in the use of knives, saws, and other tools; and building fires right in the play area.”⁵⁴⁰ While such structures and tools may seem shockingly dangerous to the modern American, one recent study found an adventure playground to be statistically safer than the traditional one over the course of five years.⁵⁴¹ This might be because the adventure playground attempts to channel a child’s risky play instead of trying to eliminate it. Furthermore, there is a method to this madness—namely, that “risk helps children develop essential life skills. Risky activities give kids a chance to develop confidence and competence as they master challenges.”⁵⁴² Rather than eliminate all forms of risk from their lives, we should offer children controlled-risk environments so that they can learn to process and assess risk more accurately for themselves. It could allow them to be better citizens and more responsible decisionmakers, particularly vis-à-vis emerging technologies.

2. *Engineering and Design*

Engineers and designers in the field of emerging technology can, and should, develop technology with our cognitive biases and heuristics in mind. Specifically, developers can make technology more palatable by providing users with illusions of control and a false sense of familiarity.⁵⁴³ As explained in Part III, lack of familiarity and the feeling of losing control are main drivers of systemic technological risk over-perception. But as we also saw, the brain can be tricked into experiencing feelings of familiarity and control.⁵⁴⁴ Exploiting this observation could greatly reduce users’ aversions to technology.

In the field of user experience (“UX”) design, experts have been concerned with illusions of control since the early days of personal computing.⁵⁴⁵ “The most common solution is the loading screen. It keeps us waiting, but at least we understand what’s going on—loading is in progress.”⁵⁴⁶ While we may not have control over the process of loading, the status bar does provide us with some

539. Amanda R. O’Connor & James F. Palmer, *Skrammellegepladsen: Denmark’s First Adventure Play Area*, PROCEEDINGS 2002 NE. RECREATION RSCH. SYMP., 79, 80–81 (2002) (explaining that risk is partially controlled by an adult play leader who “does not interfere with the children’s play but offers guidance and assurance. They also provide a shield from interference by other adults . . .”); see also Walker, *supra* note 537.

540. Barbara J. King, *Is It Time to Bring Risk Back into Our Kids’ Playgrounds?*, NPR (Mar. 15, 2018, 3:19 PM), <https://www.npr.org/sections/13.7/2018/03/15/594017146/is-it-time-to-bring-risk-back-into-our-kids-playgrounds> [<https://perma.cc/9PDA-GL4X>].

541. Morgan Leichter-Saxby & Jill Wood, *Comparing Injury Rates on a Fixed Equipment Playground and an Adventure Playground* 1 (2018), <https://popupadventureplaygrounds.files.wordpress.com/2018/02/parish-just-the-facts-final.pdf> (last visited Jan. 16, 2022) [<https://perma.cc/J5ZZ-LFPL>].

542. Jennifer L.W. Fink, *Let Them Take Risks*, U.S. NEWS (July 12, 2017, 10:56 AM), <https://health.usnews.com/wellness/for-parents/articles/2017-07-12/let-them-take-risks> [<https://perma.cc/H9PQ-6KDW>].

543. Alec Vishmidt, *Mental Tricks in UX Design: Illusions of Control*, MEDIUM (Dec. 12, 2017), <https://medium.com/trinetix/mental-tricks-in-ux-design-illusion-of-control-d144cfbb9f5> [<https://perma.cc/C3TV-WTFU>].

544. *See id.*

545. *Id.*

546. *Id.*

reassurance.⁵⁴⁷ Other examples include placebo buttons, which do nothing except provide feelings of control (such as the refresh button on your email interface); incoherent controlled processes, which give us something to keep us occupied while we wait; and redundant actions such as a “cancel” button and an “X” button on a browser window (both buttons do the same thing yet evoke different feelings when used).⁵⁴⁸ As technology continues to increase in complexity, UX designers will need to invest more into developing illusions of control if they want the public to accept new technology.

Developers can also design familiarity into emerging technology. A prime example includes the dials and gauges in motor vehicles.⁵⁴⁹ Over the past decade, manufacturers have slowly replaced mechanical dials and gauges with LCD screens.⁵⁵⁰ However, in designing the LCD interface, many manufacturers have mimicked the mechanical predecessors.⁵⁵¹ By repackaging a familiar design into a new piece of technology, a driver can switch back and forth between the two without missing a beat.⁵⁵² Like the trashcan icon on your computer operating system, these skeuomorphs provide users with feelings of familiarity.⁵⁵³ This field of “nostalgic design” offers developers a tool to combat systemic technological risk misperception and democratize technology.⁵⁵⁴ Designers, developers, and engineers alike should invest in these fields, lest their emerging technology be rejected by the average consumer simply because it seems unpalatable or unfamiliar.

3. *Libertarian Paternalism and Nudging*

As this Article has shown, systemic technological risk misperception operates as a thumb on the average decisionmaker’s scales.⁵⁵⁵ Consequently, we need to develop principles and rules of decision-making to counterbalance our own biases. Libertarian paternalism and nudging are a good place to start. While some regulations take the form of mandates and bans,⁵⁵⁶ which restrict choice, nudges offer “liberty-preserving approaches that steer people in particular directions, but that also allow them to go their own way.”⁵⁵⁷ In regulation, nudges can include

547. *See id.* (“That perceived feeling of control of the system will cause user’s satisfaction. They also will sense some degree of comfort even despite the fact they can’t influence the process.”).

548. *See id.*

549. *See* Mark Knapp, *Moving the Needle on Automotive Clusters*, TEXAS INSTRUMENTS (Feb. 23, 2018), https://e2e.ti.com/blogs_/b/behind_the_wheel/posts/moving-the-needle-on-automotive-clusters [<https://perma.cc/3BWD-YH73>].

550. Michael E. Porter & James E. Heppelmann, *How Smart, Connected Products Are Transforming Competition*, HARV. BUS. REV. (Nov. 2014), <https://hbr.org/2014/11/how-smart-connected-products-are-transforming-competition> [<https://perma.cc/J66Q-AM2W>].

551. *See id.*

552. *See* Knapp, *supra* note 549.

553. WILLIAM C. KURLINKUS, *NOSTALGIC DESIGN: RHETORIC, MEMORY, AND DEMOCRATIZING TECHNOLOGY* 3 (2018).

554. *See id.* at 3–15 (delineating the parameters and nostalgic design and explaining its implications).

555. *See supra* Parts III–IV.

556. Cass R. Sunstein, *Nudging: A Very Short Guide*, 37 J. CONSUMER POL’Y 583, 583 (2014).

557. *Id.*

“road signs, speed bumps, disclosure of health-related or finance-related information, educational campaigns, paperwork reduction, and public warnings.”⁵⁵⁸ Done properly, nudging “should be transparent and open rather than hidden and covert.”⁵⁵⁹ This form of light-handed regulation is becoming more and more popular as humans are increasingly forced to interact with government.⁵⁶⁰

In the context of emerging technology, this form of regulation allows government to guide individuals’ interactions with new forms of technology while still respecting their right to choose what is best for themselves and their families.⁵⁶¹ It is highly useful when regulating in an area of uncertainty, such as emerging technology, because it allows for the possibility that the regulation could be slightly misguided or even plain wrong.⁵⁶² For example, educating consumers on the costs of not adopting or underutilizing a piece of technology where they erroneously place more trust in themselves could help individuals make better decisions.⁵⁶³ We nudge car purchasers by telling them how costly a given car may be in terms of gas mileage.⁵⁶⁴ Why not also educate them on how costly a human-operated car would be in terms of lives lost compared to an autonomous one? Even after the point of sale, we could nudge users by reminding them of the costs associated with underutilizing their technology (*e.g.*, a warning light might come on that says, “if you want to be seven times safer, turn on your autopilot by pressing here”). Finally, we could adopt default rules that automatically enroll individuals in the benefits of a given emerging technology and then allow them to opt-out.

In the spirit of fighting fire with fire and designing more palatable technology, AI itself can nudge us into making better choices about technology.⁵⁶⁵ It can be trained to “to mimic the way people behave in constructive relationships.”⁵⁶⁶ In that sense, it can learn our idiosyncrasies and biases when it comes to technology and politely nudge us in the right direction.⁵⁶⁷ Of course, nudging may not be the best nor the only form of regulation that could be used to counteract the average American’s biases with respect to technology. But it is a good and relatively safe place to start.

558. *Id.* at 584.

559. *Id.*

560. *See id.* (“All over the world, nations have become keenly interested in nudges. To take two of many examples, the UK has a Behavioral Insights Team (sometimes called the ‘Nudge Unit’), and the USA has a White House Social and Behavioral Sciences Team. The growing interest in nudges stems from the fact that they usually impose low (or no) costs, because they sometimes deliver prompt results (including significant economic savings), because they maintain freedom, and because they can be highly effective. In some cases, nudges have a larger impact than more expensive and more coercive tools.”).

561. *See id.*

562. *See e.g.*, Calandrillo et al., *supra* note 383, at 191.

563. *See* Sunstein, *supra* note 556, at 584.

564. *See* Alexis C. Madrigal, *New Labels Try to Nudge You to Better Fuel Economy Decisions*, ATLANTIC (Aug. 31, 2010), <https://www.theatlantic.com/technology/archive/2010/08/new-labels-try-to-nudge-you-to-better-fuel-economy-decisions/62310/> [<https://perma.cc/2DMJ-3CS4>].

565. Bob Suh, *Can AI Nudge Us to Make Better Choices?*, HARV. BUS. REV. (May 2, 2019), <https://hbr.org/2019/05/can-ai-nudge-us-to-make-better-choices> [<https://perma.cc/YT3R-FELP>].

566. *Id.*

567. *See id.* (explaining how AI can be trained in emotional quotient or “EQ”).

IV. CONCLUSION

Systemic technological risk misperception is an underappreciated but increasing problem that American lawmakers and regulators must face. While the status quo might feel comfortable, progress is critical to maintain our leadership role on the world stage and our quality of life. When agencies allow human biases to control technological policy and rulemaking, deaths that otherwise might have been prevented result. Lives that otherwise might have been lifted out of poverty continue to be left behind. Opportunities to enrich the human condition are continually put off.

But this does not have to be the case. Our biases are not a ball and chain, and U.S. regulatory policy towards emerging technology need not be influenced by them. The industrial and legal reforms proposed in this Article offer the chance to protect our decision-making process from the distortionary effects of systemic technological risk misperception.

In the end, it is no mere coincidence that many of the heuristics and biases that drive systemic technological risk misperception have been inadvertently codified in colloquial proverbs such as “better safe than sorry,” “better the devil you know than the one you don’t,” or “you can’t teach an old dog new tricks.” These proverbs are simply repackaged, western manifestations of human cognition and systemic biases. For centuries, we have accepted these colloquialisms as fact because to do otherwise would be to question the prism of human existence, something we have just recently become comfortable doing. The problem we face now is a question of how to combat truisms that are simply not true and how to counteract principles that are paralyzing. Simply put, how do we protect us from ourselves?