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Madison and Shannon on Social Media

Justin "Gus" Hurwitz

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ABSTRACT

The Internet has changed speech, and our traditional understandings of speech regulation are struggling to adapt. This article argues that the Internet has tipped the quantity of information that individuals are exposed to beyond the point which they are able to meaningfully process. This article draws from a range of fields—from Information Theory, to cognitive psychology, to informatics—to provide both empirical and theoretical support for the idea that there is a limit to how much information individuals can meaningfully process and that we have surpassed that limit. This argument poses a direct challenge to bedrock First Amendment concepts such as the marketplace of ideas and the mantra that "the best response to bad speech is more good speech."

> "1990: The internet will put all of human knowledge at our fingertips, ushering in a new age of enlightenment. Now: People have stopped vaccinating their kids, think the Earth is flat, and are falling into the Grand Canyon while taking selfies for Instagram."
>
> - Literally a random tweet I saw while writing this article[1]

*Associate Professor of Law and Co-Director, Space, Cyber, and Telecom Law Program, University of Nebraska College of Law and Director of Law & Economics Programs, International Center for Law & Economics; Program Affiliate NYU School of Law Classical Liberalism Institute. JD, University of Chicago, 2007; MA, George Mason University (economics), 2010; BA, St. John's College, 2003. With thanks to Jackson Slechta and Justin McCully for helpful research assistance.

1.John Lyon (@JohnLyonTweets), TWITTER (May 7, 2019, 5:08 PM), https://twitter.com/JohnLyonTweets/status/1125915332575727617.

I. INTRODUCTION

The Internet has changed speech, and our traditional understandings of speech regulation are struggling to adapt. This is not a new idea: since it was opened to popular use in the early 1990s, academics have argued that the Internet changes the dynamics of speech in ways that current legal doctrine does not abide.[2] This article goes a step further to make the case that "this time things are different." It argues that the Internet (social media in particular) has unquestionably tipped the quantity of information that individuals are exposed to beyond the point which they are able to meaningfully process that information. Additionally, it argues that those individuals are exposed to so much information that they are unable to meaningfully discriminate "good" information (meaningful signal) from "bad" information (noise), such that *all* information to which they are exposed becomes indistinguishable from noise.

This article draws from a range of fields—from Information Theory, to cognitive psychology, to informatics. It will provide both empirical and theoretical support for the idea that there is a limit to how much information individuals can meaningfully process, and that we have surpassed that limit. This, in turn, poses a direct challenge to bedrock First Amendment concepts such as the marketplace of ideas and the mantra that "the best response to bad speech is more good speech." The purpose of this article is modest–merely to argue that First Amendment doctrine has run up against a hard limit that requires potentially fundamental change. While it offers some musings about potential solutions, it does not purport to solve what may legitimately be the most important challenge to a defining element of our democracy.

This article proceeds in four parts. Part II discusses how the Internet has changed speech, focusing on the exponential growth in the production and distribution of information, juxtaposed with our relatively constant ability to process or otherwise use that information. This part also discusses how dramatically decreased costs of producing and distributing information has reduced the need for speech intermediaries to facilitate the production and distribution of speech. One effect of this dynamic is that it is much easier today to create and spread "bad" speech. Part III looks at the traditional models in American law for addressing "bad" speech, most notably the marketplace of ideas metaphor, and argues that these mechanisms are ill-suited to the world of "too much speech." Part IV turns to Information Theory to argue that we may be at a point of too much speech, explaining that every communication channel has a theoretical maximum information carrying capacity and that once you exceed that capacity, meaningful signal (akin to "good" speech) becomes indistinguishable from noise (akin to "bad" speech). This effectively reduces the overall ability to communicate information. However, Information Theory also offers possible solutions to this information saturation problem, which are explored in the context of speech. Finally, Part V offers tentative thoughts about possible paths forward.

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2. *See, e.g.*, Qasim Rashid, *In Harm's Way: The Desperate Need to Update America's Free Speech Model*, 47 STETSON L. REV. 143, 143–44 (2017); Jeffrey Rosen, *Free Speech, Privacy, and the Web That Never Forgets*, 9 J. TELECOMM. & HIGH TECH. L. 345, 355 (2011); Eugene Volokh, *Cheap Speech and What It Will Do*, 104 YALE L. J.1805, 180–1807 (1994).

II. HOW THE INTERNET HAS CHANGED SPEECH

A. Exponential Growth in Information Production Outpaces Human Ability to Process that Information

Few would contest that the Internet has changed how we produce, distribute, and consume information.[3] The growth in the amount of information produced every year is well documented.[4] The Internet has given the majority of humans alive today near immediate access to these immeasurable troves of information,[5] and more people are spending more time consuming information than ever before.[6] While much of this growth is attributable to the Internet and, more generally, the information technology revolution of the past century, it is also worth noting that this is a continuation of a much longer-term trend in the exponential growth in human production of information.[7]

Over roughly the same period that we have seen exponential growth in the human ability to produce and distribute information, our ability to process that information has remained relatively static. While there may be seemingly large variations in individuals, as a species, humans in ancient Egypt, Greece, Dark Ages England, the Renaissance, and the era of Twitter have all had roughly constant mental capacity.[8] Indeed, while there may be (or have been) significant differences between Aristotle, Einstein, and Kelly Bundy, that difference in infor-

3. Richard L. Hasen, *Cheap Speech and What It Has Done (To American Democracy)*, 16 FIRST AMEND. L. REV. 200, 200–202 (2017) (discussing consumer reactions to fake news.); Volokh, *supra* note 2, at 1826 (discussing how the internet will lower production cost thereby increasing the overall number of producers which will cater to more unique tastes).

4. *The Exponential Growth of Data*, INSIDEBIGDATA (Feb. 16, 2017), https://insidebigdata.com/2017/02/16/the-exponential-growth-of-data/; Elisabetta Raguseo, *Big data technologies: An empirical investigation on their adoption, benefits and risks for companies*, 38 INTER'L J. OF INFO. MGMT. 187, 188 (2018) ("For example, more than 98,000 tweets are written every sixty seconds, 695,000 status updates are posted on Facebook, 11 million instant messages are written, 685,445 Google searches are lunched, more than 169 million emails are sent, more than 1820 TB of data are created, and there are 217 new mobile web users."); Martin Hilbert and Priscila López, *The World's Technological Capacity to Store, Communicate, and Compute Information*, 332 SCIENCE 60 (2011); Martin Hilbert, *How much information is there in the "informationsociety"?*, 9 SIGNIFICANCE 8 (2012).

5. J. Clement, *Number of internet users worldwide from 2005 to 2018 (in millions)*, STATISTA, https://www.statista.com/statistics/273018/number-of-internet-users-worldwide/ (last updated Jan. 9, 2019).

6. JEFFREY I. COLE, MICHAEL SUMAN, PHOEBE SCHRAMM, & LIUNING ZHOU, THE 2017 DIGITAL FUTURE REPORT: SURVEYING THE DIGITAL FUTURE 10 (2017), https://www.digitalcenter.org/wp-content/uploads/2018/04/2017-Digital-Future-Report-2.pdf.

7. For a fascinating discussion of the exponential nature of growth in information, s*ee generally* Phil Metzger (@DrPhiltill), TWITTER (May 29, 2019), https://twitter.com/DrPhiltill/status/1133876121114697728. In human terms, these trends can be seen by following the development of spoken, and then written, language, leading to the development of writing and improved writing technologies, and then the development and improvement of transmission technologies – from language to writing to couriers to postal networks to books to the printing press, to the telegraph to the radio to the telephone to the transistor and then the computer to the Internet, at each stage along this progression the cost of producing, distributing, and using information went down and the production, distribution, and use of information was made possible for an increasing number of people, leading to exponential growth.

8. Suzana Herculano-Houzel & Jon H. Kaas, *Gorilla and Orangutan Brains Conform to the Primate Cellular Scaling Rules: Implications for Human Evolution*, 77 BRAIN, BEHAVIOR AND EVOLUTION 33, 43 (2011).

mation-processing ability is orders of magnitude less significant than the growth in our ability to produce and distribute information.

Many factors have driven this exponential growth in our ability to produce and distribute information. One driver has certainly been decreasing costs (broadly defined). Additionally, though, literacy is now widespread, as is access to media for recording information, both physical (paper) and digital (computers or phones). There is more standardization in language, such that most of the world's population can communicate in one of relatively few dominant languages, and even those who cannot are able to use technology to communicate in multimedia format (e.g., photos and video).

B. Disintermediation

The loss of intermediation in how information is communicated has been an important driver in the Internet's effect on speech. This change results from, but is as important as, the decrease in distribution costs. Before the modern era, mass distribution of information required access to an expensive platform – like a television, radio station, or printing press. This meant that only those who had access to (and, by necessity, the resources to have access to) these platforms could distribute information at a large scale.[9] Today, anyone with access to a computer can send a tweet, with greater reach than any platform that existed before this millennium.[10]

This loss of the *need* for intermediaries has, in turn, led to a loss in (or a change in the nature of) those intermediaries that continue to exist.[11] The lack of need for intermediaries has created competitive pressures that have changed the nature of the traditional intermediated media.[12] Simply stated, in an era where the New York Times is competing with Twitter for readers, the content produced by the New York Times has become more like the content one would find on Twitter.[13]

An important second-order effect of this loss of intermediation is that the burden of evaluating information has shifted from those distributing information to those receiving information. In an era of intermediated information distribution, intermediaries necessarily perform an editorial and filtering function by gathering, evaluating, and selecting information for distribution on their platforms. Only a platform that was able to distribute information at near-zero cost (that is, it did not face scarcity on its platform) would forego this selection process, but any platform

9. Volokh, *supra* note 2, at 1806-07 ("…Speaking today is expensive....").

10. Hasen, *supra* note 3, at 212 (indicating that President Trump would not be able to directly reach his millions of followers if he used a weekly radio address or a speech from the Oval Office).

11. *Id.* at 203.

12. *Id.*

13. Sofia Grafanaki, *Drowning in Big Data: Abundance of Choice, Scarcity of Attention and the Personalization Trap, A Case for Regulation*, 24 RICH. J.L. & TECH. 1, 14 (2017) (discussing how news entities are beginning to allow collaboration between the business department and journalists to increase clickability); *see also* MANUEL CASTELLS, RUPTURE: THE CRISIS OF LIBERAL DEMOCRACY 21 (2019) ("In a world of digital networks that allow anyone to express themselves, there are no real rules other than personal agency and freedom of speech. This means that traditional checking and censuring mechanisms fall by the wayside, messages of all types form a powerful and polymorphic groundswell, bots multiply and spread memes and sound bites all around and the post-truth world, which the traditional media end up participating in, transforms uncertainty into the only reliable truth: 'my truth,' each individual's truth.").

with such abundant capacity would more likely transition from the business of being an intermediary to instead being a distribution platform.[14]

In an ecosystem with exceptionally low distribution costs, in which a significant portion of content is distributed directly from producer to consumer without an evaluating intermediary in between, it is up to the consumer to evaluate the information. This leads to an important question: how has the increased availability of information affected the cost of evaluating that information? One could imagine, for instance, that the availability of low-cost, near-immediate access to the world's collected knowledge would make it exceptionally easy for information consumers to evaluate information; the answer to every question is just a Google search away! On the other hand, if information consumers need to evaluate an increasing quantity of information that exceeds the decline in the cost of evaluating that information, the loss of intermediated information effectively shifts a substantial burden from information intermediaries to information consumers.

The shifted burden raises concerns of the bearability of such costs. In an information ecosystem with, say, one million information consumers that used to have ten intermediaries, even assuming that those consumers are as good at evaluating information as those intermediaries (which is unlikely), the disintermediated ecosystem has as a starting baseline 100,000 times the information-evaluation costs as the intermediated one. These costs are entirely duplicative (that is, there are one million information consumers spending resources evaluating information as opposed to ten intermediaries).

The disintermediation of information distribution, in other words, and as will be discussed at greater length below, is a central part of the contemporary story of information.

III. TRADITIONAL UNDERSTANDINGS OF SPEECH REGULATION (DO NOT WORK)

The state of affairs described above bodes ill for traditional American understandings of speech and information, as captured in the First Amendment. The prevailing American approach to speech and information is to overwhelmingly reject restrictions on speech. Where "bad" speech is interjected into our social, political, economic, or other discourse, we rely on the so-called marketplace of ideas to embrace "good" speech as inherently more valuable than, and therefore as a corrective to, the ills of bad speech. This stands in contrast to the alternative, which would rely on some form of government control over speech, necessarily in the form of restrictions placed upon speech deemed "bad" by the government or majoritarian groups favored by the government.

The discussion below develops these ideas further, discussing traditional understandings of speech regulation in American law. This discussion lays the groundwork for Part IV, which synthesizes the discussions here and in Part II to

14. And, indeed, this is largely what led to the advent of our modern information ecosystem. For instance, as cable systems' capacity expanded greatly in the early 1990, they regularly bartered channel capacity in exchange for content. This is how many traditional broadcasters, such as NBC, developed their contemporary cable networks (e.g., CNBC, MSNBC, &c). W. RUSSELL NEUMAN, LEE W. MCKNIGHT & RICHARD JAY SOLOMON, THE GORDIAN KNOT: POLITICAL GRIDLOCK ON THE INFORMATION HIGHWAY 209–211 (1999).

understand why the modern speech environment poses fundamental challenges to traditional American free speech principles.

A. The First Amendment

Among other things, the First Amendment prohibits Congress from "abridging the freedom of speech, or of the press."[15] This is a bedrock doctrine of our democratic republic. A society structured around the vote of the people necessarily depends on those people to be informed to meaningfully provide governance through their votes. More specifically, they should be informed by voices independent from the government over which their votes provide oversight.[16] As such, the First Amendment has been interpreted broadly: for instance, it allows the press to publish top secret government files,[17] allows citizens to burn the American flag,[18] requires the government to allow Nazis to gather and demonstrate in public spaces,[19] prohibits the government from requiring Internet-based platforms from ensuring that children are not exposed to pornography,[20] and even prohibits the government from barring convicted sex offenders from accessing social media sites where children are known to gather.[21]

But the First Amendment is not an absolute guarantee of free speech. To the contrary, government regulation of speech is governed by complex doctrine that specifies (if often in non-specific terms) the circumstances and conditions under which different types of speech can be regulated. For instance, regulations based on the content of speech are subject to strict scrutiny by the courts, under which only regulations narrowly tailored to address a compelling government interest, and that do so in the lease restrictive means, are permissible.[22] On the other hand, content-neutral speech regulations are subject to intermediate scrutiny, under which the time, place, and manner of speech can be reasonably proscribed to advance an important government interest.[23] Some types of speech are not protected by the First Amendment at all.

B. The Marketplace of Ideas and Bad Speech

The discussion of the First Amendment above is not meant to offer a comprehensive introduction to, or overview of, the First Amendment. Rather, it is to

15. U.S. CONST. amend. I.

16. *See, e.g.*, G. Edward White, *The First Amendment Comes of Age: The Emergence of Free Speech in Twentieth-Century America*, 95 MICH. L. REV. 299, 334 (1996) (discussing the "indispensable connection [of free speech] to the maintenance of democratic principles"); Whitney v. California, 274 U.S. 357, 375–76 (1927) (Brandeis, J., concurring) (observing that the founding generation viewed public discussion as a civic duty and that the means to prevail over bad thoughts is through public discussion); *see also* Jeffrey Rosen*, America Is Living James Madison's Nightmare*, THE ATLANTIC (Oct. 2018), https://www.theatlantic.com/magazine/archive/2018/10/james-madison-mob-rule/568351/.

17. New York Times Co. v. United States, 403 U.S. 713, 714 (1971).

18. Texas v. Johnson, 491 U.S. 397, 420 (1989).

19. Nat'l Socialist Party of Am. v. Vill. of Skokie, 432 U.S. 43, 44 (1977).

20. Reno v. Am. Civil Liberties Union, 521 U.S. 844 (1997).

21. Packingham v. North Carolina, 137 S. Ct. 1730, 1733 (2017).

22. David L. Hudson, Jr., *Legal Almanac: The First Amendment: Freedom of Speech* §2:2 (2012).

23. *Id*.

highlight the American Constitutional commitment to free speech – a uniquely strong one, even among liberal Western democracies.[24] While America is not unique in placing great value on freedom of speech, the American commitment to it is uniquely constitutional, sounding in the importance of revolutionary speech in the establishment of the country.[25] Speech is a critical bulwark, and perhaps the most important organizing force, against the sort of government abuses that animated the American Revolution. As a result, these values are part of the American constitutional DNA.

This conception of speech does not deny the potential for harmful speech. Its focus is not so much on the nature of speech as it is on the mechanism for moderating potentially harmful speech. The First Amendment means that it is not the responsibility of the government to police speech–and, indeed, that the government is expressly prohibited from acting as arbiter of speech.

In place of the government as arbiter of ideas, we rely on the famous metaphor of the marketplace of ideas to regulate speech.[26] Under this model, speech occurs in a competitive marketplace. Better ideas will achieve more success than lesser ideas; false speech will be eschewed in favor of true speech; socially valuable speech, and the speakers uttering it, will be rewarded. Speech that is better for citizens will be heard and be powerful, regardless of whether that speech is favorable to the government, and bad speech from those in political power will be checked by responses from those outside of power.

The First Amendment is a necessary, but not sufficient, condition for this marketplace of ideas to operate. Freedom of speech only ensures that such a marketplace is free to operate. But its operation, in turn, assumes a robust dialogue between speakers. As captured by Justice Brandeis, "[t]hose who won our independence believed … that the greatest menace to freedom is an inert people [and] that public discussion is a political duty."[27] This was more succinctly stated in subsequent opinions: the response to bad speech is more, better, speech.[28] Success

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24. Derek E. Bambauer, *The New American Way of Censorship*, ARIZ. ATT'Y, Mar. 2013, at 32, 34 ("Most observers saw America's free speech protections as exemplary, if not outright exceptional, in an international environment of increasingly pervasive censorship."); James M. Boland, *Is Free Speech Compatible with Human Dignity, Equality, and Democratic Government: America, A Free Speech Island in A Sea of Censorship?*, 6 DREXEL L. REV. 1, 16 (2013).

25. For a discussion of traditions of freedom of speech from around the world, *see generally* Ronald Krotoszynski, THE FIRST AMENDMENT IN CROSS-CULTURAL PERSPECTIVE (2006) (discussing the traditions of freedom of speech around the world).

26. Joseph Blocher, *Institutions in the Marketplace of Ideas*, 57 DUKE L.J. 821 (2008) ("Ever since Justice Holmes invoked the concept in his Abrams dissent, academic and popular understandings of the First Amendment have embraced the notion that free speech, like the free market, creates a competitive environment in which the best ideas ultimately prevail."); Abrams v. United States, 250 U.S. 616, 630 (1919).

27. Whitney v. California, 274 U.S. 357, 375 (1927), *overruled in part by* Brandenburg v. Ohio, 395 U.S. 444 (1969).

28. *Id*. at 377 ("If there be time to expose through discussion the falsehood and fallacies, to avert the evil by the processes of education, the remedy to be applied is more speech, not enforced silence."); Linmark Assocs., Inc. v. Willingboro Twp., 431 U.S. 85, 97 (1977) (" The township obviously remains free to continue "the process of education" it has already begun"); Lorillard Tobacco Co. v. Reilly, 533 U.S. 525, 586 (2001) (Thomas, J., concurring) ("And, if its concern is that tobacco advertising communicates a message with which it disagrees, it could seek to counteract that message with "more speech, not enforced silence,"); United States v. Alvarez, 567 U.S. 709, 727 (2012) ("The remedy for speech that is false is speech that is true. This is the ordinary course in a free society."); Williams-Yulee v. Fla. Bar, 135 S. Ct. 1656, 1684 (2015) ("If there is concern about principled, decent, and

of the marketplace of ideas, in other words, is premised both on the freedom of speech, as guaranteed by the First Amendment, as well as the exercise of that freedom, as believed would be fulfilled as a matter of political duty.

But markets fail, and the marketplace of ideas is no exception. Citizens may fail to hold up their end of the speech bargain; they may fail to exercise their duty to engage in the public discussion that guides operation of the marketplace of ideas, or they may simply be insufficiently equipped to meaningfully participate in that market.[29] More concerningly, there may be a fundamental error in the founding generation's belief in the possibility of a marketplace of ideas. The duty for citizens to engage in public discourse may be an impossible one to be discharged at scale.[30]

C. A Madisonian View

The idea that the marketplace of ideas can fail is not surprising to most participants in the contemporary media marketplace. At its best, the era of the "vast wasteland"[31] of modern media was dominated by an ethos of "if it bleeds it leads."[32] Today, the same phenomenon is more pithily captured by the epithet of "clickbait."[33] Success in the contemporary marketplace of ideas is determined by consumption of those ideas, not by their quality; therefore, those "ideas" that command greater attention are the ones driving the intellectual economy. At some level this is driven by the economics of media markets – that is, by advertising. The more consumer engagement a platform can generate, the more ad revenue follows, and the path to engagement is the more prurient interests, not the enlightened ones.

There is another explanation for this failure that is more charitable to the consumers of ideas: the more ideas that we are exposed to, the more time we must spend evaluating those ideas. But we only have finite time, so we can only evaluate so many ideas.[34] The more robust the competition is in the marketplace for ideas, that is to say, the more ideas there are–the less effective the marketplace becomes as a filter. This suggests that the failure of the marketplace results less

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thoughtful discourse in election campaigns, the First Amendment provides the answer. That answer is more speech.")

29. *See supra* Part III A.

30. *See supra* Part IV B.

31. Newton N. Minnow, FCC Chairman, Speech at Convention of the National Association of Broadcasters (May 9, 1961).

32. *See* Bill Gates (@Bill Gates), TWITTER (June 11, 2019, 1:58 PM), https://twitter.com/BillGates/status/1138520780042465280; Robert E. Shepherd, Jr., *How the Media Misrepresents Juvenile Policies*, CRIM. JUST., Winter 1998, at 37, 38 ("It seems to be true that 'if it bleeds, it leads' is a governing maxim on both local and network news shows."); David N. Lawrence ET AL., *It's the Cyber Crime and Its Sponsors (Not My Cyber-Security), Stupid*, 5 J.L. & CYBER WARFARE 1, 32 (2017) ("Increasingly, when it comes to hacked information and our social media platforms: If it bleeds, it leads, reads and gets believed.").

33. Alexandra Andorfer, *Spreading Like Wildfire: Solutions for Abating the Fake News Problem on Social Media Via Technology Controls and Government Regulation*, 69 HASTINGS L.J. 1409, 1424 (2018).

34. *See* Bryan Caplan, *Rational Ignorance versus Rational Irrationality*, 54 KYKLOS 3 (2001); *see also* Bryan Caplan, THE MYTH OF THE RATIONAL VOTER: WHY DEMOCRACIES CHOOSE BAD POLICIES (2007).

from a failure of its participants to faithfully discharge their duty of public discourse and more from that duty being impossible for the public to bear.

Regardless of the nature of this failure, the founders of the nation were aware that a freedom of speech alone would not be a sufficient bulwark against an incipient intellectual tyranny that could wreck the American experiment.[35] Perhaps none was more keenly aware of this than James Madison, who recognized these failures as endemic. As he wrote in Federalist 55, "[i]n all very numerous assemblies, of whatever characters composed, passion never fails to wrest the sceptre from reason. Had every Athenian citizen been a Socrates; every Athenian assembly would still have been a mob."[36] The deliberative process of the marketplace of ideas moves slowly. But the power of the individual ideas moving through that marketplace to grab the attention of their consumers is potent; popular ideas, regardless of their merit, can grab the attention of the masses and be translated into belief and action quickly. This gives rise to what Madison labeled in Federalist 10 as "factions," or groups "united and actuated by some common impulse of passion."[37]

Just as speech was intended to serve as a bulwark against the excesses and abuses of government, Madison envisioned the structure of our government to serve as a bulwark against the excesses of speech that give rise to factions. Our government was deliberately designed to be inefficient, incorporating various deliberative circuit breakers to slow the formation of factions and to impose time of reflection upon their calls to action.

The House of Representatives was intended to translate the will of the people quickly into actions proposed to the slower-moving and more deliberative Senate.[38] The Electoral College stood as a slowing intermediary between the will of the people and the election of a President.[39] Madison even viewed the young nation's relatively vast geography and large population as virtues in this light, ensuring that ideas would be slow to spread and that there would be ample time for deliberation and response before any single idea could give rise to action. In other words, under the Madisonian view, the response to bad speech emphatically is not more, better, speech. It is slower, more deliberative speech.

This, unfortunately, is also the cause of the great failure that we are seeing today in the marketplace of ideas approach to speech: the trend of exponential growth in information production and distribution, which began with the advent of language, has shrunk the geography of communication at a rate that far exceeds the rate of growth in geography and population. Today, the decision of a mayor of a small town can be just as visible, just as quickly as that of the President of the

35. Rosen, *supra* note 16 (discussing the Madisonian concerns about the risk that factions pose to democracy and discussing various mechanisms built into our Constitutional structure that are designed to cool down speech and promote greater deliberation).

36. The Federalist No. 55, at 275 (James Madison) (Oxford University Press, 2008).

37. The Federalist No. 10, 49 (James Madison) (Oxford University Press, 2008).

38. Todd J. Zywicki, *Beyond the Shell and Husk of History: The History of the Seventeenth Amendment and Its Implications for Current Reform Proposals*, 45 CLEV. ST. L. REV. 165, 180 (1997).

39. Harv. L. Rev., *Rethinking the Electoral College Debate: The Framers, Federalism, and One Person, One Vote*, 114 HARV. L. REV. 2526, 2528 (2001) ("To effectuate this compromise, the Framers divided the presidential election process into two stages: a "nomination" stage, in which an electoral college of elders would express a filtered version of the popular will, and a "selection" stage, in which the House of Representatives would ultimately choose the winner from among the top several candidates.").

United States; a state legislator is subject to the same media coverage as a member of the House of Representatives or a Senator (both of whom are treated as roughly equivalent in contemporary media); and the CEO of a Fortune 10 company is subject to the same media attention as a middle school principal.[40]

The institutional circuit breakers that Madison envisioned as sufficient to slow down the flow of information in the 1800s and stymie the formation of factions and advantage deliberative discourse may have been suitable to the information technology of the era. However, they are meaningless in the face of the flow of information that exists today.

IV. AN INFORMATION THEORY UNDERSTANDING OF SPEECH REGULATION

The Madisonian and marketplace of ideas views of how to deal with bad information discussed in Part III—more (and slower) deliberation versus more information—are remarkably different. As a phenomenological matter, Madison's approach has lost out: as technology has improved, every one of us has consistently been exposed to more and more information. But that does not mean that our contemporary superabundance of information is a desirable alternative.

Our contemporary information age was made possible, in part, by the formalized study of the nature of information. The mathematic field of Information Theory was developed precisely to study questions of the nature of information and the theoretical limits of information density and transmission capacity. This field gives us reason to pause over the marketplace of ideas' "more speech" theory of addressing bad speech – indeed, Information Theory suggests that, after a certain point, more speech makes *all* speech bad speech. But it also gives us tools to think about how to mitigate the problems of both bad speech and simply too much speech.

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40. Dave Goldiner, *Barney Frank predicts Mayor Pete will fall short of White House - not that there's anything wrong with that*, N.Y. DAILY NEWS (June 4, 2019, 10:43 AM), https://www.nydailynews.com/news/politics/ny-barney-frank-pete-buttigieg-gay-president-20190604-p325ij74cfb6nhicppmuxcd6iq-story.html; Dave Goldiner, *Trump Claims Immigration Problem 'Solved!' After Murky Mexico Tariffs Deal*, N.Y. DAILY NEWS (June 8, 2019 12:15 PM), https://www.nydailynews.com/news/politics/ny-trump-immigration-mexico-tariffs-democrats-20190608-ch7jr47atrdsdi5fartvjw7hry-story.html; Michael McAuliff, *Nita Lowey went from the Queens PTA to being the most powerful NY congresswoman*, N.Y. DAILY NEWS (Jan. 13, 2019, 6:00 AM), https://www.nydailynews.com/news/politics/ny-pol-nita-lowey-chair-of-appropriations-trump-alexandria-ocasio-cortez-20190112-story.html; Denis Slattery, *AOC returning to her bartending roots to advocate for raising minimum wage for restaurant employees and other tipped workers*, N.Y. DAILY NEWS (May 28, 2019, 4:00 AM), https://www.nydailynews.com/news/politics/ny-ocasio-cortez-restaurant-workers-minimum-wage-tipped-20190528-gmvdbirsxfdgrbkumfwp42hpaq-story.html; *Ex-Fortune 500 exec pleads guilty to killing couple, unborn baby in attempted suicide car wreck in New Hampshire*, N.Y. DAILY NEWS (Feb. 19, 2018, 1:01 PM), https://www.nydailynews.com/news/crime/ex-fortune-500-exec-pleads-guilty-wreck-killed-couple-article-1.2121520; Michael Gartland & Michael Gartland, *Bronx middle school principal demoted after racism allegations*, N.Y DAILY NEWS (June 7, 2019 7:00 AM), https://www.nydailynews.com/new-york/ny-metro-catania-224-race-20190607-jhhxqi5dajdj5djsxajdhs4ndm-story.html.

A. Information Theory

A phenomenally abstract area of science,[41] Information Theory studies how we can encode and transmit information – and how we can do so efficiently. Two of its fundamental theorems, the source coding theorem and channel coding theorem, explain the absolute minimum amount of storage (e.g., "bits") needed to encode a piece of information and the absolute maximum capacity of a communications channel , respectively.[42] Together, these two theorems express a fundamental limit to how much information can be communicated between any two points over any given communications channel.

Although phenomenally abstract, the existence of such a limit is as important for a society living in an "information age" to understand as Newton's laws of motion or the speed of light have been to understanding our physical world. Information can fairly be called the bedrock of most democratic institutions. The idea that information exists in discretely measurable quantities and is subject to constraints on how it can be represented and communicated is as fundamentally important as the concept of scarcity is to physical resources. Indeed, an implication of Information Theory is that information may be as subject to the laws of scarcity, at least along some dimensions, as any other resources. The only reason that these ideas have not already presented recognizable (let alone significant) challenges to society is that we have not previously approached the limits of how we use information. However, contemporary information technology increasingly pushes against these limits. Indeed, Claude Shannon initially developed Information Theory to understand the theoretical limits of the digital communications technologies being developed by AT&T. His goal was to establish a benchmark against which information and communications technologies could be measured.[43] As our society increasingly relies upon these technologies, which in turn push against the technological limits of information, our society is increasingly likely to find itself pushing up against the limits on the use of information in society.

One of the central theorems of Information Theory, the channel capacity theorem, tells us that any communications channel has a maximum theoretical capacity. A telephone line, a fiber optic cable, and a 5G smartphone, for instance, each have a theoretical maximum data transfer rate; because we can calculate those rates, we design those systems to operate as closely to those maximum rates as possible given the current state of technology.

The key insight from (and the mathematical determinant of) the channel coding theorem is that the capacity of a given communications channel is bounded by the signal-to-noise ratio. "Signal" is the portion of a communication that carries information intelligible to the recipient; noise is anything else. By way of meta-

41. *Information Theory,* WIKIPEDIA, https://en.wikipedia.org/wiki/Information_theory (last visited Sept. 1, 2019) (explaining that Information Theory "is at the intersection of mathematics, statistics, computer science, physics, neurobiology, information engineering, and electrical engineering.").

42. *See* Shannon, *A Mathematical Theory of Communication*, 27 BELL SYSTEM TECH. J. 379m 379, 381 (1948). This is the foundational article of Information Theory, which defines both of these theorems.

43. *Id.* at 380–381 ("We wish to consider certain general problems involving communication systems. To do this it is first necessary to represent the various elements involved as mathematical entities, suitably idealized from their ideal physical counterparts.").

phor, if you are having a conversation in a noisy room, "signal" is the words you are exchanging with your interlocutor, and noise is just that—background noise.

The differentiator between "signal" and "noise" is intelligibility. Background noise makes it harder to make out what your interlocutor is saying. To overcome that noise, the speaker will either need to speak more slowly or more loudly, or both. If she speaks more slowly, the channel capacity is obviously reduced (it will take longer for anything to be said). If she speaks more loudly, then everyone else in the room will also have a more difficult time hearing each other speak, so they will need to speak more loudly in turn; the net result in this scenario is that the channel capacity for everyone will be reduced.

That last part is the critical observation for our modern, high velocity, low intermediation, information age: if you exceed the capacity of a communication channel, the "signal" being carried by that channel becomes unintelligible noise. The traditional "answer bad speech with more speech" understanding of the marketplace of ideas attempts to answer bad information (noise) with more information. This may work if you are in a quiet room. But if you are in a noisy room, a room where everyone is already struggling at the limits how much information can be transmitted, that approach only increases the noise floor, which has the unintended effect of reducing the amount of information that can be communicated. The Madisonian approach, on the other hand—that the solution to bad speech is slower, more deliberative, speech—is akin to slowing down your rate of speech and speaking more slowly and clearly.

B. Have We Reached Our Channel Capacity?

Before asking whether we have exceeded humans' information channel capacity, it is worth validating this concern by noting that there is empirical evidence that humans are subject to a channel capacity constraint. This is a difficult question to study directly, but there is indirect evidence of such a capacity limitation. For instance, a 2011 study, which has led to various follow-up studies, looks at the information density of human languages.[44] Languages spoken around the world have different characteristics. Some have very large vocabularies and others have relatively small vocabularies. In some, speakers converse very quickly, while in others they speak relatively slowly (in terms of words per minute).[45] This study reached the remarkable result that the information density of languages is roughly constant. For instance, languages with more words tend to be spoken at a slower rate, whereas those with fewer words are spoken at a faster rate. This suggests that these languages have evolved subject to a common constraint of human listeners' ability to process them. In a recently published follow-up study, the authors of the

44. François Pellegrino, Christophe Coupé & Egidio Marsico, *A Cross-Language Perspective on Speech Information Rate*, 87 LANGUAGE 539, 539–558 (2011). ("All languages exhibit an equal overall communication capacity") Because there are different encoding strategies and distinct complexities, we cannot say they are equally overall complex. *See also* Morten H. Christiansen & Nick Chater, *The Now-or-Never bottleneck: A fundamental constraint on language*, 39 BEHAVIORAL AND BRAIN SCIENCES 1, 2 (2016).

45. For instance, English has been measured at a syllabic rate of 6.19 syllables per second, compared to Spanish at 7.82 and Mandarin Chinese at 5.18; the information density of English (that is, how much information is conveyed per syllable) has been measured at 0.91, compared to 0.63 for Spanish and 0.94 for Mandarin Chinese. *See* Pelligrino, *supra* note 44, at 544.

2011 study estimate a universal average information rate of 39 bits/second as a common feature of human language.[46]

Approaching the question of channel capacity from the other direction, there is evidence that human brains adapt to optimize the ability to process information. At one level this suggests that we have ways around any channel capacity constraints, but in purely information theoretic terms, this may alternatively suggest that how we speak and communicate evolves in response to our communications capacity constraints (and, indeed, if we did not face those constraints, we would not need to adapt). For instance, studies of "choice paralysis" show that those who are averse to shopping are more fatigued by it, due to the overwhelming number of choices at their disposal, and therefore are more prone to experiencing choice paralysis.[47] There is also research showing that exposure to information technology is actually altering the structure of Millennials' brains. While the evidence is split, with some suggesting that technology is making us (to use the crude phrase) "stupider,"[48] there is other evidence that digital natives' brains are better adapted to certain aspects of our current information age.[49] Somewhat more anchored to the metaphor of language, some languages have many words expressing nuanced variations of concepts important to the speakers of that language, compared to other languages with simpler vocabularies in other languages where such nuance is not needed. The most common example is the richness of Inuit and Yupik dialects' words for different types of snow as compared to English.[50] This example suggests that there is optimization around those speakers' abilities to communicate specific concepts, not that they have developed a language that exceeds other languages' information densities.

Perhaps most important, even if we have not already exceeded our collective individual capacity to intelligibly process and use the information that we receive, given the ongoing growth in the production and distribution of information, it is conceivable that this limit could be soon met. Thinking along these lines, the traditional "answer bad speech with more speech" understanding of the marketplace of ideas only exacerbates this concern. As individuals approach their informational capacity, signal (good speech) will increasingly become indistinct from noise

46. Christophe Coupé, Yoon Mi Oh, Dan Dediu, & François Pellegrino, *Different languages, similar encoding efficiency: Comparable information rates across the human communicative niche*, 5 SCIENCE ADVANCES 1, 5 (2019) ("This study provides the most extensive estimation of spoken IR [Information Rate] to date, whether in terms of numbers of speakers, languages, or language families. Such an IR [is] centered on 39 bits/s … . Despite the across-language dispersion observed for ID and SR, their regulatory interaction seems to give rise to a universal attractor.").

47. *See generally* Raúl G. Sanchis, José-Manuel Rey & Francisco Álvarez, *Numerical analysis of a time allocation model accounting for choice overload*, 91(2) INT'L J. OF COMPUTER MATHEMATICS 315 (2014) (explaining a research study finding that people who are adverse to shopping are more prone to fatigue and choice paralysis.)

48. *See* Elaina Zachos, *Technology is changing the Millennial brain*, PUBLICSOURCE, (Nov. 14, 2015), https://www.publicsource.org/technology-is-changing-the-millennial-brain/ ("Too much technology use also shrinks the outermost part of the brain, making it more difficult to process information."); M.R. O'Connor, *Ditch the GPS. It's Ruining your brain*, WASHINGTON POST (June 5, 2019), https://www.washingtonpost.com/opinions/ditch-the-gps-its-ruining-your-brain/2019/06/05/29a3170e-87af-11e9-98c1-e945ae5db8fb_story.html?utm_term=.bf0ca4501c71.

49. *See, e.g.,* Carolyn Crist, *On the Mind: What Science Says about Digital Natives*, UCLA LONGEVITY CTR. (April 10, 2017), https://www.semel.ucla.edu/longevity/news/mind-what-science-says-about-digital-natives.

50. David Robson, *Are there really 50 Eskimo words for snow?*, NEW SCIENTIST (Dec. 18, 2012), https://www.newscientist.com/article/mg21628962-800-are-there-really-50-eskimo-words-for-snow/.

(bad speech), which will prompt a cascade of more speech (making more signal indistinguishable from noise). Adopting the Madisonian approach, on the other hand, would have an opposite, moderating effect on speech that occurs near the limit of individuals' informational capacity.

C. What Problem Information Theory Describes, Information Theory Answers?

Of course, the capacity of communications systems has grown dramatically–literally exponentially over the past century. The lesson Information Theory conveys is not that that there is a maximum amount of information that can be transmitted. Rather, it is that any given communications channel has a finite capacity.

If more capacity is needed in a given communications channel, Information Theory tells us that we have a few options. First, we can improve the signal-to-noise ratio; that is, we can reduce the amount of noise on the channel. Second, because signal becomes noise if when we exceed the capacity of the channel, in cases where the capacity of a communications channel has been exceeded we can increase the effective capacity by reducing the amount of information that we are attempting to communicate.[51] Third, we can increase the amount of bandwidth allocated to a communications channel or, what is largely the same thing, add communications channels.

The concern being explored in this article is that modern media is exceeding the human capacity to process information. This constraint, the amount of information that the human mind can process in a given amount of time, is not one that can be circumvented by adding capacity. Instead, if it is the case that we need to work around this constraint, we need to do better at managing the signal-to-noise ratio.

From an engineering perspective, we generally do this by one of two means: noise filtering or signal splitting (both of which end up, analytically speaking, being the same thing). With noise filtering, we reduce background or other unwanted noise in the communications channel. This is the equivalent of moving to a quiet room to hear a phone call, or even just putting your finger in one ear so that you can hear the voice coming from a phone's speaker more clearly. Signal splitting means moving different parts of a signal to different communications channels. For instance, the cellular telephone network works by dividing each calling area up into lots of smaller areas (called "cells"), each of which is served by a single, dedicated antenna. Because each antenna is serving a smaller area, the signal is shared between fewer telephones than if the entire town were served by a single antenna. This is the rough equivalent of having people placing phone calls each go to a separate room to speak.[52]

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51. That is to say, if a communications channel has a maximum capacity of 100 words per minute (to use that as the relevant measure of capacity) but a speaker is speaking at 120 words per minute, the recipient may only be able to make out half of the words being said (for an effective communications rate of 60 words per minute. If the speaker slows down to 100 words per minute, the effective communications rate will be 100 words per minute.

52. The difference between these two telephone examples is subtle, but important. It also demonstrates why noise reduction and signal splitting end up being the same thing. In the noise reduction example, the person trying to *hear* what is being said on the phone goes to a separate, quiet, room. In the case of signal splitting, a group of people each of whom is trying to speak on a phone call (that is,

D. Information and Intermediation

Applying these ideas to how individuals receive information yields another important insight–and an important limitation. If the concern is that individuals are receiving too much information (not distinguishing between information as signal or noise) to meaningfully process, neither noise filtering nor signal splitting is a viable solution at least not as a solution that can be implemented by the individual. Rather, any solution needs to be implemented before the signal reaches the individual.

This is why the disintermediation effect of modern information production and distribution is so important to the story.[53] In bygone eras we relied on intermediaries—newspapers, book publishers, and broadcasters—to process and distribute information; there were relatively few of those entities because their operations were relatively expensive. Today, social media allows for direct peer-to-peer production and distribution, at a negligible cost and with a greater potential reach. Individuals today have immediate access to nearly every newspaper, blog, and other website on the planet. Thirty years ago, most people had access to perhaps a few newspapers, television networks, and radio stations–and other sources of information, such as books, magazines, or even their peers, could only be consulted at relatively significant cost (whether in terms of time, infrequency of communication, or communications medium). Today, however, the Internet makes it possible for anyone to receive a seamless stream of information from potentially millions of independent, unfiltered, voices. In other words, thirty years ago the challenge was to acquire enough information to make informed decisions; today, the challenge sort the useful information from the rest, so that it can be put to productive use.

In a one-to-one, peer-to-peer, communications network like the Internet, every communications pathway is maximally split, which maximizes the amount of information that sources from across the Internet can send to any given individual; the concept of "splitting" the signal at the point of the recipient is incoherent. This is tantamount to saying that, to double an individual's ability to process information, we should double the amount of brain that they have to process that information.

Rather, the solution to increasing the capacity of individuals to receive information is to filter out the noise. This needs to be done before the information reaches the individual already saturated by an overwhelming amount of information. We need to re-invent the intermediated media marketplace.

V. FILTERING IDEAS

Parts III and IV of this article have endeavored to explain why traditional marketplace of ideas understandings of the First Amendment may not be viable

to transmit information via a signal), go into separate rooms. If they don't go into the separate rooms, the listeners on the other end of the line may be able to intelligibly make out what is being said by all of the speakers – that is, they are receiving signal, not noise. But if collectively the speakers are transmitting too much signal, then the listeners may not be able to make out what any one speaker is saying – that is, the signal becomes noise when the information capacity of the communications channel is exceeded.

53. *See generally supra* Part I B.

approaches to moderating speech in an era of information superabundance. The purpose of this article is primarily to make that case, or at least to stake out its contours about Information Theory. But announcing a problem such as this begs for thoughts on potential solutions.

A. Government Regulation is Not a Solution

As an initial matter, direct government regulation of online speech is not a viable solution – from any tenable American perspective. Prohibiting entire categories of speech is abhorrent to the Constitution and only occurs in the starkest of cases, only targeting very specific categories of speech where there is broad consensus that the category of speech has no redeeming value. The typical example is child pornography, typical both because it is a strong example of such indefensible speech and because it is one of so few categories of speech.

More doctrinally, "social media," "online speech," and other examples of the sort of speech that has driven exponential growth in American's access to information refer generally to general-purpose communications platforms that are capable of transmitting any type of information. Any prohibition or regulation of those platforms necessarily encroaches upon very broad categories of speech – some bad, much good. Such broad regulation would be untenable under First Amendment doctrine.[54] As a matter of First Amendment principle, such an approach runs headlong into the concerns that the First Amendment was meant to protect against, and against which the marketplace of ideas concept was intended as a bulwark.[55]

B. May the Marketplace of Ideas (Redux) Save Us?

Parts III and IV together argue that the marketplace of ideas fails as we reach the limits of individuals' information capacity. Even before we reach that point, we are likely to see a race to the bottom as the costs of producing and distributing information decrease, creating opportunities for false speech to monetize their market shares at the expense of good speech. As we approach the limits of individuals' informational capacities, the "answer bad speech with more speech" theory exacerbates the informational deficit in which consumers of ideas operate under the marketplace of ideas model.

Perhaps this story is too cynical. Perhaps new forms of intermediaries will enter the market, demonstrating their value to consumers in a way that allows them to successfully compete with low-quality disintermediated speech. Perhaps the advertising-based model that directs the regressive, race-to-the-bottom dynamic of our current marketplace of ideas will collapse–or will merely be displaced by alternative approaches to speech intermediation. Perhaps new social norms will develop, leading to widespread skepticism of questionable online content and an

54. *See, e.g.*, Reno v. ACLU, 521 U.S. 844, 875 (1997) (holding a statutory requirement that ISPs filter pornographic material to keep it from children to violate the First Amendment, explaining, "It is true that we have repeatedly recognized the governmental interest in protecting children from harmful materials. But that interest does not justify an unnecessarily broad suppression of speech addressed to adults. As we have explained, the Government may not reduce the adult population to only what is fit for children." (quotation and citations omitted)).

55. *See supra*, notes 26–28.

embrace of higher-quality, more reliable, speech. Perhaps our current generation of Americans are simply lost, condemned to drift about as uninformed informational consumers; but on their (our) heels will come a new generation, raised in the information economy and more savvy about information hygiene. Perhaps, in other words, our current failing marketplace is the fault of the consumers of information, but in the long run, it will yield higher-quality consumers of information for whom the marketplace will function effectively. Or perhaps today's more savvy consumers of information will succeed in our current marketplace–at the expense of less savvy consumers–and usher in a new era of the marketplace based on their successes.

There is reason to be skeptical of each of these possibilities, but also reason to believe that any of them could come to pass and usher in an era of informationally adept individuals. In effect, each is premised on the idea that individuals, as information consumers, will develop better noise filters–and that these filters will operate by treating all online information as noise by default. In each case, to the extent that consumers view online-sourced information as meaningful signal, it will be because that information bears some external hallmark of quality. In effect, this is the recreation of an intermediated information marketplace, just one in which the intermediaries may look different from those in past marketplaces of ideas.

C. Can We Sue Our Way Into Better Speech?

The First Amendment is primarily concerned with government regulation of speech, but it also informs the use of law to regulate speech between private parties. This is best seen in defamation law. As in other areas of law, the United States is generally more protective of speech rights than most other countries around the world.[56] In the context of defamation law, this strong level of protection is demonstrated by the general principles that truth is a defense to claims of defamation and that the institutional press must demonstrate actual malice to be deemed liable for defamation against a public figure.[57] In general, and under First Amendment principles, we prefer that the law not be used as a sword in speech debates. As is so often the case with the First Amendment, the response to true speech, even if truly harmful, is more speech; the response to false speech, if not harmful to an individual, is more speech. There is a strong presumption in favor of institutional platforms of speech (the institutional press) to facilitate and encourage the production of more speech even in the face of harmfully erroneous speech.

As with the First Amendment generally, this article is not intended to delve deeply into defamation doctrine. Rather, it makes a single observation and a single suggestion. The observation is that American law has traditionally placed the burden for acting against harmful speech on the listener or subject of that speech, not on the speaker. The suggestion is that, in light of the changing costs of producing and distributing speech, the balance of this burden may need to change. The traditional burden has served as an inducement to speech: given the historically high

56. Allison G. Belnap, *Defamation of Religions: A Vague and Overbroad Theory That Threatens Basic Human Rights*, 2010 B.Y.U. L. REV. 635, 651 (2010) (discussing how definitions of "incitement" in non-U.S. countries allow for broader regulations than in the United States).

57. *Id.* at 645.

cost of engaging in speech, and the view that public discourse is important to the functioning of our democracy, we have wanted to avoid placing undue burdens on those who engage in speech. Instead, we have channeled those disagreeing with such speech to avail themselves of speech, not speech-silencing litigation, as the preferred form of response.

The (deliberate) effect of this approach has been to prompt a signification amount of speech in this country. This effect is generally understood as a good thing. But if the Information Theory account of speech offered above is correct, then too much speech–even if it is "good" speech–can in fact be harmful. This is a puzzle for First Amendment doctrine to struggle with. But it is not a novel or even particularly difficult puzzle for the law to address: the law generally allocates burdens to minimize social costs.[58]

VI. CONCLUSION

The first line of this article stated that "[t]he Internet has changed speech and our traditional understandings of speech regulation are struggling to adapt." This observation, on its own, is both obvious and uninteresting, even if it captures the essence of one of the most important challenges our country faces today.

This article has added a perspective from Information Theory to how we discuss the First Amendment. Information Theory suggests that there is a hard limit to how much information any given individual can process. Perhaps more important, from the perspective of a nation predicated on the deliberative engagement of the people in the formation and operation of its democratic government, it suggests that once this threshold of informational capacity is surpassed, it becomes increasingly difficult for the listener to differentiate meaningful information from noise. Saturating ourselves with information does not just mean reaching a plateau–it actually reduces our ability to use information.

To the extent that this understanding is true, this poses a direct challenge to the marketplace of ideas understanding of the First Amendment and the idea that "the response to bad speech is more speech" is a viable basis for a deliberative democracy in the age of information technology. To be clear, this article does not assert that we have definitely reached this point of informational saturation; it does, however, argue that we *may* have, because such a limit absolutely does exist. Perhaps the marketplace of ideas will adapt, finding ways to reward slower, more deliberative speech, or rejecting informationally saturated (or saturating) platforms such as social media. If this does not happen, the law, including the First Amendment, may be the only bulwark against information saturation and the dangers that it bears for democratic institutions.

58. *See generally* Ronald H. Coase, *"The Problem of Social Cost,"* 3 J. OF L. & ECON. 1 (1960); *see generally* Guiudo Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules and Inalienability: One View of the Cathedral*, 85(6) YALE L.J. 1089 (1972).