Scientific communication in a post-truth society

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Within the scientific community, much attention has focused on improving communications between scientists, policy makers, and the public. To date, efforts have centered on improving the content, accessibility, and delivery of scientific communications. Here we argue that in the current political and media environment faulty communication is no longer the core of the problem. Distrust in the scientific enterprise and misperceptions of scientific knowledge increasingly stem less from problems of communication and more from the widespread dissemination of misleading and biased information. We describe the profound structural shifts in the media environment that have occurred in recent decades and their connection to public policy decisions and technological changes. We explain how these shifts have enabled unscrupulous actors with ulterior motives increasingly to circulate fake news, misinformation, and disinformation with the help of trolls, bots, and respondent-driven algorithms. We document the high degree of partisan animosity, implicit ideological bias, political polarization, and politically motivated reasoning that now prevail in the public sphere and offer an actual example of how clearly stated scientific conclusions can be systematically perverted in the media through an internet-based campaign of disinformation and misinformation. We suggest that, in addition to attending to the clarity of their communications, scientists must also develop online strategies to counteract campaigns of misinformation and disinformation that will inevitably follow the release of findings threatening to partisans on either end of the political spectrum.

communication | media | politics | science | bias

In today's fragmented and polarized media environment, trust in America's basic institutions has waned. Of 13 institutions examined in one study, public confidence had declined for 11, rising only in the case of the military (1). Although trust in science has remained fairly steady over time, as of 2016 only 21% of US adults had "a great deal of confidence" that scientists would act in the best interests of the public (2) On many issues—climate change, genetically modified foods, vaccines—the views of scientists and the public are now very far apart (3). Since 2012, the National Academy of Sciences (NAS) has held a series of colloquia on the Science of Science Communication in an effort to identify strategies and practices that might enable scientists to communicate more effectively with the public. We jointly participated in a session of the third of these colloquia, held in Washington, DC on November 16–17, 2017.

Although the stated purpose of the colloquium series was to improve the ability of scientists to communicate with the public, we have come to believe that in today's political and media environment faulty communication skills are no longer the core of the problem. Although scientists can always do a better job communicating, we suspect that distrust in the scientific enterprise and misperceptions about the knowledge it produces increasingly have less to do with problems of communication and more to do with the ready availability of misleading and biased information in the media, often inserted deliberately by unscrupulous actors with ulterior motives. The crux of the matter is that the media and political environments of the United States have changed very dramatically over the past three decades in ways that impede effective communication.

The Road to Infowars

Through the 1970s, Americans got their information from a rather small number of sources, really only a handful of newspapers, magazines, and television broadcasts. Although some 1,745 daily newspapers boasted a cumulative circulation of around 62 million readers in that year (4), actual coverage was dominated by two wire services (the Associated Press and United Press International) along with a few prominent newspapers that were nationally syndicated (the *New York Times*, the *Washington Post*, the *Wall Street Journal*, and the *Los Angeles Times*). At the same time, weekly digests of national and international news were published by only three magazines: *Time*, *Newsweek*, and *US News and World Report*.

Broadcast news at the time was dominated by three corporate television networks (ABC, CBS, and NBC), a dominance that was only beginning to be challenged by public networks. NPR began transmitting in 1971, and PBS went on the air in 1975. In addition to the small number of sources, broadcast news was regulated by the Federal Communications Commission (FCC), which required broadcasters to reserve a small share of airtime to cover matters of public interest; under the FCC's "fairness doctrine" they had to do so in a manner that was honest, equitable, and balanced. Consequently, the major broadcasters all presented much the same information to the public.

The situation began to change in the 1980s with the rise of cable television and talk radio. The first 24-hour news channel, CNN, debuted in 1980; Rush Limbaugh introduced his talk radio program in 1984; and Fox News began broadcasting in 1986. The big change came in 1987, when the FCC eliminated the fairness doctrine, which had never been applied to cable channels, and thereby freed radio and television broadcasters from the need to present news in ways that were factual and honest. This policy change opened the door to the dissemination of ideologically biased content, and the number of broadcast news outlets quickly expanded. CNBC went on the air in 1989, followed by Bloomberg in 1990, FSTV in 1995, and MSNBC in 1996.

With the passage of the 1996 Telecommunications Act, private companies were permitted to own multiple television and radio stations throughout the nation. As chains such as Clear Channel Communications, iHeart Media, and the Sinclair Broadcast group bought up formerly independent stations across the land, ideologically inspired talk radio hosts proliferated, with Sean Hannity going live in 1990, Michael Savage in 1999, Glenn Beck in 2000, and Laura Ingraham in 2001. Many of these radio hosts offered parallel programs on conservative television networks,

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not only on Fox but also on newer entries such as One America News, which began broadcasting in 2013, and Newsmax TV, which went on the air in 2014.

Truth, Lies, and the Internet

Beginning in the 1990s the internet also became a major purveyor of news and information. Netscape introduced the first web browser in 1994, and Microsoft followed suit in 1995 with Explorer. Google introduced its search engine in 1998 and quickly rose to dominate internet searches. The influence of the internet then multiplied with the rise of social media. LinkedIn was introduced in 2002 followed by Myspace in 2003. These platforms were soon eclipsed by Facebook, which launched in 2004 and quickly rose to enroll some 2.2 billion users. YouTube debuted in 2005 and was acquired by Google in 2006, the same year that Twitter made its debut. Instagram came into the world in 2010, and Snapchat came on line in 2011.

Into this expanding virtual universe came a host of news and opinion websites with varying degrees of allegiance to facts and logic. According to Aelieve Digital Marketing, the most popular liberal website today belongs to CNN, and the top conservative website is that of Fox News (https://insights.aelieve.com/website_rankings/news-media/). PolitiFact rates 59% of Fox's assertions as mostly or all false; the figure for CNN is 27% (https://www.politifact.com/punditfact/), still rather high for a national news organization.

Among Aelieve's top 10 liberal websites, most belong to mainstream outlets that predate the internet era such as the *New York Times*, *ABC*, the *Washington Post*, *Time*, and *Rolling Stone*. Among liberal websites, the oldest is *Slate* (1996), followed by the *Daily Kos* (2002), the *Huffington Post* (2005), and *Politco* (2007). Among the top 10 conservative websites, in contrast, only two are mainstream outlets that predate the internet (the *Telegraph* and the *Wall Street Journal*). The oldest conservative websites belong to *The Hill* (1994) and the *Drudge Report* (1995), followed by the *American Conservative* (2002), *Breitbart* (2007), the *Conservative Tribune* (2009), the *Daily Caller* (2010), and the *Daily Wire* (2015).

The power of these alternative internet news platforms is amplified by internet trolls and bots. A troll is an actor who uses social media to start arguments, upset people, and sow confusion among users by circulating inflammatory and often false information online. Many trolls are actually bots—automated accounts pretending to be humans—which can be programmed to spread false and misleading stories rapidly through online social networks. Between 9% and 15% of Twitter accounts are estimated to be bots, and Facebook estimates that as many as 60 million bots are currently trolling its platform; in 2016, ∼20% of all tweets concerning the presidential election came from bots (5–7). In response, both Twitter and Facebook recently have attempted to cull bots and fake accounts from their platforms (8, 9).

The miasma of online confusion has been further heightened by algorithms written to select and recommend additional content for users based on past choices (10). Social media firms make money by presenting targeted advertising to users, and the job of these algorithms is to generate attractive "clickbait," so that users succumb to clicking through to additional content. The more clicks the algorithm generates, the more time users spend online, and the greater are the opportunities for advertising, thus maximizing profits (11).

To entice users to keep on clicking, algorithms identify content that is similar to content consumed in the past, only more narrowly tailored and more outlandish, progressively narrowing the range of information and topics the user sees. Increasingly these routines rely on machine learning to automate the process and push users into a vortex of ever more extreme views. In this way, "given its billion or so users, YouTube may be one of the most powerful radicalizing instruments of the 21st century" (12, 13).

Misleading information put into the internet comes in three overlapping forms: fake news, which is fabricated information designed to mimic mainstream media content but which in reality is designed to spread lies rather than truth; misinformation—false or misleading information put into circulation to cause alarm and confusion; and disinformation—false information that is circulated with the intention to deceive (11).

The amount of fake news, misinformation, and disinformation circulating in cyberspace also has multiplied rapidly through the rising influence of dark money, funds of unknown provenance that sponsor trolls and bots to sow confusion and create distrust. In 2016, election spending by undisclosed donors totaled $27 million (https://www.opensecrets.org/dark-money/basics/). From 2009 to 2013, political and issue spending (through 501c4 and 501c6 entities) totaled $1.1 billion, while spending by nonprofit and technically nonpolitical organizations (501c3 entities) totaled $87.9 million (14).

While scientists prefer to remain above partisan politics, deliberate efforts to undermine trust in science unfortunately come predominantly from the right of the political spectrum. One of the most influential and effective organizations is Americans for Prosperity, a conservative advocacy group funded by David and Charles Koch to promote lower taxes and less government regulation. According to Tim Phillips, president of the organization, "most of these candidates have figured out that the science has become political . . . . What it means for candidates on the Republican side is if you . . . buy into green energy . . . you do so at your political peril. The vast majority of people who are involved in the [Republican] nominating process—the conventions and the primaries—are suspect of the science. And that's our influence. Groups like Americans for Prosperity have done it" (15).

Although public confidence in science remains relatively high in general, it is not trusted equally by all citizens. Whereas 72% of US adults in 2016 agreed that the benefits of scientific research outweighed the harms, the share expressing "a great deal of confidence in the scientific community" was only 40%, ranging from 28% of those without a high school degree to 61% among those with an advanced degree (16). The degree of trust in science also varies depending on the issue, with 55% of US adults in 2016 trusting scientists "a lot" about the risks of vaccines but only 39% trusting them "a lot" on climate change (17).

In today's political climate, it is unsurprising that confidence in science has come to vary by ideology. Whereas in 1974 56% of conservatives expressed a great deal of confidence in the scientific community, by 2016 the figure had dropped to 36%. In contrast, confidence in the scientific community among liberals hardly changed, with half expressing great confidence at both dates. Likewise, among Republicans the share expressing great confidence was 53% in 1974 but only 37% in 2016; the corresponding share for Democrats was 45% in 1974 and 44% in 2016 (18).

Party Polarization; An Impediment to Science Communication

In the classic social psychological paradigm, effective communication occurs when credible sources deliver strong arguments to a target audience receptive to information and evidence (19). In the current polarized environment, however, strong political identities make partisans see political opponents and their ideologies as existential threats. We describe the various symptoms of this form of party polarization below.

Increased Partisan Animosity. Beginning in the mid-1980s, data from the American National Election Surveys (ANES) show that Democrats and Republicans not only increasingly disliked the opposing party but also imputed negative qualities to supporters of the other party (20). Survey indicators of out-group prejudice based on party identity exceed comparable indicators based on

race, religion, gender, and other significant social cleavages (21). While the percentage of partisans who evaluate the other party negatively has increased steadily since the 1980s, the share of partisans expressing intense negativity (rated on a 0–100 scale) for their other-party opponents remained quite small until 2000. Post-2000, the size of this group has increased dramatically, from 8% in the ANES 2000 study to 21% in 2016. Thus, the first two decades of the 21st century represent an acute era of polarization in which partisans' mild dislike for their opponents has been transformed into a deeper form of animus.

In the United States, partisanship is a particularly salient aspect of people's sense of personal identify for several reasons. First, it is acquired at a young age and rarely changes over the life cycle, notwithstanding significant shifts in personal circumstances (22). Second, political campaigns—the formal occasions for expressing one's partisan identity—recur frequently and last for many months (or even years) in the contemporary United States, meaning that individuals constantly receive partisan messages and cues. It is no surprise, therefore, that ordinary Americans see the world through a partisan prism.

Polarization has strengthened to the point that party identity is now a litmus test for personal character. People prefer to associate with fellow partisans and are less trusting of partisan opponents (21). The most vivid evidence of increased social distance across the party divide concerns attitudes toward interparty marriage. In the early 1960s, the percentage of partisans concerned over the prospect of their son or daughter marrying someone from the opposition party was in the single digits, but 45 y later it had risen to more than a third of all partisans (20). Data from online dating sites and national voter files confirm that partisanship is a key trait underlying the selection of long-term partners (23). At the same time, residential segregation on the basis of social class, political preference, and partisan ideology have increased even as racial segregation has declined (24).

Implicit Partisan Bias. A major limitation of survey-based indicators of partisan affect is that they are reactive and susceptible to intentional exaggeration or suppression based on normative pressures. Unlike race, gender, and other social divides in which group-related attitudes and behaviors are subject to strong social norms (25), there are no corresponding pressures to temper disapproval of political opponents. If anything, the rhetoric and actions of political leaders demonstrate that hostility directed at the opposition is not only tolerated but appropriate. Implicit measures yield more accurate markers of intergroup prejudice because they are much harder to manipulate than responses to survey questions.

Political scientists have developed several measures of implicit or subconscious partisan prejudice. One indicator, based on the Implicit Association Test (26), compares the speed with which partisans associate the symbols of the two parties with positively valenced terms (e.g., pairings of the Republican elephant or Democratic donkey with "wonderful"). The results show that implicit partisan bias is widespread, with ∼70% of Democrats and Republicans showing a bias in favor of their own party (21). (Based on the idea that ingrained prejudice allows people to make associations between either positively or negatively valenced terms and the in and out group more rapidly and with fewer errors, these measures focus on the error rates and time taken to respond to pairings of, for example, Democrat+good and Republican+good.) Strikingly, implicit partisan bias is considerably more widespread than implicit racial bias, long considered the major form of group prejudice in the United States, and its validity as a measure is confirmed by a strong and significant correlation with explicit partisan bias assessed via a survey-based feeling thermometer.

Potential Explanations for Increased Polarization. The phenomenon of affective party polarization has intensified over the past three decades (27) for a number of reasons. First, the correspondence between party divisions and major socioeconomic divides has sharpened. Democrats are the party of the poor, city dwellers, women, nonwhites, and secularists. Republicans, in contrast, represent white males, rural areas, evangelicals, and the well off. The confluence of party affiliation and other group attachments has, of course, strengthened the sense of "us versus them." (The intensification of partisan affect, of course, does not apply to the segment of the electorate that does not identify with a party. However, these "pure" independents who lack any attachment to either of the two major parties made up only 13% of the electorate in the 2016 ANES.)

Second, the digital revolution has brought about profound changes in the media market. Today, partisans have ample opportunity to seek out information from providers whose perspective on events aligns with their own. As already noted, the US media market today includes dozens of news sources that provide explicitly partisan coverage of issues and events and whose content is not subject to conventional journalistic or editorial gatekeeping. Although the most inflammatory partisan sites attract only a miniscule share of the market (limited to strong partisans), the emergence of massive online social networks through Facebook and Twitter make it possible for reports from these sites to recirculate through a much larger secondary audience. In this way, they reach relatively "unmotivated" individuals with weak partisan motives. Millions of Americans encountered false reports about the 2016 election on Facebook and Twitter, and, given the political naiveté of the electorate, many likely believed in their accuracy [although the available evidence indicates that the level of exposure was insufficient to have had an impact on the election (28)].

Another plausible explanation for increased partisan polarization is social homophily. Today, most Americans are embedded in social networks that are politically homogeneous, meaning that we infrequently encounter political disagreement. At the level of the nuclear family, both spousal and parent–offspring agreement on party affiliation exceed 75% (29). The composition of online social networks is only marginally less monolithic (30). Many occupations show a similar trend toward reduced partisan diversity (31), so that the workplace no longer provides an opportunity to encounter different political outlooks.

The reinforcement of partisan identity with other salient identities, the opportunity to exercise selective exposure to news providers, and the prevalence of "echo chambers" in Americans' social networks have all contributed to the intensification of polarization. As we describe below, a major consequence of polarization is that partisans have become more motivated to reject information and arguments that clash with their worldview. Rather than process information dispassionately, they resort to motivated reasoning with the goal of protecting their beliefs and values from external threat. The upshot is that when evidence clashes with individuals' partisan loyalties, it is either dismissed or distorted, thereby impeding the diffusion of scientific findings.

Evidence of Partisan Motivated Reasoning. The intensified party divide has created stronger pressures toward consistency in beliefs and attitudes implicating partisan loyalties. To take the most obvious case, elected officials are viewed unfavorably by opposing partisans, no matter the course of events. President Trump frequently laments Democrats' continued hostility toward his presidency despite evidence of significant growth in employment and wages, to say nothing of the booming stock market. Conversely, the steady drip of scandal-related news concerning ongoing criminal investigations has done little to erode President Trump's standing among Republicans. The party cue has become so powerful that

only a handful of partisans defect during campaigns, even when their party nominates candidates with obvious flaws.

Pressures for partisan consistency extend to beliefs and opinions not clearly related to the individual's party preference. For instance, partisans offer more upbeat and optimistic assessments of economic conditions when their party is in power (32–34). They also distort the ideological positions of party leaders by perceiving copartisans as being closer to their own position while viewing officials of the other party as being closer to the ideological extreme (35). In keeping with this pattern, individuals' own preferences on questions of policy often follow the position taken by their party (36). In all these cases partisans follow a simple rule: Maximize in-group favoritism and out-group animus. The predictability of partisan beliefs and attitudes represents a classic case of motivated reasoning in which affirmation of one's partisan identity takes precedence over dispassionate consideration of the evidence (37, 38).

An especially insidious form of motivated reasoning takes the form of partisans' willingness to believe in "alternative facts." While small numbers of Americans have always expressed a willingness to believe in conspiracy theories of politics and implausible rumors (39), the first instance of large-scale partisan bias in factual beliefs occurred in the aftermath of the 2003 invasion of Iraq. The Bush Administration had justified the invasion on the grounds that the regime of Saddam Hussein possessed weapons of mass destruction. Once the Hussein regime fell, it became clear—and was widely reported in the media—that the invading forces had failed to find any trace of chemical or biological weapons. Nonetheless, large numbers of Republicans continued to believe that the United States had, in fact, found the weapons in question (40).

Misinformation about Iraq stemmed not only from motivated reasoning (the unwillingness to accept that the Bush Administration had waged a war based on faulty intelligence) but also from the availability of news and commentary that propagated news coverage with a partisan slant. Viewers of Fox News, for instance, were especially likely to express false beliefs about the war in Iraq (40).

Partisans' commitment to misleading or false claims from their side is illustrated starkly by the case of President Trump. Before he ran for president, he organized the movement questioning former President Obama's citizenship and religion. As president he has made a number of misleading or false statements. He incorrectly claimed that the crowds at his inauguration were larger than those at the Obama inaugurations. He further claimed, without providing evidence, that millions of illegal immigrants had voted in the 2016 election and that the Obama Administration had ordered a wiretap of Trump Tower. Survey data indicate that Republicans believe these claims.

In a 2015 CNN poll, in response to the question "Do you happen to know what religion Barack Obama is?" 43% of Republicans answered "Muslim" compared with only 15% of Democrats (41). This partisan divide in misinformation is magnified when we consider Trump's claims concerning his inauguration. In a 2017 survey, respondents were shown aerial photographs of the crowds at the Trump and 2008 Obama inaugurations and were asked to match each image with the corresponding inauguration. More than 40% of Trump supporters matched the image showing the larger 2008 crowd with the Trump inauguration, while less than 10% of Clinton supporters made this error (42). The substantial partisan gap in erroneous beliefs suggests that partisans are willing to accept dubious claims made by their leaders. Even more ominously, in experimental settings misperceptions are found to persist despite exposure to credible information rebutting the claims in question (43).

Science vs. Motivated Reasoning: The Case of Immigration

In recent years, immigration has become a very divisive, polarizing, and increasingly partisan issue, the subject of a bitter public debate that is long on emotion and hyperbole but short on reason and facts. In announcing his candidacy, Trump set the tone by claiming that "the US has become a dumping ground for everybody else's problems . . . . When Mexico sends its people, they're not sending their best . . . . They're bringing drugs. They're bringing crime. They're rapists . . . . A lot of people . . . can't get jobs. They can't get jobs because there are no jobs, because China has our jobs and Mexico has our jobs." His well-known solution is to "build a massive wall to secure our southern border—and nobody can build a bigger and better wall than Donald Trump" (44).

According to a 2017 poll by the Pew Research Center, 84% of Democrats agreed that "immigrants strengthen America because of their hard work and talents," but 42% of Republicans did so (45). A 2018 Pew Survey likewise found that 90% of liberal Democrats and 75% of moderate Democrats believed that immigrants were no more likely than US citizens to commit serious crimes, whereas the respective figures were 57% and 40% for moderate and conservative Republicans (46). The partisan association of immigrants with crime persists despite the widespread dissemination of data indicating that, in fact, immigrants commit many fewer crimes than natives (47, 48).

The partisan split on immigration also extends to the economic effects of immigration. Whereas 88% of liberal Democrats and 79% of moderate Democrats agree that immigrants mostly take jobs that US citizens do not want, the share was only 62% for moderate Republicans and 55% for conservative Republicans (46). In an effort to bring the results of social scientific research to bear on this issue, the National Academy of Sciences (NAS) published a report commissioned by its Committee on National Statistics entitled *The Economic and Fiscal Consequences of Immigration* (49). Its reception in the public sphere provides a vivid illustration of the difficulty of communicating science in today's polarized media environment.

Like many NAS reports on topics of public interest, its publication was inaugurated with a press release with a reporting embargo of September 22 at 1 PM (50). The release summarized the report's findings, accurately stating that "the impact of immigration on the wages of native-born workers overall is very small;" that "there is little evidence that immigration significantly affects the overall employment levels of native-born workers;" that "immigration has an overall positive impact on long-run economic growth in the US;" and that although "first-generation immigrants are more costly to governments" as adults, the children of immigrants . . . are among the strongest economic and fiscal contributors in the US population."

These conclusions were duly reflected in the mainstream press, with headlines in the *New York Times* such as "Immigrants Aren't Taking Americans' Jobs, New Study Finds" (51) and "Immigration Does More Good than Harm to Economy, Study Finds" in the *Wall Street Journal* (52). However, unbeknownst to the report's authors, it had already been surreptitiously leaked to Breitbart News, and this accurate and balanced reportage was quickly buried in an avalanche of fake news, misinformation, and disinformation emanating from the right-wing media networks. Breitbart News led the way, with an online headline stating that "National Academies' Study Shows $500 Billion Immigration Tax on Working Americans" (53).

The Center for Immigration Studies (which despite its anodyne name advocates restrictive immigration policies) went forward with the headline "National Academy of Sciences Study of Immigration: Workers and Taxpayers Lose, Businesses Benefit" (54). The conservative Heritage Foundation proclaimed "National Academy of Sciences Report Indicates Amnesty for Unlawful Immigrants Would Cost Trillions of Dollars" (55), and the same headline appeared in the *Daily Signal* (56). Infowars, for its part, proclaimed that the "Report Explains Financial Cost of Illegal Immigrants for American Taxpayers" (57).

Eventually Donald Trump entered the fray, claiming in his 2017 State of the Union Message that "according to the National Academy of Sciences our current immigration system costs America's taxpayers many billions of dollars a year," for which the *Washington Post* awarded him three Pinocchios, noting that "it's easy to cherry pick numbers to make a particular point. But, alas, Trump took one line out of a 500-page report, and totally skewed the intricate findings" (58). Given research showing how erroneous beliefs stubbornly persist despite exposure to credible rebuttals, it is unlikely that many people in the president's base absorbed the report's actual findings; instead, most probably retained the misinformation spread through the conservative blogosphere (59).

Communicating Science Today

In the decades since 1970, the nation has witnessed profound structural changes in the media environment resulting from broadcast deregulation, the repeal of the Fairness Doctrine, the rise of cable television, the advent of the internet, and the expansion of social media. These changes have, in turn, contributed to greater political polarization, partisan homophily, ideological homogamy, class segmentation, and political segregation within the social sphere and to ever-increasing partisan animosity and motivated partisan reasoning in the psychological realm.

As a result, whenever scientific findings clash with a person or group's political agenda, be it conservative (as with climate science and immigration) or liberal (as with genetically modified foods and vaccination risks), scientists can expect to encounter a targeted campaign of fake news, misinformation, and disinformation in response, no matter how clearly the information is presented or how carefully and convincingly it is framed. Under these circumstances, the information is unlikely to penetrate the cognitive structures of those it threatens and therefore is likely to be either rejected or ignored by otherwise open-minded people who have absorbed the campaign of false and misleading information.

Although the public is beginning to awaken to the dangers of today's frenzied media landscape and the scions of Silicone Valley have offered some mea culpas, the way forward remains unclear. Nebulous proposals for government regulation are being bandied about, and the purveyors of social media are talking about how better to police themselves and their platforms. Reforms will be difficult to implement, however, given the size, diversity, and pace of change in the media environment. As long as serial click-throughs and high audience ratings continue to generate bountiful profits from microprofiling and advertising, and as long as billionaires are willing and able to spend large sums of money to protect their political and economic interests online, media owners and managers have little incentive to change their algorithms or programming content.

At this point, probably the best that can be done is for scientists and their scientific associations to anticipate campaigns of misinformation and disinformation and to proactively develop online strategies and internet platforms to counteract them when they occur. For example, the National Academies of Science, Engineering, and Medicine could form a consortium of professional scientific organizations to fund the creation of a media and internet operation that monitors networks, channels, and web platforms known to spread false and misleading scientific information so as to be able to respond quickly with a countervailing campaign of rebuttal based on accurate information through Facebook, Twitter, and other forms of social media. Of course, this is much easier said than done, and—given what research tells us about how the tribalization of US society has closed American minds—it might not be very effective.

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