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Editorial: Addressing Public Mistrust of Science and Mathematics

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We have a growing problem with public mistrust of science and mathematics. On Saturday, December 12, 2020, U.S. Congressman-elect Bob Good addressed a crowd of people, mostly not wearing face masks, with these words:

> I can't tell you how great it is to look out there and see your *faces*. This looks like a group of people that get that this is a phony pandemic .... It's a serious virus, but it's a virus, it's not a pandemic. It's great to see your faces, you get it. You stand up against tyranny. Thank you for being here today, thank you for saying 'no' to the insanity. (Dorman, 2020, para. 3)

Considering that, at the time of writing this editorial, COVID-19 had already taken over 1.6 million lives (with over 300,000 from the U.S. where this elected official was speaking), how could such words result in applause? How can the public so willingly agree that the knowledge and recommendations shared by experts in the fields of medicine, epidemiology, and infectious disease represent 'tyranny' and 'insanity'? Tom Nichols, author of *The Death of Expertise*, describes the expansion of a dangerous political movement, especially evident during the COVID-19 pandemic, centered on the rejection of science and expertise (Pazzanese, 2020). This lack of respect for science and mathematics extends beyond the current coronavirus threat - for decades, subsets of the American population have doubted the safety of routine vaccines (see LaCour & Davis, 2020), climate change (see Spencer, 2010), and even the age of our planet (Morris, 2007), among other accepted scientific claims.

The upcoming change in administration, about to take place in the U.S. government, could provide an opportunity for science and mathematics educators to contribute to the work of reversing this trend. In their acceptance speeches, after the November elections, both Vice President-elect Kamala Harris and President-elect Joe Biden, alluded to the importance of scientific expertise in guiding policy decisions.

> I [Vice President-elect Kamala Harris] know times have been challenging, especially the last several months. The grief, sorrow, and pain. The worries and the struggles. But we've also witnessed your courage, your resilience, and the generosity of your spirit. For four years, you marched and organized for equality and justice, for our lives, and for our planet. And then, you voted. You delivered a clear message. You chose hope, unity, decency, science, and, yes, truth. (Stevens, 2020a, paras. 17-22)

> Now, that the campaign is over - what is the people's will? What is our mandate? I [President-elect Joe Biden] believe it is this: Americans have called on us to marshal the forces of decency and the forces of fairness. To marshal the forces of science and the forces of hope in the great battles of our time. The battle to control the virus. The battle to build prosperity. The battle to secure your family's health care. The battle to achieve racial justice and root out systemic racism in this country. The battle to save the climate. … I will name a group of leading

> scientists and experts as transition advisers to help take the Biden-Harris COVID plan and convert it into an action blueprint that starts on January 20, 2021. That plan will be built on a bedrock of science. It will be constructed out of compassion, empathy, and concern. I will spare no effort - or commitment to turn this pandemic around. (Stevens, 2020b, paras. 50-56, 60-62)

These comments, which outline the "mandate" for the incoming administration, also present a mandate for science and mathematics educators. We can contribute to the reestablishment of trust in science and mathematics through focused instruction on the natures of science and mathematics (Bloom & Quebec Fuentes, 2020). However, we also need to understand the source of this mistrust as well as how to establish trust in science and mathematics for people with varying perspectives and lived experiences.

While the quotes presented show how politics can foster or erode trust in science and mathematics, distrust can come from other sources such as religious conflicts (Bloom, 2021) and historical mistreatment and marginalization of communities. An example of religiously-induced mistrust is the Cornwall Declaration on Environmental Stewardship, drafted in 2000 and signed by more than 1,500 clergy, which describes "destructive manmade global warming, overpopulation, and rampant species loss" as "unfounded" or as "undo concerns" (Cornwall Alliance, 2000, para. 7). Religious beliefs can also lead to discomfort in learning about biological evolution (see Miller, 2008), foster apprehension regarding novel genetic medicine (see Fanning & Clayton, 2010), or even present ethical dilemmas surrounding preventative medicine such as the HPV vaccine (see Intlekofer et al., 2012).

While the aforementioned perceived contradictions between religious beliefs and scientific claims are arguably unfounded, historical marginalization and mistreatment of particular groups of people, including BIPOC and LGBTQ, can legitimately give rise to unhealthy skepticism. In a recent PEW research poll (PEW, 2020), only 42% of black Americans indicated that they would be comfortable taking the new COVID-19 vaccine (although this number seems to be increasing). A brief study of the Tuskegee airmen or systemic racism in America (see Alsan & Wanamaker, 2016) or of the use of Henrietta Lacks's cells for vaccine production (see Caplan & Trogen, 2017) could provide plausible explanations for such mistrust. Similarly, the history of the AIDS epidemic in America reveals that the initial limited response was likely due to the fact that HIV was mainly limited to "spatially and socially isolated groups" and was not "spreading out to the broad American population" (NRC, 1993, para. 22). Considering how these groups of citizens have been marginalized and disrespected by the medical community, is it any wonder why they might view its recommendation with some suspicion?

Part of the mistrust in science and mathematics may be fundamentally attributed to a mistrust in experts. Nichols (2017) points out that in the U.S.:

> To reject the advice of experts is to assert autonomy, a way for Americans to insulate their increasingly fragile egos from ever being told they're wrong about anything. It is a new Declaration of Independence: no longer do we hold *these* truths to be self-evident, we hold *all* truths to be self-evident, even the ones that aren't true. All things are knowable and every opinion on any subject is as good as any other. (p. xx)

But, we know that this is just not true. When we experience engine trouble, we seek help from a mechanic. When an architect designs a building, she employs an engineer to ensure the building is structurally sound. To identify the best course of treatment for an infectious disease, a medical doctor turns to the advice of pharmaceutical research scientists. The mechanic, engineer, and researcher are each experts in their specific field; however, they do not warrant our trust solely on their own merit.

The knowledge and recommendations they convey represent the work of many mechanics, engineers, and researchers over long periods of time that contributed to their expertise; we are placing our trust in this greater body of knowledge. In her TED Talk, Naomi Oreskes (Oreskes, 2014), a professor of the history of science and author or *Merchants of Doubt* (Oreskes & Conway, 2010), refers to this as the "authority of the collective community." Each individual cannot possibly be an expert in all areas of life. "The fact of the matter is that we cannot function without admitting the limits of our knowledge and trusting in the expertise of others. We sometimes resist this conclusion because it undermines our sense of independence and autonomy" (Nichols, 2017, p. 15).

So, how do we build a trust in expertise and the fields of science and mathematics and simultaneously maintain people's sense of autonomy? Oreskes (2014) argues that scientists must become better communicators. One framework speakers can use to guide they convey information is three of Aristotle's rhetorical appeals: ethos, logos, and pathos (Aristotle, 1991). With ethos, speakers establish their credibility, or expertise, via explanations that convey information with field-based language that is understandable by the public. Further, these explanations should present a logical argument supported by evidence (logos). Lastly, speakers must consider their audience, specifically how their views and backgrounds may influence how they hear the information and how speakers acknowledge the audience's lived experiences in their message (pathos). Ensuring these appeals are made helps learners listen to an argument that they might otherwise reject or view with excessive skepticism. Let us now examine how an argument can attend to these three rhetorical appeals in the context of the coronavirus pandemic. On December 3, 2020, Dr. Francis Collins, a scientist and the Director of the National Institutes of Health (NIH), was interviewed by Russell Moore, President of the Southern Baptist Convention's Ethics & Religious Liberty Commission, to discuss the impending release of the Pfizer COVID-19 vaccine and to address common concerns among American evangelicals (ERLC, 2020).

In this 30-minute interview, Moore and Collins do a masterful job meeting the rhetorical appeals and being sensitive to the audience of evangelicals. The ethos of Collins's argument is established during his introduction as well as in how he described the way the vaccine works. During his introduction, the audience is made aware that Collins is a physician and geneticist who directs the largest supporter of biomedical research in the world and that he directed the project that mapped the human genome - this clearly demonstrates his academic credibility. The audience is also told that he has served as NIH Director under both Presidents Obama and Trump - indicating his non-partisanship. While explaining how the vaccine works, Collins uses minimal esoteric language and, instead, shows a model of the virus and explains in lay terms how mRNA from the virus is used to generate immunity in the person vaccinated.

The logos of Collins's argument is established in the statistics that he presents. He assures the audience that in the clinical trials with over 30,000 volunteers, the vaccine was shown to be 95% effective - he lets the audience know this represents many more clinical trial volunteers and much higher than expected effectiveness. He respectfully contradicts misinformation about the vaccine including its production from aborted fetal tissue and even the conspiracy theory that microchips might be in the shots. Throughout the entire interview, he reiterated the priority of evidence in navigating complicated medical issues.

Collins infuses his argument with pathos in how he establishes the terrible outcome should we not utilize the vaccine and in how he frames his recommendation with biblical references. He explains that over 280,000 Americans had died from COVID-19 (at the time of the interview) and how that equates to one person each minute. He further stated that, should we rely upon developing herd immunity without the vaccine, there would be "millions of us no longer around." When addressing fears and conspiracy theories about the vaccine, he referenced Phillipians 4, which emphasizes the importance of what is true, what is noble, and what is right - he indicated that such guidance directs the audience to pay attention to what the evidence shows rather than what they read

on social media. By infusing his argument with biblical references, Collins is suiting his argument specifically for the audience to which he is speaking.

In addition to experts being good communicators, the populace needs to be good listeners (Oreskes, 2014). What makes a good listener? A good listener needs to identify who is an expert. A good listener needs to determine whether information conveyed is from credible sources. A good listener needs to demonstrate healthy skepticism and demand additional information when it is not provided. A good listener needs to have an understanding of the natures of science and mathematics. A good listener needs to consider how their lived experiences may influence how they interpret information. Our mandate as science and mathematics educators is to develop good listeners to contribute to the efforts in reestablishing trust in science and mathematics.

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