Learning from the COVID-19 Pandemic to Address Climate Change

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COVID-19 has shined a bright light on the difficulties society faces in dealing with world-wide extreme events. . As of June1, 2020, over 6.1 million persons have contracted the coronavirus and more than 372,000 individuals have died from it. These numbers could have been much lower if leaders in the private and public sectors had:

1. Recognized the cognitive biases that pose obstacles to effective action and decision-making
2. Heeded the advice of experts as to the consequences of not taking action before it is too late
3. Designed a risk management strategy that addresses cognitive biases and takes into account the concerns of experts

This paper first focuses on why these three strategies were not addressed in the United States during the early stages of COVID-19 and why social distancing measures were imposed only after illnesses and deaths from the coronavirus ballooned in mid-March 2020. Next, using COVID-19 as an example, we propose ways to implement a risk management strategy to significantly reduce carbon emissions so as to reduce the adverse impacts of climate change in the coming years.

COVID-19: Cognitive Biases and Management Strategies

Impact of Cognitive Biases

A large body of cognitive psychology and behavioral decision research over the past 50 years has revealed that decision-makers are often guided by emotional reactions, cognitive biases and simple rules of thumb that have been acquired through personal experience.[1] These processes do not work well for making choices with respect to undertaking protective measures for extreme events where individuals have limited or no past experience. With respect to

COVID-19, these cognitive biases and heuristics led the general public and leaders at the national, state and local levels to ignore the early stages of the pandemic when it most easily could have been controlled.

Underestimating exponential growth

Foremost among these biases is the failure of the human mind to grasp the concept of *exponential growth*. This was demonstrated more than 40 years ago in a series of pioneering psychological experiments conducted by William Wagenaar and his colleagues. In one study, participants were shown a hypothetical index of air pollution beginning in 1970 at a low value of 3 and rising yearly in an exponential way to 7, 20, 55 and, finally, 148 by 1974. Asked to estimate the value of the index in 1979, many of the respondents produced estimates at or below 10 percent of the correct figure of approximately 21,000 (which can be determined from the underlying exponential equation).[2] Subsequent experiments have observed similarly dramatic underestimation of exponential growth and showed that it typically results from straight-line projections based on early small increases.

The deceptive nature of exponential growth in the context of the coronavirus pandemic was conveyed nicely in a piece on March 10, 2020 in the *Washington Post*. Megan McArdle posed a brain teaser conveyed by the riddle of the growth of lily pads in a pond that doubles each day.[3] On the second day there are two lily pads, on the third day there are four, on the fourth day there are eight, etc. Suppose that on the 48th day, the pond is covered completely. How long did it take for the pond to be covered halfway? The answer is 47 days. Even after 40 days of exponential growth, you would barely notice the lily pads, as they would cover only 1/256th (0.4 percent) of the pond. For a long period of time, we can easily ignore the steady exponential growth of lily pads—until they smother the pond.

One of the reasons that the general public and key decision makers were not paying attention to the coronavirus in January or February is that they failed to appreciate the menacing impact of COVID-19 due to exponential growth. It is easy to project a pattern of smooth, linear growth: one person gets the coronavirus today, another person contracts it tomorrow, a third person gets it on the third day, and the process continues in this manner, with the cases simply adding up over time. But most people, including leaders and policymakers, find it difficult to comprehend exponential growth. Using the virus as an example, exponential growth translates into having two cases of the coronavirus tomorrow, four on the third day, hundreds after the eighth day and thousands soon thereafter.

Figure 1a depicts the exponential growth in the number of individuals contracting COVID-19 in the United States when the first case was noted in January 21 through March 31, 2020. By February 29 it was reported that only 70 individuals had tested positive for COVID-19, but by the end of March, 188,049 individuals were diagnosed as having the virus. Focusing on the period between January 21 and February 29 in Figure 1b, one again sees the exponential growth in the number of individuals with the virus.

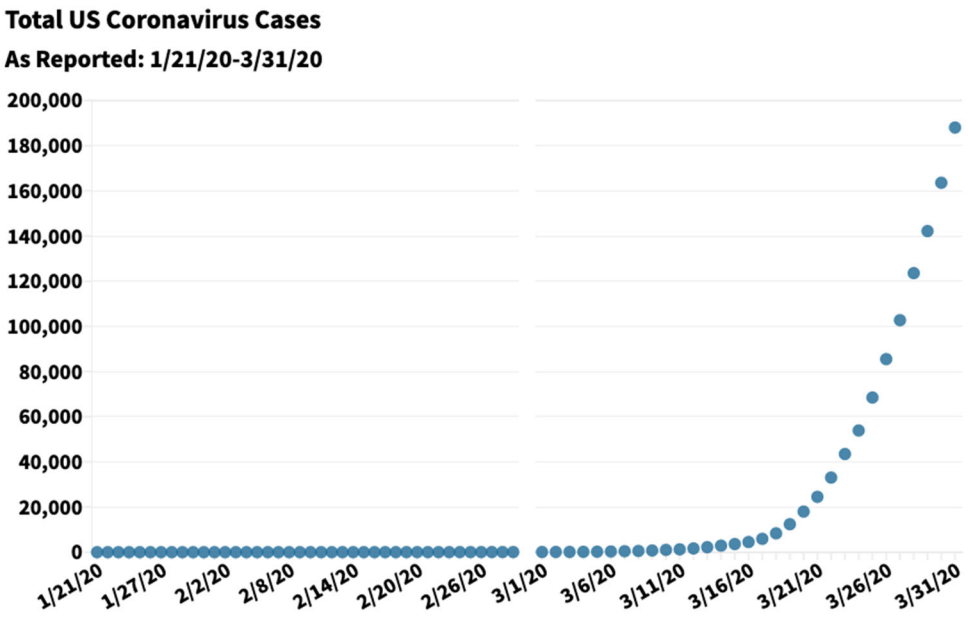

Figure 1a

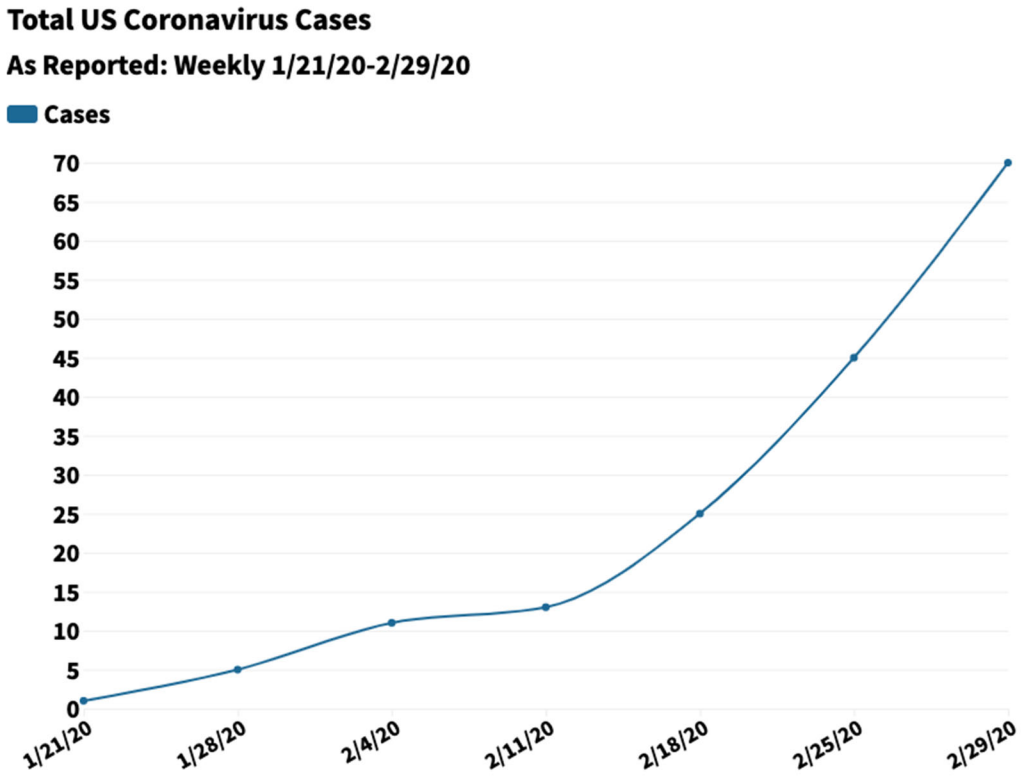

Figure 1b

Figure 1a and 1b. Exponential growth in number of reported cases from COVID-19 in the United States
Source: Data from *The New York Times* based on reports from state and local health agencies[4]

Misperception of the risk

Another factor that led to delayed response is the *availability* bias, where the perceived likelihood of an event occurring depends on its salience and memorability.[5] There is a tendency to underweight the probability of a threat if one has not recently experienced a significant loss.[6] When the threat becomes salient, individuals focus on the consequences of an illness rather than its likelihood. Few individuals in the U.S. experienced severe illnesses from SARS or the H1N1 virus, so the public was not worried about the impact of contracting the coronavirus in January and February 2020 when few illnesses were reported. Early comparisons to the seasonal flu further contributed to complacency.

Only in mid-March when the number of illnesses and fatalities skyrocketed (as noted in Figure 1a) did individuals focus on the impacts that COVID-19 could have on them. They then perceived the risk of contracting the virus to be high due to feelings of *dread* given its deadly potential and because it is a new risk. Psychometric studies in a number of countries have shown that these qualities strongly increase individuals' perception of health and safety risks.[7]

Myopia, optimism and herding

Several other biases led the general public and key decision makers to ignore the potential consequences of the coronavirus pandemic. Specifically, people tend to be *myopic,* so don't focus on the value of undertaking immediate actions to reduce the severe consequences that are likely to occur in the future. We are also unduly *optimistic* about the likelihood of adverse events occurring, and "*follow the herd,"* such that our choices are often influenced by other people's behavior, especially under conditions of uncertainty.[8] For these reasons, most people went about their normal social activities in the first two months of 2020 and continued to interact with friends and colleagues during the early part of March. A study by researchers at Columbia University revealed that if the country had begun imposing social distancing measures as early as March 1 rather than delaying it for two weeks, 54,054 fewer people would have died by early May (that is, a reduction of approximately 83 percent of the 65,307 reported deaths from the virus in the U.S. by May 3).[9]

Failure to Listen to Experts

Due to these cognitive biases, the general public and most decision-makers at the national, state and local levels in the United States were not concerned with COVID-19 during the first two months of 2020 and did not give much thought to the possibility of a pandemic. Although 11,950 individuals in China had contracted the virus and 259 of them had died by January 31, these figures did not register with most people in the U.S., the one exception being epidemiologists.

After reflecting on the Chinese experience, epidemiologists understood that COVID-19 was a new and potent virus that was likely to spread globally. By mid-February these scientists were warning national leaders that the coronavirus was likely to infect and kill a large number of individuals around the world. They were aware that it would soon be classified as a pandemic

and that it was important to take steps immediately to contain the virus from spreading. Unfortunately, government leaders in the U.S. did not heed these warnings so in the early stages of its spread within the United States no efforts were made to obtain sufficient test kits to determine who was infected with the virus, which would have allowed for contact tracing and quarantine measures.[10]

Designing A Risk Management Strategy for COVID-19

Failure to appreciate the nature of the exponential spread of COVID-19, along with other cognitive biases, led the general public and business leaders to continue their normal behavior into early March. Americans across much of the country were still going into the office, meeting with friends and neighbors and shaking hands. On March 11, over 1,000 individuals in the United States had contracted the coronavirus, ten times more than in the previous week. On that same date, the World Health Organization declared COVID-19 a pandemic.[11] Only then was there a recognition that steps needed to be taken to prevent a significant increase in illnesses and fatalities from the coronavirus.

To effectively curtail the pandemic, epidemiologists advocated three elements that comprise a risk management strategy:

- Sufficient tests to determine who might have COVID-19
- Isolate or quarantine those who tested positive for COVID-19
- Shutter non-essential business and require individuals throughout the country to shelter-in-place until the virus is under control

South Korea could have well served as a model for the United States to emulate with respect to the above strategy. After COVID-19 emerged in China, the Korea Centers for Disease Control and Prevention (KCDC) cooperated with diagnostic manufacturers to develop commercial test kits. The country had the most expansive and well-organized testing program in the world, combined with extensive efforts to isolate infected people and trace and quarantine their contacts. By mid-March, South Korea had tested more than 270,000 people – more than 5,200 tests per million residents in the country, compared to 74 tests per million residents in the U.S – according to data from the U.S. Centers for Disease Control and Prevention and the KCDC.[12]

A challenge facing the United States and other countries in the world is the tradeoff between the negative impact on the economy due to closed businesses and shelter-in-place requirements, against the positive impact of these restrictions on saving lives and avoiding a resurgence of illnesses and fatalities. Epidemiologists have expressed concern that in places where the number of cases are small but still subject to exponential growth, regulations will be relaxed prematurely, people will feel they are safe and thus ignore recommendations for social distancing, and the disease will come surging back.

Dealing with Climate Change

The same cognitive biases and failure to heed experts that led to challenges in dealing with the coronavirus pandemic also contribute to inaction regarding the looming catastrophes from climate change. In particular, the failure to appreciate that climate-destructive processes are growing exponentially has caused political leaders to resist taking action to reduce carbon dioxide (CO_2) emissions.

Recognize the Impact of Cognitive Biases

According to a survey undertaken by the Yale Program on Climate Change Communication in November 2019, a majority of Americans are now worried about the impact of climate change.[13] But this concern does not necessarily lead to positive action by a large proportion of the general public to reduce CO_2 emissions because the perceived future consequences from not taking action now --extreme weather events -- although harmful, are familiar and not viewed as controllable. As with inattention that led the general public and key decision makers to ignore the consequences of COVID-19 during the first two months of 2020, inaction with respect to climate change also is a product of individuals' cognitive biases.

To illustrate this point, relatively few homeowners have voluntarily invested in energy-saving technologies. In this case, *myopia* comes into play when homeowners are determining whether to invest in an energy efficient measure. In many areas of the country, the upfront cost of adopting these measures is less than the expected discounted savings in energy costs over time. If individuals were to focus on a longer time horizon, they would see that expected benefits exceed the upfront costs.

Individuals may also choose to ignore future climate change if they are reluctant to alter their current behavior due to the *inertia* bias. This behavior is reinforced by a *herding* bias when people interact with their friends and neighbors who feel the same way as they do, and by the *prominence effect* where households are unwilling to give up their current comforts and conveniences, such as using less air conditioning in the summer and lowering their thermostat in the winter.

Our failure to undertake measures to address climate change is also due to the way we process information: the statistical data characterizing the future risks associated with climate change do not create feelings of concern. One factor is *psychic numbing,* where numerical projections of CO_2 concentrations do not stimulate the emotional reactions necessary to motivate action. This lack of concern is exacerbated by *pseudoinefficacy,* where individuals feel that any personal contribution they make to reduce a catastrophic threat associated with climate change will be unimportant and thus ineffective.[14]

Listen to Experts[15]

As with COVID-19, it will be important for political leaders at the national, state and local levels in the United States and the rest of the world to recognize these cognitive biases and turn to experts for advice on how to deal with the impacts of climate change. Climate scientists have long recognized that CO_2 emissions and their resulting effects have been increasing exponentially. Figure 2 shows the monthly average CO_2 concentration at Mauna Loa Observatory in Hawaii—the longest record of direct measurements of CO_2 in the atmosphere. The volume of CO_2 stood at 315 parts per million (ppm) when first measured in 1958; by the end of February 2020, it had risen by 31 percent to 414 ppm.

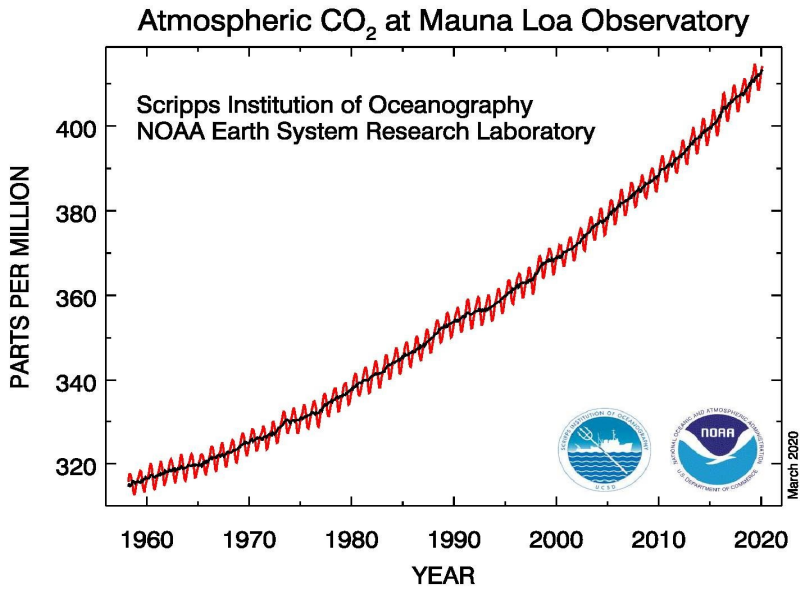

Figure 2. Mean carbon dioxide (CO_2) measured at Mauna Loa Observatory, Hawaii.
Source: NOAA ESRL Global Monitoring Division

This exponential increase signals that CO_2 emissions and their resulting concentrations are likely to be considerably higher in the coming years, unless we take strong measures now to reduce them. Otherwise, the exponential growth of CO_2 emissions will drive our climate to extremes that look nothing like a linear extrapolation of recent history. We will then experience more blistering heat waves, severe droughts, accelerating sea level rise, and unprecedented intensity of rainstorms and resulting flooding, just to name a few of the consequences.

To illustrate, consider the damage caused by climate change-related flooding, combined with population growth in hazard-prone areas. A 2013 analysis in 136 major coastal cities around the world reveals that sea level rise (SLR) of 20 cm (7.9 inches) by 2050—an optimistic scenario—will cause the average annual flood losses in those cities to increase to $1.2 trillion that year from $52 billion in 2005. A more pessimistic scenario of SLR of 40 cm (15.7 inches) by 2050 will lead to average annual flood losses of $1.6 trillion. Houston was one of the twenty

most vulnerable coastal cities in the study. Its average annual damage with an optimistic SLR scenario is estimated to increase by 78 percent, from $5.1 billion in 2005 to $9.1 billion in 2050.[16]

People are actually moving *into* harm's way, not realizing the potential for severe damage they might suffer in the coming years due to climate change. From 1980 to 2018, the population of hurricane-prone counties in Florida increased by 163 percent, from 3.7 million people to 9.8 million, compared with a 61 percent increase in the population of the United States during this period. These Florida residents might not recognize that they are likely to experience increased damage from more intense hurricanes coupled with sea level rise due to climate change.[17]

If CO_2 emissions continue to grow exponentially, most of the United States could see 20 to 30 more days annually with maximum temperatures higher than 90 degrees, with the Southeast potentially enduring 40 to 50 more such days.[18] This extreme heat poses serious health risks, especially for the very young and the elderly, construction and agricultural workers, and those living in the core of urban areas. A study by researchers at the Earth Institute of Columbia University finds that wildfires could continue to grow exponentially in California in the next 40 years due to climate change as temperatures rise.[19]

The 2015 Paris Agreement, signed by nearly every country in the world, requested an analysis from the scientists at the Intergovernmental Panel on Climate Change (IPCC) of the impacts to humanity if global warming were to reach 1. 5°C. The central finding of the 2017 Fourth National Climate Assessment, based on a large number of peer-reviewed studies, is that CO_2 emissions are already causing severe economic damage and have to be significantly reduced now to avoid even more serious losses.[20]

In this regard, a special report in October 2018 by the IPCC highlighted the benefits to people and natural ecosystem importance of limiting global warming to 1.5°C above the average temperature in the pre-industrial period (1850-1900) relative to a 2°C increase. The IPCC report indicates that limiting global warming to 1.5°C would require human-caused emissions of CO_2 to fall by about 45 percent from 2010 levels by 2030, reaching 'net zero' around 2050. Achieving these objectives involves rapid and far-reaching transitions in land, energy, industry, buildings, transport, and cities. Some of the measures that need to be undertaken in this regard are detailed in a follow-on to the IPCC report by Climainfo.[21]

A Risk Management Strategy for Climate Change

In designing a strategy for dealing with climate change, one needs to recognize that due to cognitive biases, the general public and key decision makers are not inclined to undertake steps to reduce CO_2 emissions or invest in adaptation measures for reducing losses from future disasters. Political leaders who feel that their constituency is not concerned with climate change may be reluctant to support legislation or global accords such as the Paris Agreement of

2015, because of their concerns with getting re-elected. The coronavirus pandemic provides an opportunity to implement measures for reducing CO_2 emissions now by calling attention to the severe impacts that would otherwise occur. The following features of a risk management strategy address this challenge.

Learning from Experience

Our delayed and costly response to the coronavirus pandemic may have a silver lining: a recognition that we can no longer delay aggressive actions to halt and reverse what otherwise will be even more severe crises arising from climate change. In fact, some parts of the world have experienced tipping points with residents of island nations realizing that they will have to migrate elsewhere in a few years due to sea level rise. Given cognitive biases and misperceptions of the risk and the challenges that individuals face in voluntarily dealing with the climate change problem, there is a need to develop a risk management strategy that requires well-enforced regulations at the state and national level and is economically attractive to the general public.

Provide short-term economic incentives coupled with well-enforced regulations

Consider the reluctance of many homeowners to invest in new energy technologies that reduce carbon emissions due its high upfront cost. Suppose a household is considering investing in solar panels that would cost $15,000 to install and would result in a reduction in their average annual energy bill by $3,000. If the annual discount rate is 5 percent or less, the expected discounted savings will be greater than $15,000 after six years. [22]

California has addressed the long-term economic benefits to homeowners of solar energy by requiring all new single-family homes and new multifamily residences to be constructed with solar panels on their roofs as of January 1, 2020. The California Energy Commission, which approved the new regulation, estimates that the monthly mortgage payment on the house would increase by $40 a month but the homeowner would save $80 a month in electricity costs on average.[23] By incorporating the upfront cost of the solar panels into the mortgage, the household incurs a lower total costs from the time they purchase the house. Not only is the myopia bias addressed by stretching the time horizon for paying for the solar panels, but households considering buying a new house should now be less concerned with its impact on their budget.

At least 15 states and Puerto Rico have enacted legislation establishing greenhouse gas (GHG) emissions reduction requirements, with even more states requiring their agencies to report or inventory GHG emissions. Several states have also implemented carbon pricing policies either independently or through regional agreements. California is employing a multi-sector GHG cap-and-trade program, and several Northeast and Middle Atlantic states are participating in the Regional Greenhouse Gas Initiative, the first binding cap-and-trade program aimed at reducing GHG emissions from the power sector. Many of these same states also participate in the Transportation and Climate which is committed to developing a cap-and-invest program aimed and reducing transportation sector emissions.[24]

One of the most effective ways of incentivizing firms to reduce CO_2 emissions is the passage of a carbon tax that levies a fee on the production, distribution or use of fossil fuels based on how much carbon their combustion emits. The government sets a price per ton on carbon, then translates it into a tax on electricity, natural gas or oil. Two states, Washington and Maine, have had referenda for such a tax but had insufficient support for it (Washington in 2016 and 2018, and in Maine in 2019). The challenge for national and state leaders is designing and implementing a program that will significantly reduce carbon emissions over the coming years through such a tax.

Construct Climate Change Scenarios

One way to get people to change their behavior in line with economic incentives and regulatory pressures is to construct detailed scenarios as to what could happen to those residing in communities that experience catastrophic events in the future. Then show how the likelihood and consequences of these disasters could be reduced if steps were taken now to reduce carbon emissions in the United States and other parts of the of the world. Visual images that simulate the impact of sea level rise on cities like Miami or New Orleans or coastal areas and island nations may to stir up emotions and concerns that demand action to reduce CO_2 emissions now.

People's receptiveness to change is likely to be highest following a wildfire, hurricane, flood or a heat wave that causes severe property damage and/or deaths, and perhaps indirect impacts such as business interruption. Due to the *availability* bias, heat waves, wildfires and severe storms can cause people to think about the impacts brought on by global warming. These natural disasters are likely to become more frequent and more severe in the future due to climate change. Political leaders may then pay attention and pass legislation at the state and federal level, such as a carbon tax for reducing future carbon emissions.

Business leaders can learn from the challenges they have faced in dealing with the coronavirus pandemic to plan now for the long-term consequences of climate change that are likely to adversely affect their operations in the future.[25] Some guidelines for these leaders to consider in this regard are:

- Reflect on decisions that the firm has made and how these could be improved and applied in creative ways.
- Consider the long-term costs and benefits of various alternatives before deciding on a plan of action.
- Recognize that well-enforced regulations may be needed.

Conclusion

Dealing with the serious health concerns and economic impacts of COVID-19 is everyone's top priority now. Lessons from COVID-19 will prove helpful when we turn our attention to the serious problem of climate change. Our cognitive biases coupled with the failure to appreciate the exponential process characterizing CO_2 emissions imply that the catastrophic consequences of climate change that seem distant and unreal today will arrive far sooner than we expect.

Cooperation between scientists (including behavioral scientists), and leaders from government and industry is essential for effective management of these uniquely challenging global threats. We may then have a chance to mitigate the consequences of climate change and future pandemics before it is too late.

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