Correcting misperceptions of exponential coronavirus growth increases support for social distancing

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The most effective way to stem the spread of a pandemic such as coronavirus disease 2019 (COVID-19) is social distancing, but the introduction of such measures is hampered by the fact that a sizeable portion of the population fails to see their need. Three studies conducted during the mass spreading of the virus in the United States toward the end of March 2020 show that this results partially from people’s misperception of the virus’s exponential growth in linear terms and that overcoming this bias increases support for social distancing. Study 1 shows that American participants mistakenly perceive the virus’s exponential growth in linear terms (conservatives more so than liberals). Studies 2 and 3 show that instructing people to avoid the exponential growth bias significantly increases perceptions of the virus’s growth and thereby increases support for social distancing. Together, these results show the importance of statistical literacy to recruit support for fighting pandemics such as the coronavirus.

Significance

Given the current lack of an effective vaccine to prevent coronavirus disease 2019 (COVID-19), one of the most effective ways to prevent the illness is social distancing. At the same time, a sizeable portion of the public fails to see the necessity of such measures. We identify one root cause for this: People mistakenly perceive the coronavirus to grow in a linear manner, underestimating its actual potential for exponential growth. We show that correcting this perceptual error significantly increases support for social distancing. This research shows the importance of statistical literacy among the general public for increasing support to fight the coronavirus using the most effective method currently available.

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growth or at least the perceptual readiness to understand it and its implications (11, 12). Indeed, earlier findings show that experience with exponential growth—such as in the case of hyperinflation in Israel in the early 1980s—can increase susceptibility to information that can help to overcome exponential growth bias (13). Based on this, we expected that people would be susceptible to information that can help them to correct for their biased perception of the coronavirus.

Method and Results
To test these ideas, we conducted three studies in the second half of March 2020—a period in which the coronavirus in the United States increased particularly rapidly. This allows us to compare subjective growth perception and prediction with actual growth rates. Across these studies, we recruited American participants online via Amazon MTurk, a web-based tool for recruiting and paying participants to perform tasks. MTurk samples have been shown to be as representative of the US population as other sampling methods (14, 15). To avoid the most critical problem with MTurk samples—nonnaïveté (16)—participants were barred from taking part in more than one study. All three studies were conducted consistent with the Declaration of Helsinki, and all three are exempt from Institutional Review Board approval by guidelines of the German Psychological Society DGPS (Deutsche Gesellschaft für Psychologie) (17). Data and code are available at https://osf.io/jxjwbg/ (18).

Study 1. After providing consent, participants guessed the total number of coronavirus cases over the past 5 d, from Tuesday, March 17 to Saturday, March 21. As expected, participants displayed exponential growth bias. Although some participants accurately included exponential growth in their estimates, thus producing an overall significant quadratic trend \((F = 18.78, P < 0.0001)\), its size was dwarfed by the strong linear trend \((F = 470.55, P < 0.0001)\), meaning that participants’ averaged estimates of the virus’s growth could, for practical purposes, be described as linear (Fig. 1, dark gray line). Comparing participants’ estimates against linear and quadratic trends in the actual data of the virus’s growth (Fig. 1, dashed black line), drawn from the Worldometer COVID-19 database (19), we found that participants underestimated both the virus’s linear \((P < 0.0001)\) and exponential growth \((P < 0.0001)\). Note that, as a result of their failure to see exponential growth, participants did not simply underestimate the number of cases throughout the observed time period. In fact, they overestimated the number of known coronavirus cases in the first 3 d of the week \((P < 0.0001)\) and underestimated the number in the last 2 d of the week \((P < 0.0001)\). On average, they underestimated the actual growth of the virus’s over that time period by 45.7% \((P < 0.0001)\).

As also expected, this tendency to underestimate exponential growth was not fixed but instead depended on participants’ political ideology \((P < 0.0001)\), which we measured using a validated continuous scale (20). A significant ideology \(\times\) linear trend \((P < 0.0001)\) suggested that conservatives were more likely to underestimate the virus’s absolute growth compared to liberals. A significant ideology \(\times\) quadratic trend \((P = 0.006)\) showed that conservatives also underestimated the exponential nature of that growth more than did liberals (Fig. 1; data split across the neutral midpoint between liberals and conservatives, for presentation purposes). Again, note that, compared to liberals, conservatives did not underestimate but overestimated the number of virus infections in the first 3 d of the week \((all ~ P < 0.001)\). In other words, compared to liberals, conservatives did not underestimate the problem (defined as number of infections) per se, but underestimated its exponential growth.

Study 2. Our next aim was to test whether this incorrect perception of the coronavirus’s growth could be corrected by instructing participants about exponential growth and whether doing so also affects support for social distancing measures. To do so, we repeated the design of study 1, but randomly assigned participants to one of two conditions. After providing consent, participants in the experimental condition received the following instructions, that were based on the virus’s recent developments (19):

Please keep in mind that many people forget that the speed by which the coronavirus spreads, increases each day. In other words, when making these guesses, many people erroneously think that the coronavirus cases have increased at a steady and constant pace. In reality, in the USA (as in almost all other countries) the number of coronavirus patients doubles and keeps doubling every three days.

In the control condition, participants did not receive these instructions. Next, participants guessed the number of coronavirus cases between Tuesday, March 17 and Monday, March 23. These experimental instructions affected participants’ perceptions of the growth of the virus \((P = 0.003)\). Following this up by testing interactions between condition and polynomial contrasts, we found no significant condition \(\times\) linear trend interaction \((P = 0.104)\), but only a significant condition \(\times\) quadratic trend interaction \((P = 0.001)\), suggesting that the experimental instruction primarily corrected participants’ misunderstanding of the virus’s exponential growth (Fig. 2). Consistent with predictions, participants in the experimental condition were also significantly more supportive of social distancing than participants in the control condition \((P = 0.019)\).

Study 3. An even more effective way to increase support for social distancing (compared to changing people’s beliefs about past growth) may be correcting beliefs about the virus’s future growth. After providing consent, all participants read the current estimated number of coronavirus infections in the United States and the current statistic that it doubles every 3 d (19). Next, all participants guessed the development of the virus’s spread over the next 15 d. In the experimental condition, participants were instructed to arrive at their estimate in five steps, first guessing the number of active coronavirus cases in four intermediate steps, each 3 d apart. Because this time frame matched the statistic (provided to all participants) that the number of cases doubles every third day, this helped participants understand the implications of exponential growth. In the control condition, participants instead made an immediate estimate of the number of cases after 2 wk. Importantly, these participants received the same statistical information (including the current number of cases and its speed of doubling).
but were not instructed to make the four intermediate guesses. As expected, participants in the experimental condition produced 173% higher final estimates of the number of known cases of coronavirus infection after 2 wk, than control participants (P < 0.0001; Fig. 3). Furthermore, being helped to realize the potential implications of exponential growth in the near future, participants in the experimental condition were significantly more supportive of measures to increase social distancing and a lockdown than control participants (P = 0.024). Finally, a mediation analysis showed that the latter effect of condition on support for social distancing was statistically mediated by the former effect on participants’ final estimates (P = 0.011).

Discussion

Across three studies, we found evidence of exponential growth bias in people’s perceptions of the coronavirus’s spread, meaning that people erroneously perceive the virus’s exponential growth in largely linear terms. This effect was stronger among conservatives than liberals (study 1), who followed President Trump’s incorrect remarks about the virus. This shows the danger of politicians’ downplaying of the virus. Furthermore, we found that participants can be helped to correct for the exponential growth bias in estimating the virus’s development in the recent past (study 2) and immediate future (study 3). These interventions not only help overcome exponential growth bias, but they also significantly increase support for social distancing—the most effective available way to prevent spreading of the coronavirus.

Our results stand in contrast to earlier literature that shows that the exponential growth bias is difficult to overcome (5–10, 21). Instead, in our studies, a three-sentence instruction not to make the mistake (study 2) or an instruction to estimate through four intermediate steps (study 3) effectively reduced the bias. A difference between our and earlier studies is that we focused on a threat with great personal relevance and media presence, which likely increases subjective availability and thus estimated probability of the risk. This possibly increases the readiness to understand exponential growth when instructed about it and reduces the underestimation of exponential growth (11–13).

These findings demonstrate the real-life implications of exponential growth bias. Earlier work shows the bias affects households’ financial decisions (22), but the current findings show that it also influences political opinions about matters of life and death. Given that social distancing is the most effective way to combat the coronavirus currently available, these findings are of great impact. More generally, our findings show the importance of statistical literacy and echo calls to improve that skill among the general public (23, 24).

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