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Anti-intellectualism and the mass public's response to the COVID-19 pandemic

Eric Merkley[1,2] ✉ and Peter John Loewen[1,2]

Anti-intellectualism (the generalized distrust of experts and intellectuals) is an important concept in explaining the public's engagement with advice from scientists and experts. We ask whether it has shaped the mass public's response to coronavirus disease 2019 (COVID-19). We provide evidence of a consistent connection between anti-intellectualism and COVID-19 risk perceptions, social distancing, mask usage, misperceptions and information acquisition using a representative survey of 27,615 Canadians conducted from March to July 2020. We exploit a panel component of our design ($N = 4{,}910$) to strongly link anti-intellectualism and within-respondent change in mask usage. Finally, we provide experimental evidence of anti-intellectualism's importance in information search behaviour with two conjoint studies ($N \sim 2{,}500$) that show that preferences for COVID-19 news and COVID-19 information from experts dissipate among respondents with higher levels of anti-intellectual sentiment. Anti-intellectualism poses a fundamental challenge in maintaining and increasing public compliance with expert-guided COVID-19 health directives.

The COVID-19 pandemic has thrust a wide variety of experts into the spotlight. Doctors and scientists are at the forefront of both government plans to control the pandemic and efforts to educate the public on the threat of the virus. Economists have been central in guiding policy to mitigate the inevitable and catastrophic economic consequences of government lockdowns and social distancing. Governments and citizens, for the most part, are heeding this expert advice, but there are exceptions.

Most work to date (particularly in the United States) has focused on the role of ideological conservatism and partisanship in reducing COVID-19 risk perceptions and social distancing practice (Cornelson and Miloucheva 2020, unpublished manuscript)[1–3]. We argue here that anti-intellectualism (the generalized distrust of experts and intellectuals) has played a powerful role in shaping the public's reaction to the COVID-19 pandemic above and beyond this concept's association with ideological conservatism[4].

People tend to be persuaded by speakers they see as knowledgeable (that is, experts), but only when they perceive the existence of common interests[5]. Some groups of citizens, such as ideological conservatives[4], populists[6], religious fundamentalists and the like, may see experts as threatening to their social identities. Consequently, they will be less amenable to expert messages, even in times of crisis[7]. We thus expect citizens with higher levels of anti-intellectualism to perceive less risk from COVID-19, to engage in less social distancing and mask usage, to more frequently endorse related misperceptions and to acquire less pandemic-related information.

To test these expectations, we bring to bear a large representative sample of almost 28,000 respondents from a survey that was fielded in Canada over the course of 11 waves from 25 March to 6 July 2020. This survey has a built-in panel component where almost half of the respondents from the first four waves were re-contacted in waves 5–8 for a total of 4,910 re-contacts. This allows us to test expectations of anti-intellectualism's relationship to within-respondent changes in self-reported behaviour where we expect it, in this case the usage of face masks, where expert recommendations changed over the course of the pandemic.

We also provide direct evidence of anti-intellectualism's relationship to observed information search behaviour with a pair of conjoint experiments. We find that people choose COVID-19 news over unrelated news and choose expert-featured news about COVID-19, but these effects weaken or disappear among those with higher levels of anti-intellectual sentiment. We provide pre-registered replications of both experiments. Together, our results illustrate the centrally important role of anti-intellectualism in shaping the mass public's response to COVID-19.

Citizens and experts during the COVID-19 pandemic

In an age of pandemic and a warming climate, understanding the conditions under which citizens engage with and process information from experts has taken on a central importance. Most explanations for resistance to scientific and expert consensus focus on the directional motivation of individuals. People may reflexively reject scientific and expert consensus when it is in tension with their worldviews, ideological beliefs or even partisanship[8,9]. The appeal of this approach is obvious in the context of climate change: for years there has been a stark divide between Republicans and Democrats in the United States[10]. But ideology and partisanship do a poor job in explaining climate change attitudes in other national contexts[11], nor are they particularly important determinants of attitudes toward other areas of scientific consensus[7].

The COVID-19 pandemic has afforded us with a unique, if deeply tragic, opportunity to study how citizens react to expert advice on a novel and vitally important issue. Scientists are gradually learning about the novel coronavirus and how best to mitigate the threat with individual and government responses. It would be wrong to imply that the scientific community has reached consensus on many questions related to COVID-19, but a few key points of advice have remained consistent over the course of the pandemic: COVID-19 is dangerous, especially for the elderly and people with pre-existing health conditions, and people can protect themselves through a number of preventative measures that have together been labelled as social or physical distancing. Public health officials have also converged

[1]Department of Political Science, University of Toronto, Toronto, Ontario, Canada. [2]Munk School of Global Affairs and Public Policy, University of Toronto, Toronto, Ontario, Canada. ✉e-mail: eric.merkley@utoronto.ca

on a consensus that cloth masks can be effective in preventing transmission by asymptomatic and pre-symptomatic individuals.

Meanwhile, a number of verifiably false, pseudo-scientific claims have been circulating in popular discourse (especially on social media[12]) such as a link between COVID-19 and fifth-generation (5G) telecommunications technology, the ability to cure COVID-19 with homoeopathic remedies or vitamin C and the artificial creation of SARS-CoV-2, by either China or the United States. Some of these misperceptions are conspiratorial in nature[13], while others are more accurately labelled as pseudo-scientific medical folk wisdom[14]. Perhaps the most politically salient misperception about COVID-19 is that it is not a serious disease, and that its effects are comparable to those of the seasonal flu.

Research has begun to accumulate on how citizens have engaged with expert advice on COVID-19 on the one hand, and misinformation on the other. A dominant focus, echoing scholarly research on motivated reasoning discussed above, has been on the role of partisanship in structuring COVID-19 risk perceptions and social distancing behaviour (Cornelson and Miloucheva, unpublished manuscript)[1,2,15]. However, other countries with high levels of affective polarization, such as Canada[16], show evidence of cross-partisan consensus[17], so it is not clear how far a focus on partisanship helps us understand COVID-19 attitudes and behaviours outside the rather unique US context.

Other psychological traits and predispositions also appear to have particular relevance in shaping COVID-19 risk perceptions. Ideological conservatism appears to predict COVID-19 attitudes cross-nationally, especially in Canada and the United States[3], as does one's level of science literacy, need for cognition[3] and proclivity towards conspiratorial thinking[13]. Some outcomes are also sensitive to the information environment: COVID-19 misperceptions appear to be stronger among people in the United States who watch *Fox News*[18], and among social media users in Canada[12] and the United Kingdom[19], for example.

Research to date has proceeded along several separate streams, focusing on risk perceptions, social distancing, or misperceptions alone, despite the likely close relationships between them. We argue that the concept of anti-intellectualism is centrally important in shaping the public's response to the COVID-19 pandemic across a wide range of indicators, such as risk perceptions, preventative behaviours such as social distancing and mask usage, misperceptions and information search behaviour. In what follows, we review the theoretical concept of anti-intellectualism, and then demonstrate its relationship to these beliefs and self-reported behaviours.

Anti-intellectualism and the COVID-19 pandemic

Anti-intellectualism has been an understudied concept in science communication, public policy and public opinion research, despite its clear import for understanding how and why citizens engage with expert advice and pseudo-scientific claims. The concept itself entered the scholarly lexicon with the work of Richard Hofstadter, who argued that anti-intellectualism is deeply embedded in the Protestant fabric of the United States and periodically manifests itself in political life, such as with the McCarthy trials or the rise of the John Birch Society[20].

Hofstadter implicitly saw populism (the generalized distrust of elites[21,22]) as central to his definition of anti-intellectualism, where people distrust and dislike experts and intellectuals because of a view that "the plain sense of the common man….is an altogether adequate substitute for, if not actually much superior to, formal knowledge and expertise"[20]. Anti-intellectualism is typically embraced by populists who see experts as a class of elites that aim to exploit ordinary people through their positions of power. The simultaneous democratization of knowledge and rising importance of experts in growing government bureaucracies have potentially raised the salience of this concept in political life[20].

More recently, scholarship on anti-intellectualism has deviated somewhat from Hofstadter's conceptualization. Some have identified anti-intellectualism as plain-spokenness[23,24] or as a component of populist rhetoric[21,25], rather than as a predisposition. Scholars have also increasingly seen anti-intellectualism as a component of conservative ideology[4] (rather than populism), in part due to conservative rejection of the theory of evolution and embrace of climate scepticism.

A simpler, more unifying definition treats anti-intellectualism as "the generalized distrust of experts and intellectuals"[7]. This mistrust can have a number of different sources, but foremost among them is populism[6]. Some populists see experts as a class of elites who exercise power over virtuous ordinary citizens, and historically there is some link between populism and anti-intellectualism, at least in the United States[25]. However, there have also been historical moments where populists have valued impartial experts as an antidote to corrupt political elites. For example, Progressive Era populists saw experts and a professionalized civil service as solutions to the corruption of machine politics. There are almost certainly other traits that fuel anti-intellectual sentiment, such as ideological conservatism and partisanship[4], intuitionism[26] and religious fundamentalism.

A lesson from these conflicting theoretical and empirical accounts is that we should not explicitly or implicitly build a source of anti-intellectualism into a definition of the concept or into its measurement, but rather rely on the fact that anti-intellectuals will consistently display mistrust in a wide range of experts and intellectuals. Anti-intellectualism should strongly shape the public's response to expert recommendations because citizens are persuaded by sources they perceive as trustworthy[5]. Recent work has highlighted the importance of anti-intellectualism and trust in experts in understanding public support for climate change, nuclear power, genetically modified organisms, water fluoridation[4,7] and vaccinations[27]. And experimentally, the persuasiveness of expert consensus cues appears to be moderated by anti-intellectualism, such that signals of expert consensus may make anti-intellectuals double down in their opposition to positions with expert consensus[7].

We argue that anti-intellectualism is likely a critical factor in shaping the public's response to the COVID-19 pandemic. Experts are at the forefront of the pandemic response by governments. They have communicated messages regarding the seriousness of COVID-19 and the importance of social distancing, and have often been used to debunk pieces of misinformation circulating online. Consequently, our expectation is that anti-intellectualism should be negatively associated with COVID-19 risk perceptions and social distancing compliance, but positively associated with misperceptions.

We surveyed 27,615 Canadians between March and July 2020 over 11 survey waves about their COVID-19 attitudes and behaviours, and we re-interviewed almost half of respondents from the first four waves ($N=4{,}910$). We use these respondents to test our expectations that:

H1: Anti-intellectualism is…

- A: negatively associated with COVID-19 concern and risk perceptions;
- B: negatively associated with social distancing compliance;
- C: positively associated with COVID-19 misperceptions.

The time span of our study and our panel data allow us to probe dynamics in public compliance with expert recommendations. For most of the items we surveyed, experts have struck a consistent stance: avoid in-person contact and public gatherings, avoid closed spaces such as shops and keep a distance of at least two metres from other individuals. There is one exception: the usage of medical or non-medical masks.

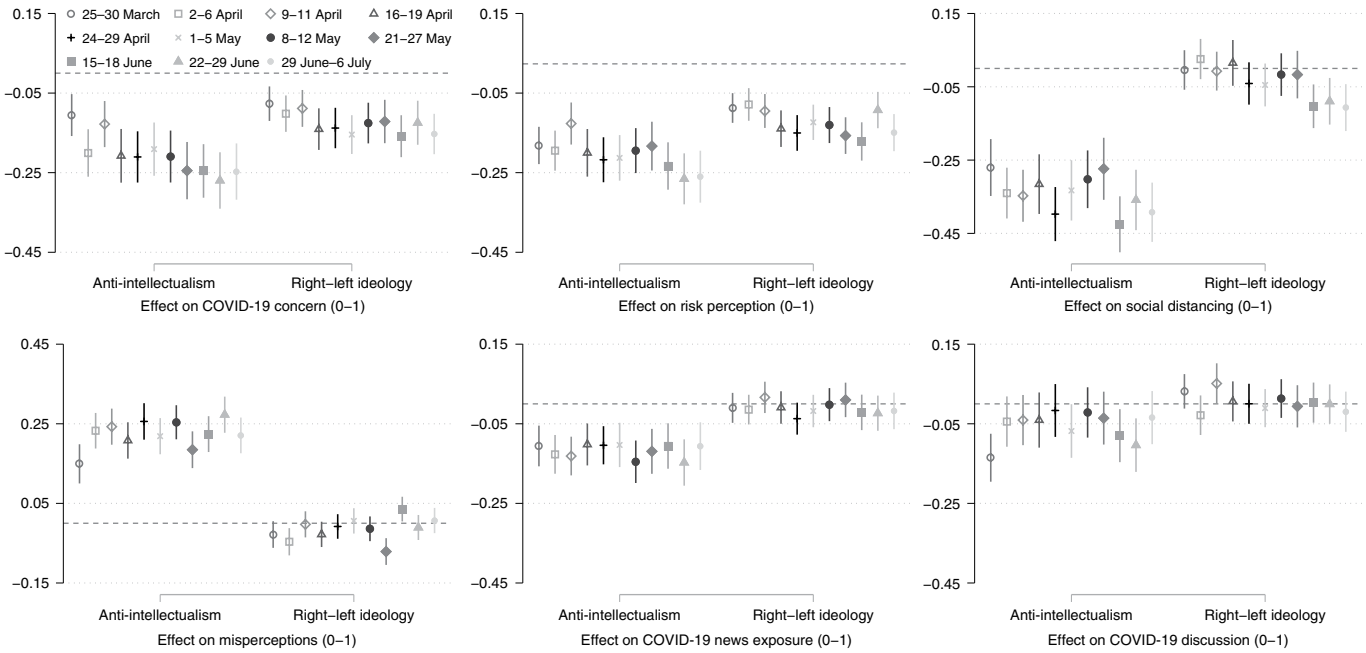

Fig. 1 | Association between anti-intellectualism and COVID-19 attitudes and self-reported behaviours. Effects of anti-intellectualism and ideology on COVID-19 concern (top left), risk perception (top centre), social distancing (top right), misperceptions (bottom left), COVID-19 news exposure (bottom centre) and COVID-19 discussion (bottom right) ($N = 25{,}074$). The 95% confidence intervals are based on heteroscedastic-robust standard errors. Controls are applied for science literacy, generalized trust, news exposure, social media exposure, political discussion, partisanship, education, age, religiosity, urban/rural, gender and region. Data are weighted within region by age and gender. Markers represent OLS regression estimates for each wave. The dashed line is at a marginal effect of zero. All variables are scaled from 0 to 1. Full regression estimates are provided in Supplementary Tables 6–11.

At the beginning of the crisis, public health officials in Canada cautioned against the use of masks by ordinary citizens because evidence had not firmly established the importance of either pre-symptomatic or asymptomatic transmission. They also feared that masks could increase the risk of transmission due to improper use and that shortages of masks for medical personnel could be triggered by the pandemic.

As experts learned more about the virus and supply problems eased, health experts changed their advice. The Centers for Disease Control and Prevention changed their advice on 2 April 2020. In Canada, the federal government's chief medical adviser, Dr. Theresa Tam, acknowledged that masks could be used as a preventative measure on 6 April 2020, but there was no official recommendation on their usage by ordinary citizens until 20 May 2020.

We expect anti-intellectualism to play an important role in shaping the dynamics of mask adoption in Canada. The mass public is generally responsive to communication from the government and political elites. Polarization occurs when predispositions afford resistance in some groups of citizens to these messages (partisanship being the classic example[28]). In this case, we expect expert messages regarding mask adoption to be accepted primarily by those who are highly trusting of experts and resisted by those with high levels of anti-intellectualism. Consequently, we expect self-reported adoption of masks to have occurred primarily among those who are highly trusting of experts. Specifically, we test the following two hypotheses using our cross-sectional study and our panel respondents:

H2A: A negative association between mask wearing and anti-intellectualism emerges and grows significantly stronger over the course of the pandemic.

H2B: Anti-intellectualism is negatively associated with within-individual changes in mask adoption.

Finally, we expect anti-intellectualism to be an important factor in COVID-19 information acquisition. A large literature has shown that anxiety triggered by national crises such as terrorist attacks and pandemics increases information seeking among ordinary citizens[29–31]. Moreover, such anxiety generates engagement with threatening information[32,33]. People tend to learn about politics from top-down communication through the news media or horizontally through their discussion networks. We see both news exposure and political discussion as important concepts in understanding information acquisition about COVID-19. They are closely correlated, but may have slightly different determinants owing to the fact that political discussion may be, at times, a less voluntary means of political information acquisition.

Nevertheless, individuals are likely to prefer news related to COVID-19 and to readily discuss this information with other people owing to the stresses created by the pandemic. This may be less true of anti-intellectuals, who feel less threatened by COVID-19 and anticipate such news to be laced with information from sources they distrust. We test this expectation in two ways. First, we evaluate whether anti-intellectualism is associated with self-reported news exposure and discussion related to COVID-19:

H3A: Anti-intellectualism is negatively associated with COVID-19 information search behaviour such as COVID-19 news exposure and discussion.

Second, we implement a conjoint design that randomizes the source and headline of profile pairs of hypothetical news articles. One limitation with the above analysis for H3A is its reliance on self-reported behaviour. People may not accurately recall their behaviour or may give socially desirable answers. Our conjoint will allow us to directly observe their information search behaviour to help mitigate this concern. We expect people to prefer COVID-19-related news profiles and to perceive these stories as more important, and that these relationships will weaken or even reverse themselves for respondents who exhibit high levels of anti-intellectual sentiment:

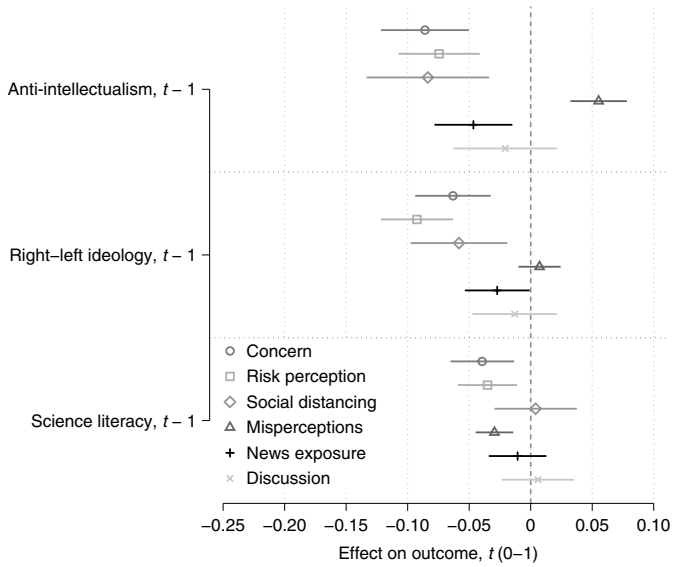

Fig. 2 | Estimated effects of lagged covariates on COVID-19 attitudes and behaviours. $N = 4{,}474$. The 95% confidence intervals are based on heteroscedastic-robust standard errors. Controls are applied for lagged outcomes, generalized trust, news exposure, social media exposure, political discussion, partisanship, education, age, religiosity, urban/rural, gender, region and contact/re-contact fixed effects. Data are weighted within region by age and gender. Markers represent OLS regression estimates. The dashed line is at a marginal effect of zero. All variables scaled from 0–1. Full regression estimates provided in Supplementary Table 12.

H3B: Anti-intellectualism moderates the effect of COVID-19 news on information selection.

H3C: Anti-intellectualism moderates the effect of COVID-19 news on perceived story importance.

A finding that anti-intellectualism structures information search about COVID-19 raises the question of why it does so. A large part of the answer is likely that anti-intellectuals are comparatively less concerned and threatened by COVID-19 because of their lack of trust in experts. However, it is also possible that anti-intellectuals are less interested in stories about COVID because they expect experts (and expertise) to be featured in such stories. Citizens gravitate towards experts in times of public health crisis[31] and thus might choose to engage with information about COVID-19 from experts. This effect should weaken as anti-intellectualism rises because anti-intellectuals see these sources as less credible. We test these expectations with a modified conjoint design where news article profiles contain randomized headlines either featuring experts or not. We expect people to prefer news profiles with headlines featuring experts and to perceive these stories as more credible, and that these relationships will weaken or even reverse themselves for respondents who exhibit high levels of anti-intellectual sentiment:

H4A: Anti-intellectualism moderates the effect of expert sources on information selection.

H4B: Anti-intellectualism moderates the effect of expert sources on perceived story credibility.

Results

Observational analyses. We begin by presenting the results of wave-by-wave cross-sectional models using COVID-19 risk perceptions, social distancing, misperceptions, COVID-19 news exposure and COVID-19 discussion as our outcome measures. Figure 1 provides the point estimates for anti-intellectualism and right–left ideology across all of our survey waves. The results show a largely consistent link between anti-intellectualism and these outcomes, after controlling for other factors. The relationship between right–left ideology and our outcomes is notably less reliable.

The estimated negative effect of anti-intellectualism (scaled 0–1) on COVID-19 concern (also scaled 0–1) increased from 0.11 ($P < 0.001$, 95% CI −0.16 to −0.05) in wave 1 to 0.25 ($P < 0.001$, 95% CI −0.32 to −0.18) in wave 11 (top-left panel), net other factors, including right–left ideology. The negative effect of right–left ideology (scaled 0–1) similarly increased from 0.08 in wave 1 to 0.15 in wave 11. We see similar results when asking citizens their perceptions of the threat posed by COVID-19 to Canadians (top-centre panel). Both anti-intellectualism and right–left ideology contribute to COVID-19 risk perceptions, and the relationship, if anything, has grown stronger over time. These results support H1A.

We see slightly different patterns when examining social distancing (top-right panel). Anti-intellectualism has been negatively associated with such self-reported behaviour from the very start of the pandemic, increasing in effect from 0.27 ($P < 0.001$, 95% CI −0.35 to −0.19) to 0.39 ($P < 0.001$, 95% CI −0.47 to −0.31) in waves 1 through 11 on the 0–1 scale. However, we find no evidence of a statistically significant association between conservative ideology and social distancing until the final three waves collected in June. These results support H1B.

A similar story is told with COVID-19 misperceptions (bottom-left panel). Anti-intellectualism is positively associated with these misperceptions, with effects ranging from 0.15 ($P < 0.001$, 95% CI 0.10 to 0.20) to 0.22 ($P < 0.001$, 95% CI 0.18 to 0.27) over the 11 waves on the 0–1 scale, providing support for H1C. We find no evidence of a consistent and statistically significant association between conservative ideology and misperceptions.

Finally, we find that anti-intellectualism is negatively associated with COVID-19 news exposure. We see consistent effects between 0.11 ($P = 0.001$, 95% CI −0.16 to −0.05) and 0.11 ($P < 0.001$, 95% CI −0.17 to −0.05) over the 11 waves on the 0–1 scale (bottom-centre panel). However, we find no consistent, statistically significant association with COVID-19 discussion (bottom-right panel). We find no statistically significant association between conservative ideology and either concept. Individuals with high levels of anti-intellectualism appear less likely to consume news about COVID-19, but we find no evidence indicating that they are less likely to talk about COVID-19 with others, in partial support of H3A.

One complication in interpreting the above findings are the threats of reverse causality and unobserved heterogeneity between respondents. It is possible that the trust people have in experts (especially towards doctors and scientists) is affected by peoples' attitudes towards COVID-19 and their willingness to engage in social distancing. We are able to exploit the panel component of our survey to reduce the threat of endogeneity and unobserved heterogeneity.

Figure 2 shows the effects of the lags of anti-intellectualism, ideology and science literacy on each of our outcomes, controlling for other lagged confounders and, importantly, the past values of the outcomes. Lagged anti-intellectualism is associated with a 0.09 lower level in COVID-19 concern ($P < 0.001$, 95% CI −0.12 to −0.05), a 0.07 point lower level in risk perceptions ($P < 0.001$, 95% CI −0.11 to −0.04), a 0.08 point lower level in social distancing ($P = 0.001$, 95% CI −0.13 to −0.03), a 0.06 point higher level in COVID-19 misperceptions ($P < 0.001$, 95% CI 0.03 to 0.08) and a 0.05 point lower level in COVID-19 news exposure in a later time period ($P = 0.004$, 95% CI −0.08 to −0.01), controlling for past values of our outcomes and confounders. This gives us some confidence that at the associations we observe between anti-intellectualism and our outcomes are not entirely due to the latter's effect on the former.

The recommendation to wear medical or non-medical face masks in public presents an interesting case because it is one in which the advice of experts clearly changed over the course of the pandemic. On 6 April 2020, health experts associated with the

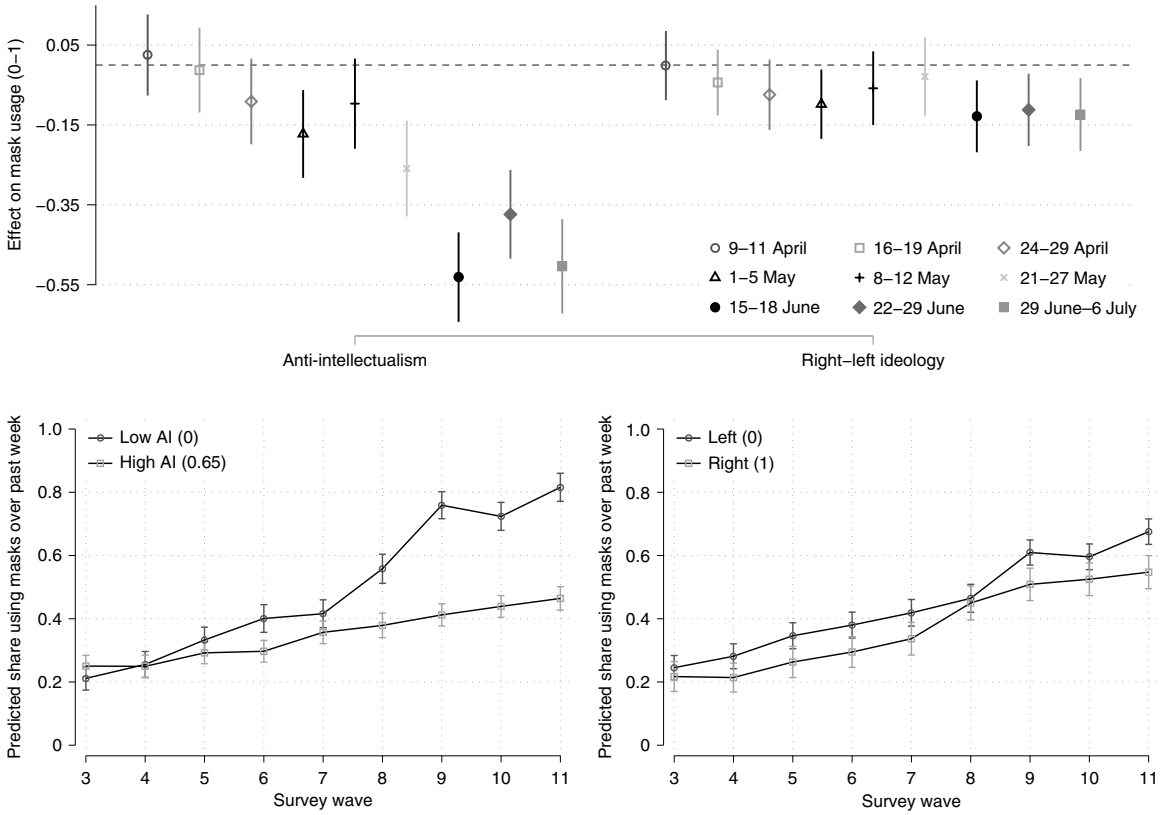

Fig. 3 | Anti-intellectualism and mask usage. Estimated effects of anti-intellectualism (AI) and right–left ideology on mask usage (top); predicted mask usage over time by levels of anti-intellectualism (bottom left) and ideology (bottom right) ($N = 20{,}579$). The 95% confidence intervals are based on robust standard errors. Controls are applied for science literacy, generalized trust, news exposure, social media exposure, political discussion, partisanship, education, age, religiosity, urban/rural, gender and region. Data are weighted within region by age and gender. In the top panel, dots represent OLS regression estimates for each wave, and the dashed line is at a marginal effect of zero. In the bottom panels, dots represent linear predictions. All variables scaled from 0–1. Full regression estimates are provided in Supplementary Table 13.

federal government noted that the use of masks could be beneficial, while they officially recommended their use on 20 May 2020.

Self-reported mask adoption increased as expert advice changed, as we would expect, but less so for those with strong anti-intellectual sentiment. The top panel of Fig. 3 shows the estimated effects of anti-intellectualism and ideology on the share of respondents wearing a mask in the past week. We find no statistically significant association between anti-intellectualism and mask usage when we began fielding the question in wave 3 (9–11 April 2020). A remarkably strong negative relationship developed as the pandemic progressed. It is associated with a 50 point reduction ($P < 0.001$, 95% CI −0.62 to −0.38) in the probability of wearing a mask over the past week as of wave 11 conducted at the beginning of July. These results provide strong support for H2A.

The bottom-left panel of Fig. 3 displays predictions of the share of respondents using masks for low and high levels of anti-intellectualism. Among those with the lowest levels of anti-intellectual sentiment, mask usage grows from 21% in wave 3 to 81% by wave 11. It rises to only 46% for those with higher levels of anti-intellectualism (0.65, 95th percentile), while at the furthest reaches of the index it does not increase at all. Resistance to adoption of masks is far stronger among those distrusting of experts. The bottom-right panel presents the same predictions for ideology, where we find no such pattern.

Our panel respondents also allow us to provide stronger causal evidence of anti-intellectualism's importance. We estimate a model predicting within-respondent changes in mask usage between the contact and re-contact periods. This allows to account for unobserved heterogeneity between respondents. The estimates are illustrated in the left panel of Fig. 4. The share of respondents using masks with the lowest possible level of anti-intellectualism increased from 21.6% (95% CI 0.17 to 0.26) to 44.4% (95% CI 0.39 to 0.50) between contact and re-contact periods, which is a 22.8 point increase ($P < 0.001$, 95% CI 0.18 to 0.28).

In contrast, mask usage only increased from 22.6% (95% CI 0.18 to 0.27) to 29.4% (95% CI 0.25 to 0.34) for respondents with high levels of anti-intellectualism, a much smaller 6.8-point increase ($P = 0.004$, 95% CI 0.02 to 0.11). Respondents at more extreme reported levels of anti-intellectualism are not expected to increase their mask usage at all, though these estimates are noisy owing to the relatively small number of respondents in that part of the distribution. In contrast, we see no evidence that ideology is significantly associated with within-respondent change in mask usage (right panel). These results strongly support H2B.

Experiment 1 analysis. In experiment 1, we find that anti-intellectualism strongly conditions news preferences in support of H3B and H3C. The marginal effects are shown in the top panels of Fig. 5. Respondents with the lowest level of anti-intellectualism were 27 points more likely to select COVID-19 news ($P < 0.001$, 95% CI 0.23 to 0.31). COVID-19 news also scored 0.26 points higher in perceived importance among these respondents on a 0–1 scale ($P < 0.001$, 95% CI 0.23 to 0.28). In both cases, causal effects weaken as anti-intellectualism rises, though it does not entirely vanish in the case of perceived importance. The interaction terms for the story selection and perceived importance models are both significant at

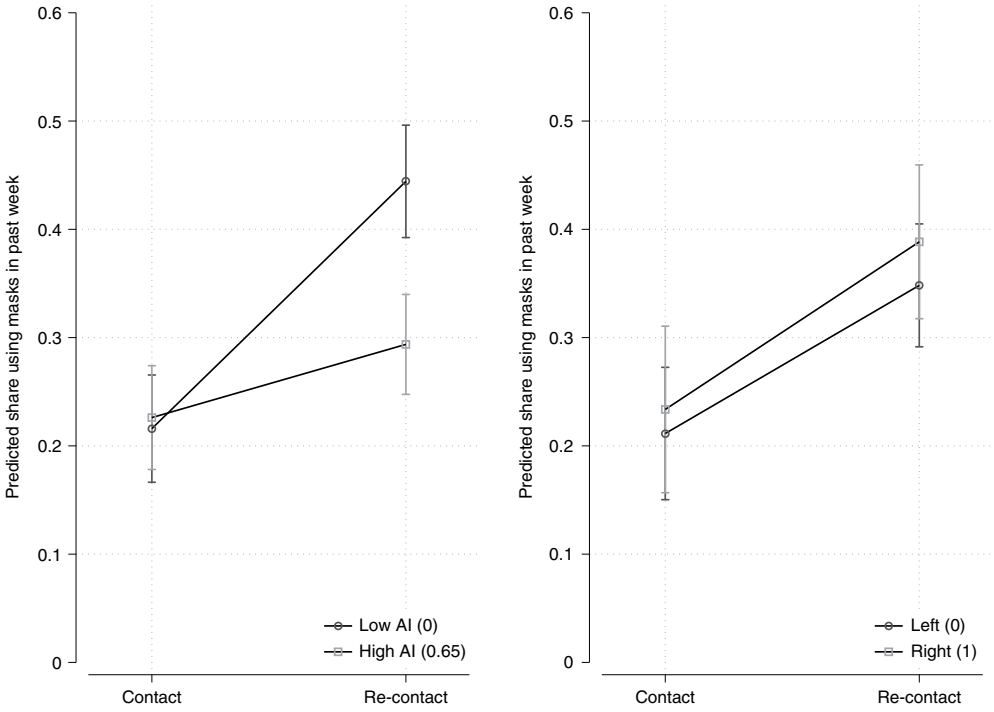

Fig. 4 | Dynamics in mask usage. Predicted level of mask usage across contact and re-contact periods by levels of anti-intellectualism (AI, left) and ideology (right) ($N = 4{,}568$). The 95% confidence intervals are based on heteroscedastic-robust standard errors. Controls are applied for science literacy, generalized trust, news exposure, social media exposure, political discussion, partisanship, education, age, religiosity, urban/rural, gender, region, and their interactions with the re-contact period. Data are weighted within region by age and gender. Full regression estimates are provided in Supplementary Table 14.

the 0.001 level. These behavioural results support our self-reported observational findings related to news exposure for H3A.

Experiment 2 analysis. We find that the effect of receiving headlines featuring experts is heterogeneous across levels of anti-intellectualism, in support of H4A. The marginal effects on story selection are shown in the bottom-left panel of Fig. 5. Respondents with the lowest levels of anti-intellectualism are 7 points more likely to select stories featuring experts than stories that do not ($P = 0.003$, 95% CI 0.02 to 0.12), but this effect disappears around 0.5 on the 0–1 scale. This interaction is statistically significant ($P = 0.047$). These are impressive effects given the simplicity of the treatment. In support of H4B, we find similar results when using credibility assessments as our outcome (bottom-right panel). Expert-featured headlines scored 0.04 points higher in perceived credibility among respondents with the lowest level of anti-intellectualism on a 0–1 scale ($P = 0.001$, 95% CI 0.02 to 0.06), an effect which disappears around 0.5 on the anti-intellectualism index. The interaction term itself is statistically significant ($P = 0.036$).

Discussion

The inability of society to cope with a warming climate has gradually drawn scholarly attention to understanding the conditions under which citizens seek out and engage with advice from experts. The COVID-19 pandemic has brought this topic to the forefront with sudden urgency: people's lives are at risk if citizens do not take seriously the advice of experts to wear masks and socially distance. Research to date, especially from the United States, has rightly pointed a finger at ideology and partisanship for undermining public compliance with health guidelines. The evidence we provide here consistently shows that anti-intellectualism matters in its own right and not simply as an outgrowth of ideological conservatism.

We find that anti-intellectualism is associated with lower levels of COVID-19 concern, risk perception, and social distancing compliance, as well as higher levels of misperceptions about COVID-19 (H1). Our data allow us to show that this has been consistently the case since the early days of the pandemic, while our panel respondents provide us some measure of confidence in saying that these associations are not simply the product of COVID-19 attitudes altering people's trust in expert communities.

Moreover, anti-intellectualism appears to be related to behavioural change as communication from experts evolved. Public health experts changed their advice on the efficacy of masks during the pandemic. At the same time, we see a growing association between anti-intellectualism and mask usage (H2A) and evidence of a strong negative association between anti-intellectualism and within-respondent changes in mask usage (H2B). Self-reported mask adoption occurred far more rapidly among those who are highly trusting of experts.

Finally, anti-intellectualism is associated with less information acquisition related to COVID-19, at least on some dimensions. Anti-intellectualism is associated with less self-reported COVID-19 news exposure, though not COVID-19 discussion (H3A), and experimentally we show that observed preferences for COVID-19 news (H3B) and for expert information about COVID-19 (H4A) are lower for those with higher levels of anti-intellectual sentiment. These behavioural observations provide independent confirmation of our findings on self-reported news exposure for H3A.

There is one important caveat: we find no evidence that anti-intellectuals avoid expert information or COVID-19 news. This is consistent with previous work demonstrating that individuals select congenial information, but do not necessarily avoid dissonant information[34]. The upshot is that anti-intellectuals are less likely not only to accept expert information, but also to opt into important streams of information about COVID-19 compared with more trusting individuals, even if they do not explicitly avoid such information.

These findings provide important insight into how the mass public responds to public health recommendations and national

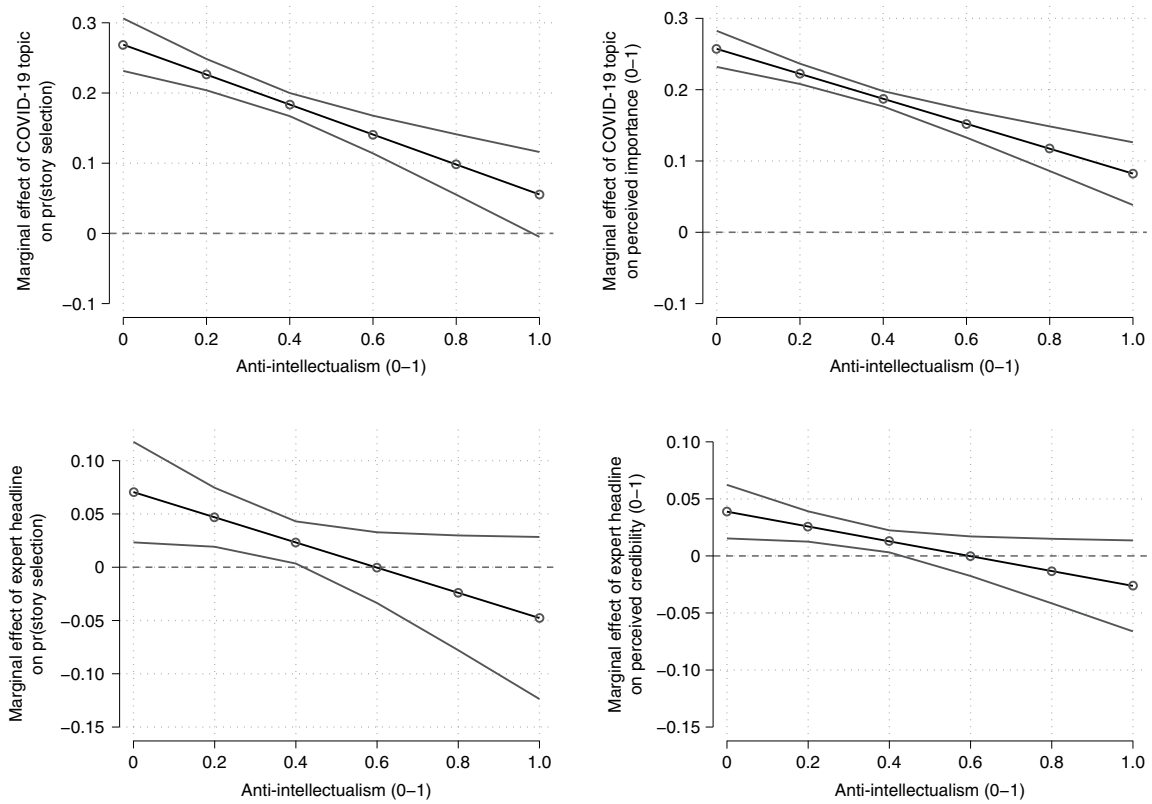

Fig. 5 | Estimated treatment effects across reported levels of anti-intellectualism. Marginal effects of COVID-19 news on story selection (experiment 1, $N = 15{,}054$; top left) and perceived importance (experiment 1, $N = 15{,}054$; top right) as well as the marginal effects of expert featured headline on story selection (experiment 2, $N = 10{,}016$; bottom left) and perceived credibility (experiment 2, $N = 10{,}016$; bottom right). The 95% confidence intervals are based on cluster-robust standard errors. The dashed line is at a marginal effect of zero. Data are weighted within region by age and gender. Models include effects of source, author (experiment 1 only) and date (experiment 1 only) and controls for ideology, cognitive sophistication, conspiratorial thinking, age, and rural/urban residence and their interactions with the treatment. Full regression estimates can be found in Supplementary Tables 17 and 18. Comparisons of exploratory and pre-registered replications can be found in Supplementary Tables 2 and 3 and Supplementary Figs. 2 and 3.

crises more broadly. Previous work has shown that citizens gravitate towards government officials and experts as a result of the stresses produced by national crises[32]. And indeed, there is evidence that the COVID-19 pandemic has produced a rally effect for incumbent governments[35]. We might think that predispositions such as anti-intellectualism, partisanship or ideology matter less in these circumstances, but this does not appear to be the case. People who are highly distrusting of experts are not simply willing to put aside their distrust of these sources to resolve the crisis and return to normalcy. Relaying information from experts is unlikely to be of use in persuading these individuals, even in times of crisis. Other communication strategies are needed.

Our study has important limitations. Most crucially, we cannot randomly assign anti-intellectualism, so we are limited in our ability to definitively attribute our effects to anti-intellectualism, rather than another closely related construct. However, a few points mitigate this concern. First, our panel analyses allow us to lessen the threat of endogeneity. It is possible that people's reactions to the unfolding crisis affect their trust in doctors and scientists. By controlling for past values on our outcomes, we can minimize the threat this poses to our inferences. Second, we are able to examine how the relationship between anti-intellectualism and outcomes respond to exogenous changes, such as expert recommendations regarding masks or our randomized headlines, which reduces the likelihood that either omitted variables or endogeneity bias our inferences.

We also note that our data come from Canada. We must be careful in generalizing to other contexts. However, we believe our particular case is advantageous. Canada lacks the polarized, elite debate on COVID-19 that is found in the United States[17]. We see the Canadian case as more closely resembling what is found in other established democracies struggling to contain the pandemic. Consequently, we fully expect these findings to travel, although we suspect that partisanship and ideology matter more (relative to anti-intellectualism) in the United States. More cross-national comparative research needs to be done to examine the determinants of COVID-19 attitudes and behaviours across different political contexts.

There are also some limitations to the experimental approach we use here. Individuals do not make decisions about which news to consume in a manner similar to an artificial survey task. That being said, the source and headline are two of the most visible components of a news story that drive engagement. In the case of experiment 2, we have reason to expect that our results are conservative. All of our headlines feature topics that are likely to make heavy use of experts whether or not they are mentioned in the headline, which may not have been lost on many respondents.

There is a strong association between anti-intellectualism and a wide range of COVID-19 attitudes and self-reported behaviours. Anti-intellectualism is also related to the public's dynamic response to expert advice and their information search behaviour. All of these effects rival, if not exceed, the effects of ideological conservatism. The implications are considerable: we cannot take trust in experts for granted. To improve public compliance with health directives, science communicators, journalists and practitioners need to use a wider variety of trusted messengers to reinforce the messages of

public health experts. Anti-intellectualism appears to be a central predisposition governing the response of citizens to the COVID-19 pandemic and is deserving of further research in other contexts.

Methods

Our research was approved by the University of Toronto Social Sciences, Humanities and Education Research Ethics Board (protocol no. 38251). Informed consent was provided by the participants. We surveyed 27,615 Canadian citizens 18 years and older from 25 March to 6 July 2020 using the online survey sample provider Dynata. This survey was fielded in 11 waves over that period ($N \sim 2{,}500$ per wave). Respondents were paid a nominal fee for participating by Dynata. Sample sizes were chosen based on imperatives for the broader Media Ecosystem Observatory project, rather than for this study in particular. Nonetheless, our large sample sizes give us the power to observe small effects with a high degree of confidence.

A total of 2,576 individuals were excluded for being non-citizens, being under the age of 18 years, completing the survey in under one-third of the estimated time, for straight-lining three or more matrix questions or for being duplicates (the second response of a duplicate respondent ID was dropped). These exclusion criteria were set in advance to ensure data quality for the Media Ecosystem Observatory project and not for reasons to do with this specific research project. These criteria were also applied to the panel data and to the survey waves containing the conjoint experiments.

National-level quotas were set for each wave on gender, age, language and region (Atlantic, Quebec, Ontario and West) to ensure their representativeness. Of the sample, 51% is female, while the mean age is 48 years. We further weight our data within region by age and gender in our analyses. We used an iterative proportional fitting algorithm to construct our weights with a maximum of 2.62 ($N=29$) and a minimum of 0.65 ($N=111$).

Approximately half of the sample for waves 5–8 were re-contacts of respondents in the first four waves ($N=4{,}910$). The fielding dates for each wave are presented in Supplementary Table 15. Note that wave 1 was conducted in English only, thus Quebec was under-sampled. Direct comparisons of the results of wave 1 with later waves should be treated with caution.

Measuring anti-intellectualism. We measure anti-intellectualism with an index based on questions asking respondents to evaluate their level of trust ('trust a lot' to 'distrust a lot', five-point) in different groups of experts: doctors, scientists, economists, professors and experts (following ref. [7]). We also ask respondents about their trust in the Public Health Agency of Canada (a close equivalent to the Centres for Disease Control and Prevention), which is an independent government agency that has been at the forefront of Canada's COVID-19 response. We construct an index of anti-intellectualism using the extracted factor from a confirmatory factor analysis estimated with GSEM in Stata (version 16) and re-scale it from 0–1, where 1 represents someone with the highest possible level of anti-intellectualism. Results for our analyses are robust to using only the trust in scientists and doctors items of the index (Supplementary Figs. 4–7). Future work should map out the relationship between trust in scientists and doctors and the broader concept of anti-intellectualism.

The left panel of Supplementary Fig. 8 shows the distribution of anti-intellectualism among our respondents. Most Canadians have low levels of anti-intellectualism (mean 0.36, s.d. 0.18). About a quarter of our respondents have middling trust in experts or worse (0.47 or greater), while only 10% of our sample lies beyond 0.59. The pandemic may have increased trust in experts because of the active role they play in mitigating its threat. However, as shown in the right panel of Supplementary Fig. 8, trust in each group of experts and our index have remained relatively steady, at least over the course of our sampling (starting on 25 March 2020).

Our panel respondents (not shown in Supplementary Fig. 8) reported significant but substantively small decreases in the share of respondents trusting doctors (−0.02, $P=0.005$, 95% CI −0.03 to −0.00), scientists (−0.02, $P=0.004$, 95% CI −0.03 to −0.00), professors (−0.02, $P=0.012$, 95% CI −0.03 to −0.00) and the Public Health Agency of Canada (−0.03, $P<0.001$, 95% CI −0.04 to −0.02), though not at statistically significantly levels for trust in generic experts ($P=0.925$) and economists ($P=0.986$). We see a very slight increase in our anti-intellectualism index as a result of these changes (0.01, $P=0.001$, 95% CI 0.00 to 0.01).

We do not take these declines in trust as evidence that the pandemic is reducing trust in experts. We began our survey a few weeks after the start of the crisis. We may have missed a spike in trust in experts precipitated by the crisis, which is slowly regressing back to the mean as the crisis wears on. Further, we find no evidence that the notable reversal in expert advice on mask wearing produced changes in respondent trust in experts or their overall level of anti-intellectualism. We see no significant difference in trust between respondents surveyed before and after the CDC announcement in April 2020 and the PHAC announcement in May after controlling for trending. These analyses can be found in Supplementary Tables 4 and 5. Anti-intellectualism and the trust people have in expert communities appears rather stable, even during a salient, rapidly unfolding crisis.

COVID-19 attitudes and behaviours. We evaluate risk perceptions by asking respondents their level of concern about the coronavirus ('very' to 'not at all', four-point) and how serious of a threat they perceived COVID-19 to be for other Canadians ('very' to 'not at all', four-point). The averages across waves are shown in the top-left panel of Supplementary Fig. 9. The panel illustrates a modest decline in COVID-19 concern and risk perceptions.

We measure social distancing by asking respondents whether they have engaged in the following actions over the past week in response to the pandemic (1 = 'yes'): (1) avoided in-person contact from friends, family and acquaintances, (2) kept a distance of at least 2 m from others, (3) avoided bars, restaurants and crowds and (4) avoided domestic travel. We construct an additive index of social distancing from these items, scaled from 0–1. We also ask the same of their mask usage over the past week, which enters our survey during wave 3, fielded from 9–11 April 2020. The top-right panel of Supplementary Fig. 9 shows that social distancing has declined somewhat, while mask usage is on the sharp rise.

Misperceptions are measured with a battery of questions asking respondents to rate the truthfulness of the following claims ('definitely false' to 'definitely true', five-point):

- The coronavirus is no worse than the seasonal flu;
- Drinking water every 15 min will help prevent the coronavirus;
- The Chinese government developed the coronavirus as a bioweapon;
- Homoeopathy and home remedies can help manage and prevent the coronavirus;
- The coronavirus was caused by the consumption of bats in China;
- The coronavirus will go away by the summer;
- Vitamin C can ward off the coronavirus;
- There is a vaccine for the coronavirus that national governments and pharmaceutical companies won't release;
- High temperatures, such as from saunas and hair dryers, can kill the coronavirus

We construct an additive index with these items, scaled from 0–1. The bottom-right panel of Supplementary Fig. 9 shows that endorsement of these misperceptions has remained largely stable.

Finally, COVID-19 information search behaviour is evaluated by asking respondents how often they read, listened to or watched news related to the COVID-19 pandemic over the past week ('several times a day' to 'never', six-point) and how often they discussed the COVID-19 pandemic with friends, family or acquaintances ('daily' to 'never', five-point). The bottom-right panel of Supplementary Fig. 9 shows that self-reported COVID-19 news exposure discussion has been on the steady decline.

Controls. We control for science literacy with an additive 0–1 index constructed from a seven-item battery taken from the American National Election Study. Cognitive sophistication and awareness of science-related issues may be associated with both anti-intellectualism and our outcome measures[4]. Our anti-intellectualism measure is based on a battery of trust items, so we control for generalized trust in people as well.

We also control for right–left ideology with an additive index constructed from a battery of policy questions where we coded responses as either right wing, left wing or neutral. Ideological conservatism is one of several sources of anti-intellectualism[4]. However, it can also exhibit effects on COVID-19 attitudes and behaviours for unrelated reasons, such as through aversion to the policy consequences of dealing with the pandemic. Furthermore, a central argument of this paper is that anti-intellectualism is more than a simple extension of conservative ideology and has important effects in its own right, so we include ideology as a control. The estimates of anti-intellectualism are then interpreted as its effect on each outcome for reasons unrelated to its causal relationship with ideology, and vice versa.

We control for partisanship because political leaders have been another source of communication about the COVID-19 pandemic[16], as well as a standard suite of demographic and non-demographic characteristics: political news exposure, social media usage, education, age, urban/rural residence, religiosity, gender and region. More information on our measures can be found in Supplementary Table 1.

Models. We test our first hypothesis by estimating the following model for each outcome measure and each wave separately in our survey, where $\mathbf{X}$ is a vector of control variables:

$$\text{outcome}_i = \alpha + \beta_1 \text{anti-intellectualism}_i + \beta \mathbf{X}_i + \varepsilon_i$$

We expect the coefficient on β_1 to be negative and significant for each outcome aside from misperceptions (which we expect to be positive) in support of H1 and H3A. We have no expectations about changes in the strength of the coefficient over the course of the pandemic for these items since we did not begin fielding this survey until late March 2020. We estimate all of our observational models with robust standard errors to account for heteroscedasticity. Our models otherwise meet the assumptions of ordinary least-squares (OLS) regression. All of the tests we present are two tailed. Model estimates can be found in Supplementary Tables 6–11.

Endogeneity is a potential problem: it is possible that people's reactions to COVID-19 shape their trust in expert communities. We address this

issue by leveraging the panel component of our survey. We expect the lag of anti-intellectualism to be associated with the outcome measures controlling for their past values and other lagged confounders. We also control for the particular pairing of contact and re-contact waves for our respondents (c). Our initial contacts occurred through the first four waves of the survey, and were gradually re-contacted over the following four waves. We therefore account for any independent effect of any particular pairing of contact and re-contact wave on our outcomes. Our estimates are then of the effect within these pairings:

$$\text{outcome}_{it} = \alpha + \beta_1 \text{anti-intellectualism}_{it-1} + \beta_2 \text{outcome}_{it-1} + \beta \mathbf{X}_{it-1} + c_i + \varepsilon_{it}$$

Again, in support of H1 and H3A, we expect the coefficient on β_1 to be negative and significant for each outcome aside from misperceptions. Model estimates can be found in Supplementary Table 12. Unlike for our other outcome measures, we have expectations of a relationship between anti-intellectualism and within-respondent change in mask usage. First, we estimate a series of cross-sectional models for each wave where we predict mask usage with anti-intellectualism and our controls.

$$\text{pr}(\text{mask})_i = \alpha + \beta_1 \text{anti-intellectualism}_i + \beta \mathbf{X}_i + \varepsilon_i$$

We expect a negative coefficient on β_1 that increases in magnitude over the course of the pandemic in support of H2A. This will show us descriptively that the effect of anti-intellectualism has grown over the course of sampling after controlling for confounders. Model estimates can be found in Supplementary Table 13.

Second, we again leverage the panel component of our survey to provide stronger causal evidence of anti-intellectualism's effect on changes in mask usage. Including a lagged dependent variable in a model is insufficient to provide evidence of relationships between explanatory variables and within-respondent change[36,37]. We instead evaluate whether within-respondent change between the contact and re-contact periods was weaker for anti-intellectuals, controlling for the dynamic effects of other confounders ($\mathbf{X}$). We include respondent-level fixed effects to eliminate between-respondent variation ($\mathbf{v}$) and ensure that our inferences are robust to the existence of time-invariant confounders with constant effects:

$$\begin{aligned}\text{pr}(\text{mask})_{it} = {} & \alpha + \beta_1 \text{anti-intellectualism}_{it} + \beta_2 \text{recontact}_t \\ & + \beta_3 \text{anti-intellectualism}_{it} \cdot \text{recontact}_t + \beta \mathbf{X}_{it} \\ & + \beta \mathbf{X}_{it} \times \text{recontact}_t + \nu_i + \varepsilon_{it}\end{aligned}$$

We expect the coefficient on β_3 to be negative and significant to support H2B. We present predicted effects of both anti-intellectualism and ideology for comparison. Model estimates can be found in Supplementary Table 14.

Experiment 1. Experiment 1 was conducted in wave 7 (8–12 May 2020) of our survey with a sample of 2,509 Canadian citizens, 18 years and older. National-level quotas were set on region, age, gender and language based on the 2016 Canadian census. Of the sample, 51.5% is female, and the mean age is 48 years. Data are weighted within each region of Canada by gender and age. More detailed sample characteristics for the surveys of both experimental studies can be found in Supplementary Table 16.

We expose respondents to three pairs of news story profiles in this study. We made no indication that these profiles were of real news stories. They were asked to choose the news story they would be most likely to read from each pair and were also asked to evaluate the importance of each story ('very', 'somewhat', 'not very' or 'not at all', re-scaled 0–1).

Each article was randomized across eight outlets in four different groups. Our first group is 'national news', which includes *CTV News* and the *Globe and Mail* (*TVA-Nouvelles* or *La Presse* for French-language respondents). Our second group is 'local news', which includes reference to their local television station or local newspaper. Our third group is 'right-congenial news', which includes *Rebel Media* and *True North News*. Our final group is 'left-congenial news', which includes the *National Observer* and *Rabble.ca*. The classification of left- and right-congenial news was taken from Owen et al. (2020, https://ppforum.ca/articles/lessons-in-resilience-canadas-digital-media-ecosystem-and-the-2019-election/), who classified Canadian news sources based on whether they were selectively shared or followed by partisans on social media.

Attributes that indicated the author (male versus female) and date (6 May, 29 April, 22 April and 15 April 2020) of the story were also each randomized independently of other factors. We are not interested theoretically in these randomizations, but they were included to maximize the realism of the task at hand. When people are making a choice of which news stories to read in the real world, these four characteristics are the first to be apparent.

Our attribute of theoretical interest is the headline. They were randomized so that respondents would either get a headline related to the health impacts of COVID-19 or one that was not. We selected our headlines by using *Lexis Uni* to download all newspaper headlines from the *Toronto Star* and *Globe and Mail* between 30 April and 6 May 2020 ($N = 719$). We did a keyword search for headlines with 'coronavirus' or 'COVID-19'. We randomly assigned numbers to headlines with and without the keywords and chose the first randomly identified 15 headlines in each category that we manually verified as either being about COVID-19 health impacts or not. This left us with 30 headlines, a list of which can be found in the Supplementary Information. An example of the conjoint task is shown in Supplementary Fig. 1. Data collection and analysis were not performed blind to the conditions of the experiments.

We expect respondents to prefer to read news about COVID-19 health impacts and to perceive these stories as more important, while these effects weaken as anti-intellectualism rises (H3B and H3C). We thus estimate models that predict story selection and perceived importance with the category of source (national, local, right-congenial and left-congenial), headline type (COVID-19 related or not), author gender, article date and an interaction between headline type and anti-intellectualism.

It is possible that there are heterogeneous effects across anti-intellectualism because of its correlation with other traits that may also moderate the treatment effect. We control for the interaction of our treatment with left–right ideology, cognitive sophistication (a combined index of science literacy and need for cognition, following ref. [17]), conspiratorial thinking (following ref. [13]), age and urban density, denoted by $\mathbf{X}$ below. We cluster standard errors by respondent. The full regression estimates can be found in Supplementary Table 17.

After this exploratory study, we pre-registered our hypotheses and conducted a successful replication. The pre-registration for experiment 1's replication can be found at https://osf.io/r4gqz. A comparison of the exploratory experiment and its replication can be found in Supplementary Table 2 and Supplementary Fig. 2.

$$\begin{aligned}\text{outcome}_i = {} & \alpha + \beta_1 \text{COVID19 news}_i + \beta_2 \text{anti-intellectualism}_i \\ & + \beta_3 \text{COVID19 news}_i \cdot \text{anti-intellectualism}_i + \beta_4 \text{local}_i \\ & + \beta_5 \text{right-congenial}_i + \beta_6 \text{left-congenial}_i \\ & + \beta_7 \text{male}_i + \beta_8 \text{April 29}_i + \beta_9 \text{April 22}_i \\ & + \beta_{10} \text{April 15}_i + \beta \mathbf{X}_i + \beta \mathbf{X}_i \times \text{COVID19 news}_i + \varepsilon_i\end{aligned}$$

Experiment 2. We conducted experiment 2 in wave 6 (1–4 May 2020) of our survey with a sample of 2,504 Canadian citizens, 18 years and older. National-level quotas were again set on region, age, gender and language based on the 2016 Canadian census. Of the sample, 51.6% is female, with a mean age of 48 years. Data are weighted within each region of Canada by gender and age.

We use a modified conjoint design for this study. We expose our respondents to two pairs of news story profiles that indicate their source, headline, author and date. The author and date were fixed for each profile, but source and headline remained randomized. They were asked to choose the news story they would be most likely to read from each pair and were also asked to evaluate the credibility of each story ('very', 'somewhat', 'not very' or 'not at all', re-scaled 0–1). Data collection and analysis were not performed blind to the conditions of the experiments.

Crucially, we randomized the headline so that some people received headlines containing a signal that the story would contain information from experts, while others received headlines that had no such indication. All headlines were taken from actual Canadian news stories in April 2020 that featured experts in the headline. We did not allow the headlines to freely vary across all four profiles. Instead, each profile contained one of the following headlines that was randomized to either include the expert signal or not to maximize experimental control. This approach gives us certainty that the only difference between treatment and control is the expert cue, and that respondents will not be exposed to both the expert and non-expert version of the same headline:

- 'Remain on guard' to keep surfaces clean of coronavirus[, experts say]
- Time for a Canada-wide standard on social gatherings[, experts urge]
- Broad coronavirus testing crucial in lifting restrictions[- experts]
- Look beyond the buzz on virus 'discoveries'; [Experts warn] research on treating COVID-19 is still in very early days

We use the term 'expert' in this manipulation because it is a generic term often used by journalists to describe a wide range of experts, including doctors and scientists[38]. We believe that using this abstraction is useful to ensure that the effects we observe are primarily a result of anti-intellectualism on story selection and perceived credibility, rather than feelings towards a specific group of experts. This design choice probably makes our estimates more conservative. Further, 'expert' was the term actually used by the authors of these headlines.

Our expectation is that respondents will be more likely to select news stories with headlines that feature experts and to perceive these stories as more credible, while these effects disappear among those with higher levels of anti-intellectual sentiment (H4A and H4B).

We thus estimate models that predict story selection and perceived credibility with the category of source (national, local, right-congenial or left-congenial), headline type (expert featured or not), an interaction between headline type and anti-intellectualism and interactions between the controls and headline type. The estimation strategy is the same as in experiment 1, with the exception that

we control for profile fixed effects (p). Regression estimates can be found in Supplementary Table 18.

After this exploratory study, we pre-registered our hypotheses and conducted a successful replication. The pre-registration for experiment 2's replication can be found at https://osf.io/t6xz8. A comparison of the experiment and its replication can be found in Supplementary Table 3 and Supplementary Fig. 3.

$$\begin{aligned}\text{outcome}_i = {} & \alpha + \beta_1 \text{expert}_i + \beta_2 \text{anti-intellectualism}_i \\ & + \beta_3 \text{expert}_i \cdot \text{anti-intellectualism}_i + \beta_4 \text{local}_i + \beta_5 \text{right-congenial}_i \\ & + \beta_6 \text{left-congenial}_i + \beta \mathbf{X}_i \\ & + \beta \mathbf{X}_i \times \text{expert}_i + p_i + \varepsilon_i\end{aligned}$$

Reporting Summary. Further information on research design is available in the Nature Research Reporting Summary linked to this article.

Data availability

Datasets analysed for the current study are available at the Open Science Foundation repository at https://osf.io/pqhju/.

Coding availability

Code used to analyse data for the current study are available at the Open Science Foundation repository at https://osf.io/pqhju/.

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Author contributions

E.M. contributed to the study design, data collection and analysis, as well as the drafting of the manuscript. P.J.L. contributed to the sampling design, acquisition of the data and the drafting of the manuscript.

Competing interests

The authors declare no competing interests.

Additional information

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Correspondence and requests for materials should be addressed to E.M.

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Corresponding author(s): Eric Merkley

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Our web collection on statistics for biologists contains articles on many of the points above.

Software and code

Policy information about availability of computer code

Data collection	Survey responses were collected using the Qualtrics survey platform.
Data analysis	Data was analyzed with Stata version 16. Replication code can be found at the Open Science Foundation repository at https://osf.io/pqhju/

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Behavioural & social sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	The manuscript includes a quantitative cross-sectional study, a quantitative panel study, and two quantitative experimental studies.
Research sample	Respondents were part of an online panel maintained by the sample provider Dynata. Participants had to be Canadian citizens and 18 years of age or older. Each sample cohort is representative of the Canadian population by age, gender, language, and region due to the use of quotas. 51% are female, 27% are between 18-34, 34% are between 35-54, and 40% are 55 and older. 7% live in the Atlantic provinces, 22% in Quebec, 39% in Ontario , and 32% in the West. 19% are French Canadian. The sample provider was chosen as a cost-effective means of gathering representative samples of the Canadian population over the course of the COVID-19 pandemic.
Sampling strategy	Respondents were sampled from an online panel maintained by the sample provider Dynata. Quotas were set for each sample cohort on age (18-34, 35-54, 55+), gender, region (Atlantic, Quebec, Ontario, West), and language (French, English) based on the 2016 Canadian census and respondents were filtered out of the collection once requisite quotas were met. Weekly cohort sample sizes were set by the research team for projects unrelated to this manuscript.
Data collection	The respondents completed the survey online through the Qualtrics survey platform. Researchers were not blind to experimental condition, but respondents were. Informed consent was received from participants
Timing	March 25-30, 2020; April 2-6, 2020; April 9-11, 2020; April 16-19, 2020; April 24-29, 2020; May 1-5, 2020; May 8-12, 2020; May 21-27, 2020; June 15-18, 2020; June 22-29, 2020; June 29-July 6, 2020
Data exclusions	2,576 respondents were excluded for being non-citizens, being under the age of 18, completing the survey in under 1/3 of the estimated time, for straight-lining three or more matrix questions, or for being duplicates (the second response of a duplicate respondent ID was dropped). These exclusion criteria were set in advance for unrelated projects.
Non-participation	14,537 respondents failed to complete the survey or were filtered out of the survey when quotas were exceeded
Randomization	Respondents were randomly assigned into treatment conditions for the experiments.

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☒	☐ Clinical data
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Methods

n/a	Involved in the study
☒	☐ ChIP-seq
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Policy information about studies involving human research participants

Population characteristics	See above.
Recruitment	Respondents were participants of an online panel maintained by the sample provider Dynata. They are paid a nominal fee for participation in surveys. Online panels have been shown to be generally representative of the general population, though the sample is skewed toward respondents who are more frequent users of the Internet.

Ethics oversight	University of Toronto Social Sciences, Humanities, and Education Research Ethics Board

Note that full information on the approval of the study protocol must also be provided in the manuscript.