

Belief in Science and Beliefs about COVID-19: Educational Gradients

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Abstract

Prior research has attributed the socio-economic disparity in COVID-19 infections to differences in degrees of exposure or economic resources. This study proposes beliefs about COVID-19 as a potential additional explanation. We conducted a nationally representative US survey with six measures of COVID-19 beliefs. Socio-economic status was measured through educational level. Compared with less-educated respondents, highly educated respondents treat COVID-19 more seriously, including believing in (1) face mask use, (2) asymptomatic transmission, (3) media non-exaggeration, (4) the necessity of stay-at-home orders, (5) a likelihood of themselves being infected with COVID-19 and (6) no protection of God against COVID-19. The educational gradient in COVID-19 beliefs was largely explained by differential levels of belief in science across education. Our findings suggest that encouraging public trust in science can potentially reduce the educational gradient in COVID-19 infections in the USA.

Keywords

belief in science, beliefs about COVID-19, COVID-19, COVID-19 beliefs, education, United States

Introduction

Confirmed cases of COVID-19 have surpassed 400 million globally as of 17 February 2022. Thus far, the United States has accumulated over 78 million infections (Johns

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Hopkins Coronavirus Resource Center, n.d.). Social groups in the USA, however, are not being equally affected. Low socio-economic status (SES) is found to be a risk factor for COVID-19 (Abedi et al., 2021; Drefahl et al., 2020). Existing research has mostly attributed the unequal health impact of the pandemic to inequalities in economic resources or COVID-19 exposure through employment (e.g. Baker et al., 2020; Burstrom and Tao, 2020; Dorn et al., 2020). Advancing prior research, we propose beliefs about COVID-19 as a potential additional explanation.

The USA is unique among western developed nations in that a large proportion of its citizens, especially those who are less educated, do not trust science (American Academy of Arts and Sciences, 2018). For instance, according to a cross-national study published in *Science*, over 30% of American adults thought that evolution was ‘definitely false’, compared to 7–15% in European countries (Miller et al., 2006). Distrust of science leads to a poor understanding of COVID-19 and thus to behaviours that increase vulnerability to contracting the disease (Galasso et al., 2020). Encouraging public trust in science therefore has the potential to reduce the educational gradient in COVID-19 infections in the USA.

Data and Method

In May 2020, we conducted a nationally representative survey of 2523 adults through Ipsos KnowledgePanel, a probability-based web panel representative of US adults. After excluding 93 observations (3.7%) with missing data on the variables used, our analytical sample consisted of 2430 respondents.

We measured COVID-19 beliefs with a scale derived from six questions. Four questions asked respondents to indicate whether they strongly agreed, agreed, disagreed or strongly disagreed with the following statements: (1) I might become infected with COVID-19 if I don’t wear a mask in public; (2) God protects us from COVID-19; (3) COVID-19 might be spread by people who are not showing symptoms; (4) The health risks posed by COVID-19 are exaggerated in the news media. One question asked respondents to rate on a 1–5 scale the necessity of stay-at-home orders in combating COVID-19 (1 = not necessary at all; 5 = very necessary). Another question asked respondents to assess their chances of getting COVID-19 in the next three months (not at all likely, not very likely, somewhat likely and very likely).

We constructed a composite scale, ‘COVID-19 beliefs’, using the six items, because they serve as indicators of a single latent construct in a factor analysis (Eigenvalue = 1.83). To do this, we first re-scaled the item relating to stay-at-home orders, so that all items ranged from 1 to 4 and were weighed equally on the scale (Fan and Qian, 2015). We then consistently coded all items, with higher scores indicating that respondents treated COVID-19 more seriously. Lastly, we calculated the average score across the six items (Cronbach’s $\alpha = 0.69$). This composite scale preserves the scale metric of the items, thereby allowing for easier interpretation (DiStefano et al., 2009).

As a key dimension of SES (Fischer and Hout, 2006; Hout, 2012), educational level was measured through four categories: less than high school, high school, some college and bachelor’s degree or above. Belief in science was measured through two questions adapted from existing research (Funk et al., 2019; Newport, 2009): (1) How much confidence, if any, do you have in scientists to act in the best interest of the public? (1 = no

confidence at all, 2 = not too much confidence, 3 = a fair amount of confidence, 4 = a great deal of confidence); (2) Do you, personally, believe in the theory of evolution? (believe in evolution, do not believe in evolution, no opinion either way). Higher levels of confidence in scientists and higher levels of acceptance of evolution are indicators of greater belief in science (Funk et al., 2019; Miller et al., 2006).

Covariates included gender (0 = male, 1 = female), age and its squared term, race (non-Hispanic white, non-Hispanic black, Hispanic, other), employment (not working, mainly working remotely, mainly working onsite), marital status (married, cohabiting, never married, previously married), the four census regions of residence (Northeast, Midwest, South, West), adjusted household income (household income divided by the square root of household size), self-rated health (ranging from 1 = poor to 5 = excellent) and whether respondent's family or acquaintances had been infected with COVID-19 (0 = no, 1 = yes).

Conceptually, this study aims to evaluate whether belief in science mediates the relationship between educational level and beliefs about COVID-19. Guided by this conceptual framework, we conducted ordinary least squares (OLS) analyses (using the statistical software Stata, version 16.1). We examine the educational gradient in COVID-19 beliefs, excluding and then including belief in science, while holding other covariates constant. We further test whether belief in science significantly accounts for the educational gradient in COVID-19 beliefs (with the command *suest* in Stata). We applied weights to all analyses (with the commands *svyset* and *svy* in Stata).

Descriptive Results

Figure 1 presents the mean values of both the component measures and the composite measure of COVID-19 beliefs by educational level. The upward lines, across all measures of COVID-19 beliefs, indicate that highly educated people tended to treat COVID-19 more seriously than the less educated. Overall, the mean of the composite scale is lowest for people without any college education (2.81) but highest for college graduates (3.05), with those who have some college education in between (2.87).

Figure 2 presents the mean values of COVID-19 beliefs by confidence in scientists and acceptance of evolution. Figure 2a reveals a positive association between confidence in scientists and treating COVID-19 seriously across measures of COVID-19 beliefs. The mean of the composite scale increases from 2.29 for people with no confidence at all in scientists to 3.23 for those with a great deal of confidence. Similarly, Figure 2b shows that acceptance of evolution is associated with higher values on the composite scale, with means of 2.60, 2.85 and 3.08 for evolution disbelievers, those with no opinion and evolution believers, respectively.

Figure 3 presents percentage distributions of confidence in scientists and acceptance of evolution by educational level. Figure 3a reveals a sharp educational gradient in confidence in scientists. For example, 7% of high school dropouts, 6% of high school graduates, 5% of those with some college education and 2% of college graduates have no confidence at all in scientists to act in the best interest of the public. By contrast, 45% of college graduates have a great deal of confidence in scientists, compared with 22% of high school dropouts, 25% of high school graduates and 32% of those with some college education.

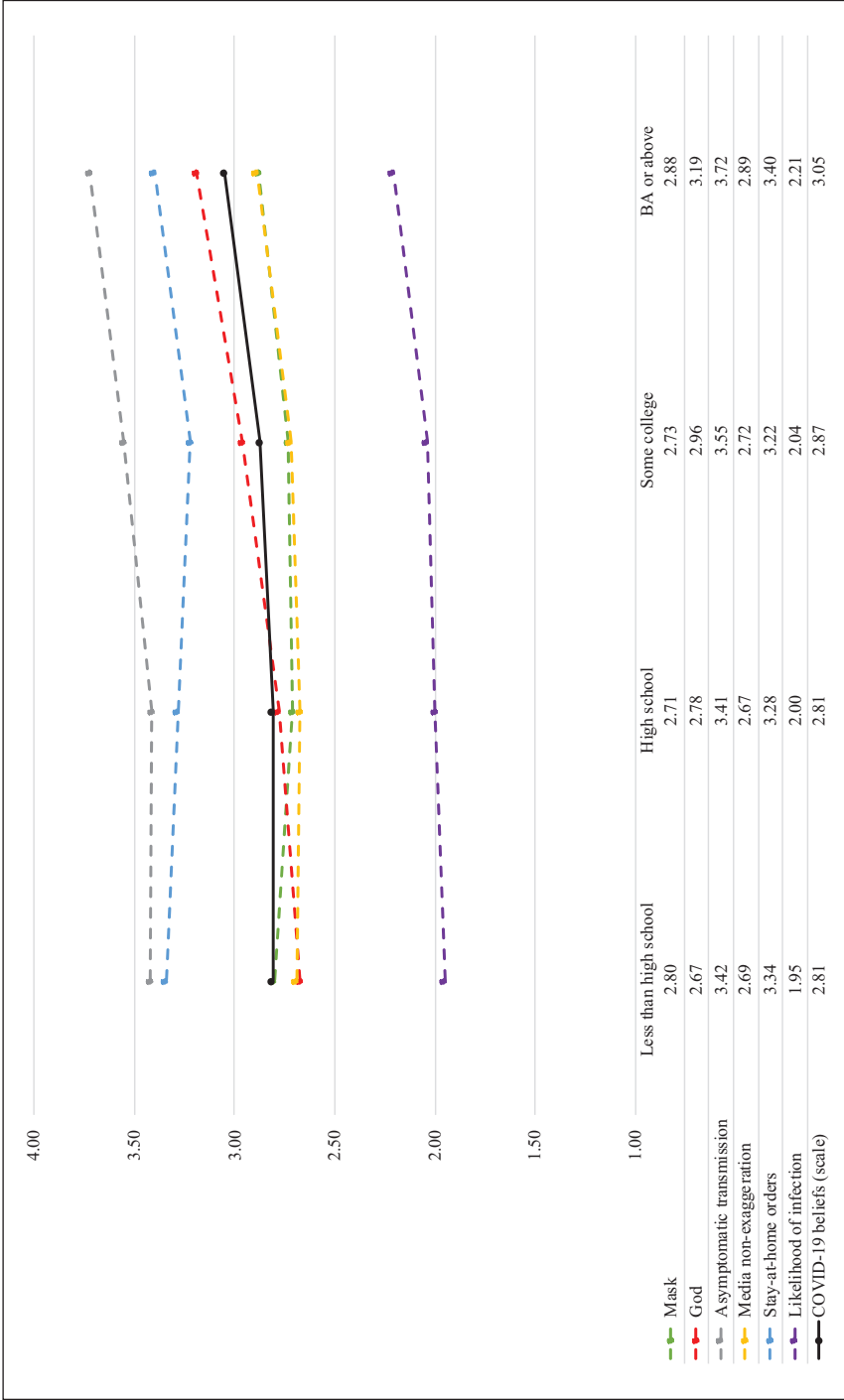


Figure 1. Means of the items and scale that measure COVID-19 beliefs, by educational level.
 Note: Significance tests indicate that the means of the items and scale that measure COVID-19 beliefs differ significantly by educational level ($p < .01$ for all).

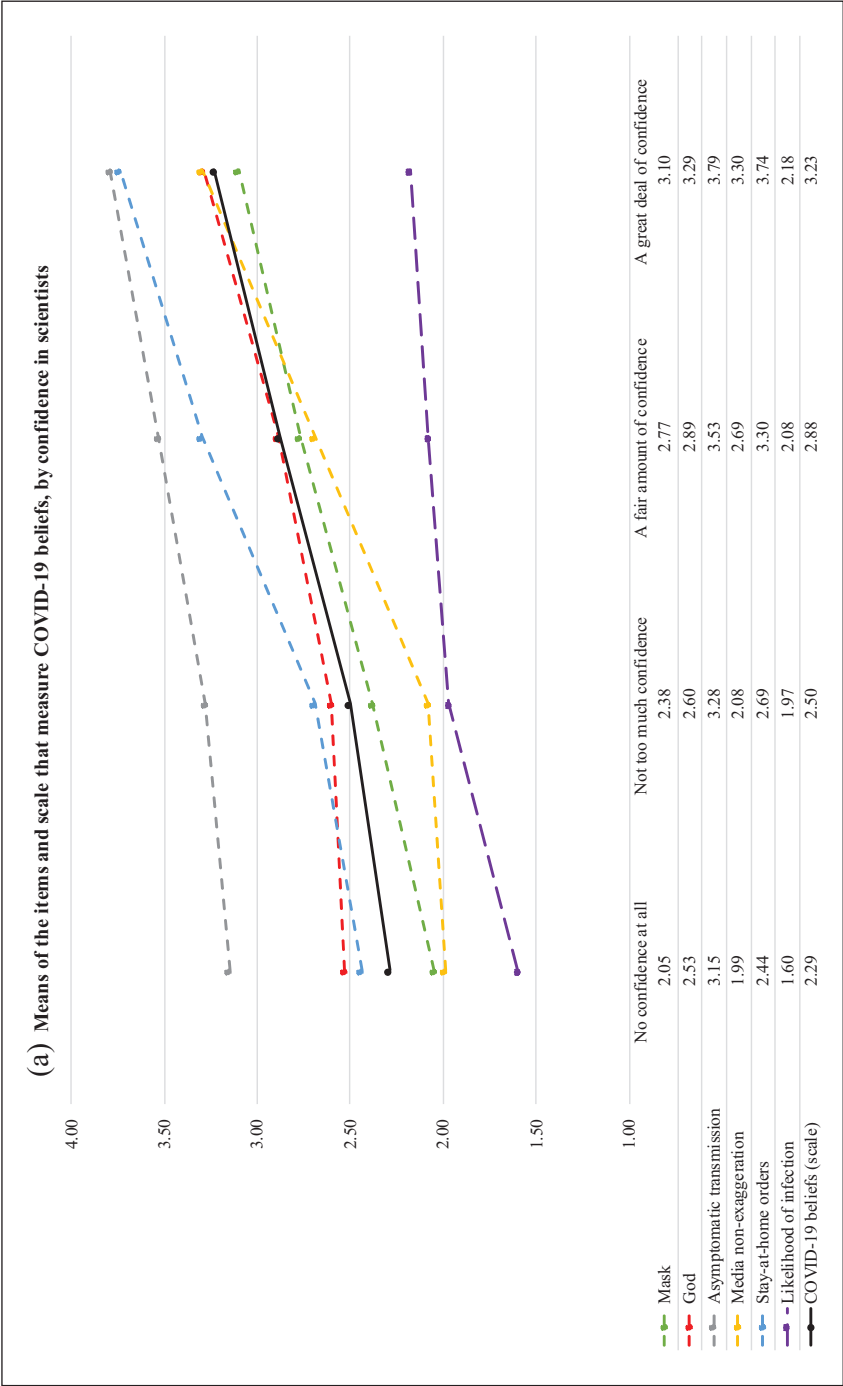


Figure 2. (Continued)

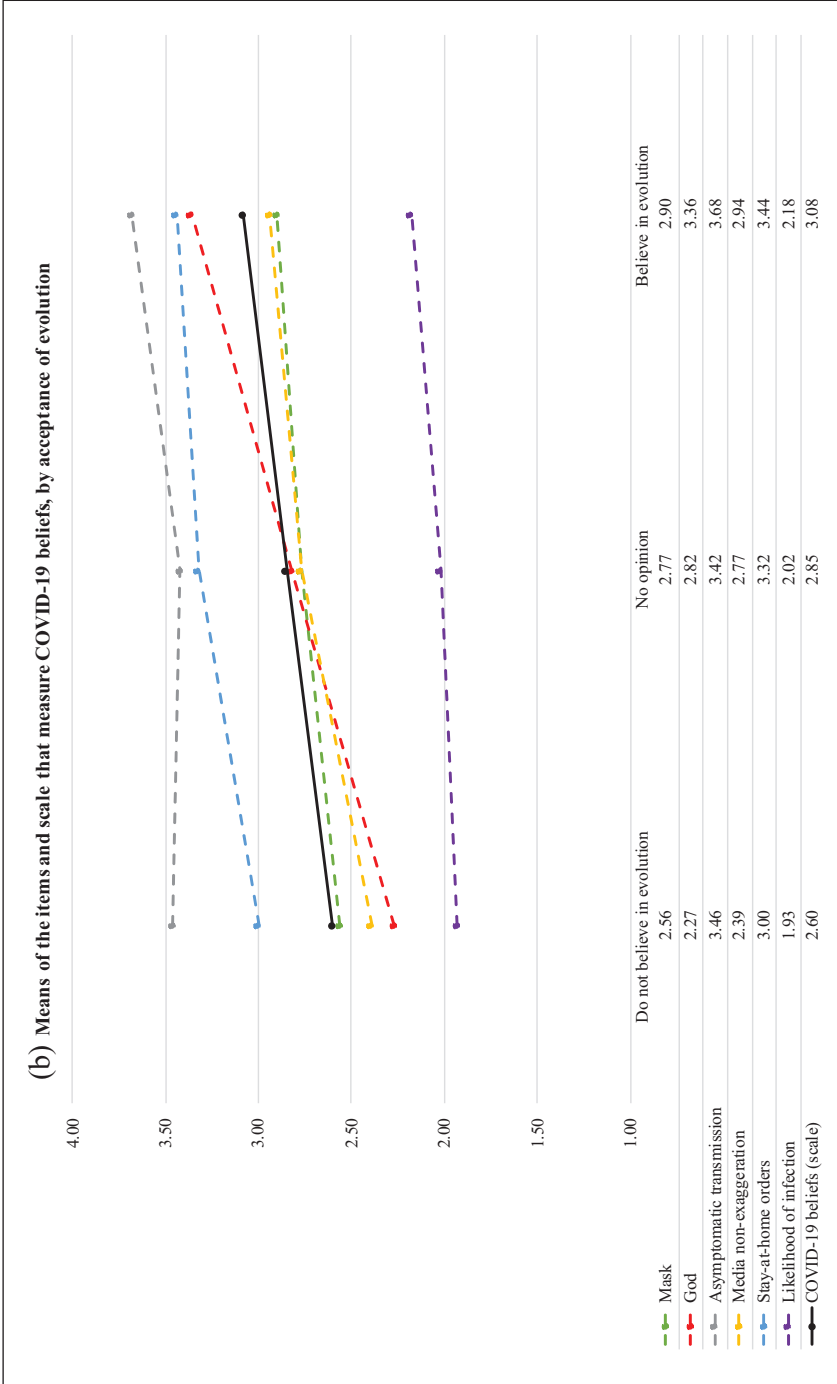


Figure 2. Means of the items and scale that measure COVID-19 beliefs, by: (a) confidence in scientists and (b) acceptance of evolution. Note: Significance tests indicate that the means of the items and scale that measure COVID-19 beliefs differ significantly by confidence in scientists and by acceptance of evolution ($p < .001$ for all).

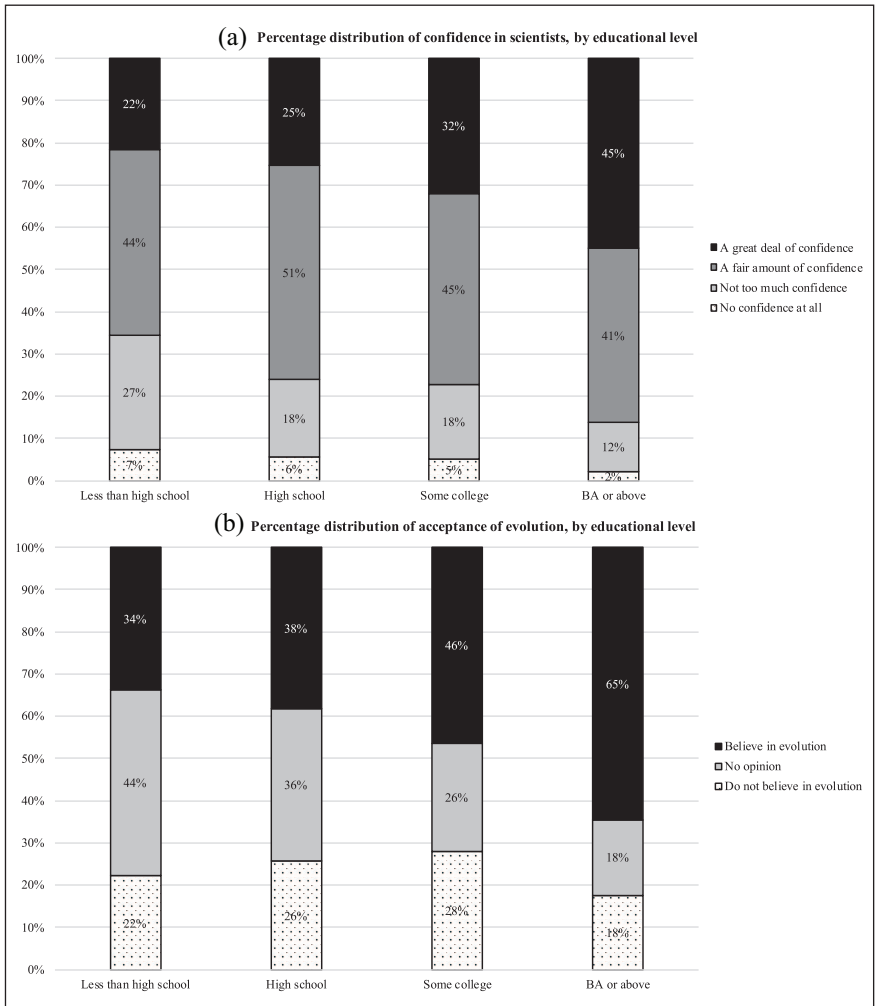


Figure 3. Percentage distributions of: (a) confidence in scientists and (b) acceptance of evolution, by educational level.

Note: Significance tests indicate that both the distribution of confidence in scientists and the distribution of acceptance of evolution differ significantly by educational level ($p < .001$ for both).

As shown in Figure 3b, education is positively associated with acceptance of evolution, a finding that is consistent with prior research (Pew Research Center, 2015). As much as 65% of college graduates are evolution believers, whereas 46% of people with some college education, 38% of high school graduates and only 34% of high school dropouts believe in evolution. Meanwhile, only 18% of college graduates are evolution disbelievers, but 22% of high school dropouts, 26% of high school graduates and 28% of those with some college education do not believe in evolution.

Table 1. OLS regression models predicting COVID-19 beliefs (scale).

	Model A	Model B	dif. ^a	% explained ^b
Educational level (ref. = BA or above)				
Less than high school	-0.20*** (0.05)	-0.05 (0.04)	***	75
High school	-0.17*** (0.03)	-0.08** (0.03)	***	53
Some college	-0.13*** (0.03)	-0.05* (0.03)	***	62
Confidence in scientists		0.30*** (0.01)		
Acceptance of evolution (ref. = Do not believe in evolution)				
No opinion		0.18*** (0.03)		
Believe in evolution		0.27*** (0.03)		
R-squared	0.11	0.39		

Notes: $N=2430$. ref. = reference category. Standard errors are in parentheses. Both models control for gender, age and its squared term, race, employment, marital status, region of residence, adjusted household income, self-rated health and whether respondents' family or acquaintances had been infected with COVID-19.

^aThe column denoted by 'dif.' specifies the significance level of the differences in the coefficients for educational level between Model A (which excludes confidence in scientists and acceptance of evolution) and Model B (which includes confidence in scientists and acceptance of evolution).

^bThe column denoted by '% explained' specifies the extent to which the educational differentials in the score of the composite scale measuring COVID-19 beliefs are explained by confidence in scientists and acceptance of evolution. The numbers in this column were calculated by comparing the coefficients for educational level from Model A and the corresponding coefficients from Model B. For example, after confidence in scientists and acceptance of evolution were included, the magnitude of the coefficient for 'less than high school' was reduced from 0.20 in Model A to 0.05 in Model B, suggesting that 75% of the difference in COVID-19 beliefs between college graduates and those with less than a high school education is explained by confidence in scientists and acceptance of evolution.

*** $p < .001$, ** $p < .01$, * $p < .05$.

Results of OLS Regression Models

Table 1 presents OLS regression results predicting the composite scale of COVID-19 beliefs. The 'dif.' column indicates whether or not controlling for belief in science significantly changes the coefficients for education. An educational gradient is apparent before we control for belief in science (Model A): compared with college graduates, high school dropouts score 0.20-point lower on the scale, high school graduates score 0.17-point lower and those with some college education score 0.13-point lower ($p < .001$ for all three).

Model B shows that every one-unit increase in confidence in scientists is associated with a 0.30-point increase in the score on the composite scale ($p < .001$). Compared with evolution disbelievers, those with no opinion score 0.18-point higher on the composite scale and evolution believers score 0.27-point higher ($p < .001$ for both). After we control for belief in science, the coefficient for high school dropouts is reduced to non-significance ($b = -0.05$, $p > .05$); the coefficients for high school graduates and those with some college education are also attenuated, despite remaining significant ($b_{High\ school} = -0.08$, $p < .01$; $b_{Some\ college} = -0.05$, $p < .05$). Comparing the coefficients for educational level in Model A and the corresponding coefficients in Model B, we show that belief in science (i.e. confidence in scientists and acceptance of evolution) significantly explains 53–75% of the educational differentials in the score of the composite scale measuring COVID-19 beliefs.

Discussion

In this study, we draw on nationally representative US data to show that highly educated people are more likely than the less educated to adopt beliefs that affirm the seriousness of COVID-19. Existing research shows that beliefs do shape behaviour: if individuals take COVID-19 more seriously, they are more likely to take part in actions that help reduce the risk of infection and slow the spread of COVID-19, such as social distancing, staying home and wearing masks (Galasso et al., 2020). Thus, advancing existing research that attributes the disproportionate disease burden borne by people of lower SES to their greater COVID-19 exposure at work and fewer economic resources (e.g. Baker et al., 2020; Burstrom and Tao, 2020; Dorn et al., 2020), we provide an additional explanation for health inequalities in times of COVID-19: the polarization of coronavirus responses by education is in part due to differing COVID-19 beliefs held by people of different educational levels.

We further postulate that COVID-19 beliefs can be conceptualized as a subset of schemas relating to belief in science. In other words, how individuals think about science shapes their understanding of COVID-19. We show that the lack of beliefs that acknowledge the seriousness of COVID-19 among less-educated Americans is largely attributable to their distrust of and disbelief in science, manifested in lacking confidence in scientists and rejecting evolution. Thus, an educational gradient in beliefs about COVID-19 reflects an educational gradient in belief in science in general.

This study is not without limitations. Given the cross-sectional data, we are unable to firmly establish causality between belief in science and COVID-19 beliefs, or capture changes over time in individuals' beliefs about COVID-19. Data limitations also prevent us from examining the relationship between COVID-19 beliefs and COVID-19 infection.

In conclusion, the lack of trust and belief in science among the US public poses challenges to fighting the COVID-19 pandemic. A significantly higher proportion of American adults than those in other western countries firmly reject scientific concepts such as evolution (Miller et al., 2006). Americans' distrust of scientists and disbelief in scientific knowledge can threaten the legitimacy of science-based authority (Baron and Berinsky, 2019; Barry et al., 2020). In light of the ongoing pandemic, our findings underscore that there is an urgent need for the government, the media and the scientific community to rebuild Americans' confidence and trust in science.

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