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Political views, health literacy, and COVID-19 beliefs and behaviors: A moderated mediation model

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ABSTRACT

Rationale: Mitigating the spread of COVID-19 requires that people understand the need for and engage in protective behaviors. Given the complexity and rapid progression of media information about the pandemic, health literacy could be essential to acquiring the accurate beliefs, concern for societal risks, and appreciation of restrictive policies needed to motivate these behaviors. Yet with the increasingly politicized nature of COVID-related issues in the United States, health literacy could be an asset for those with more liberal views but less so for those with more conservative views.

Objective: This study tested a hypothesized model proposing that political views moderate the associations of health literacy with COVID-19 protective behaviors as well as the mediational roles of accurate and inaccurate COVID-19 beliefs, concern for society, and governmental control attitudes.

Methods: We surveyed residents in three diverse regions of California in June 2020 ($N = 669$) and February 2021 ($N = 611$). Participants completed measures of health literacy, political views, and COVID-19 beliefs and behaviors.

Results: Moderated mediational analyses largely supported the proposed model with both samples. Health literacy was associated with more accurate COVID-19 beliefs, less inaccurate COVID-19 beliefs, greater concern for societal risks, more positive attitudes regarding restrictive government control, more protective behavior, less risky behavior, and stronger vaccine intentions; beliefs, concern for society, and governmental control attitudes mediated the health literacy-behavior relationships. As predicted, however, these associations of health literacy with adaptive beliefs, attitudes, and behaviors varied according to political views. The direct and mediated relationships were held for participants with more liberal views and, to a lesser extent, for those with moderate views, but they were weaker or absent for participants with more conservative views.

Conclusions: These findings contribute new evidence of processes linking health literacy with adaptive beliefs, attitudes, and behaviors and how social and political contexts can shape those processes.

1. Introduction

COVID-19 variants have spread rapidly throughout the world, leading to over 547, 231, 000 cases and 6,347,000 deaths by June 2022 (Worldometer, 2022). The profound health, social, and financial consequences of the pandemic are far-reaching (United Nations Department of Economic and Social Affairs, 2022). Protective measures, including social distancing, isolation, vigilant handwashing and sanitizer use, use of face masks, and vaccine uptake have been the primary means for

controlling infection rates. Yet in many countries such as the U.S., engagement in these behaviors has been uneven despite extensive dissemination of public health information and media coverage (Yamamoto et al., 2021). One potential reason for limited adherence, particularly during the first year of the pandemic, is that COVID-19 emerged as a new and unfamiliar threat and the rapidly evolving information about its spread and the importance of these previously atypical behaviors required sufficient health literacy to comprehend. In the swirl of new, confusing, and often misleading information about

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COVID-19, health literacy could be essential in navigating towards adaptive beliefs and protective behaviors and away from inaccurate beliefs and risky behaviors. To date, evidence regarding how health literacy influences COVID-related responses remains limited.

Health literacy is defined as the capacity to obtain and understand health information and services needed to make appropriate health decisions and to communicate and act on them (Institute of Medicine, 2004; International Union for Health Promotion and Education, 2018). Although health literacy is related to general literacy skills, it is distinct as people who have high reading and vocabulary skills often find health information to be unfamiliar, complicated, and confusing (International Union for Health Promotion and Education, 2018). Health literacy is typically regarded as an important asset in promoting health, yet evidence on the relationships between health literacy, health knowledge, and health behaviors remains inconsistent. Whereas many studies find that higher health literacy is associated with adaptive behaviors and better health outcomes (Berkman et al., 2011; Miller, 2016), some studies find no association (e.g., Al Sayah et al., 2016; Lee et al., 2015, 2018; McDougall et al., 2018) and others find that higher health literacy is associated with lower adoption of health recommendations and poorer outcomes (e.g., Aharon et al., 2017; Polite et al., 2019; Veldwijk et al., 2015). These mixed findings suggest that health literacy effects may vary across social groups, health and social contexts, and behaviors. More research is needed to understand the dynamics of these relationships, including the conditions under which health literacy is and is not a critical factor in health promotion.

The COVID-19 pandemic provides an arena for examining the roles of health literacy in promoting adaptive responses to a new and rapidly evolving health threat. Early studies suggested that lower health literacy might be associated with poorer knowledge of COVID-19 symptoms (Wolf et al., 2020), less preparedness for outbreaks (Bailey et al., 2020), and fewer protective behaviors (Babicz et al., 2021). Yet other studies provide more limited and conflicting evidence on the associations of health literacy with COVID-19 knowledge and behaviors (Coriou et al., 2020; O’Conor et al., 2020).

In the US, the formation of COVID-related beliefs and decisions to engage in behaviors that increase or reduce COVID-19 risk have taken place within an increasingly politicized context, with growing evidence that conservative political views are linked with cynicism about COVID-19 risks and the importance of protective behaviors (Gollwitzer et al., 2020; Latkin et al., 2020; Moon et al., 2021). These doubts correspond

with conservative values about the importance of freedom in movement and choices, which could contribute to attitudes that governmental COVID-19 policies are excessive. Given the deep political divides in the US, political affiliation could outweigh health literacy in terms of its influence on COVID-related beliefs and behaviors.

In the present study, we tested a hypothesized model based on established tenets of health cognition and behavior (e.g., the common-sense model of self-regulation; Leventhal et al., 2012) of the interactive associations of health literacy and political views with COVID-related behaviors (see Fig. 1). According to this model, health literacy directly influences mental representations of COVID-19. These representations can include accurate beliefs, such as that COVID-19 can spread through aerosolized particles and droplets emitted by infected people; and inaccurate beliefs, such as that COVID-19 cannot be transmitted in hot climates. Higher health literacy promotes accurate beliefs which, in turn, promote concern for communities and the broader society regarding health, financial, and social consequences of COVID-19 as well as attitudes endorsing governmental policies to control it. Health literacy promotes protective behaviors and reduces risky behaviors, both directly through enhanced comprehension of behavioral recommendations and indirectly through the mediational mechanisms of beliefs, concerns for society, and government control attitudes.

Whereas this mediational model is predicted to hold for health threats for which there is little political debate, the politicized nature of COVID-19 is such that political views are predicted to moderate the direct and indirect associations of health literacy with COVID-related behaviors. Specifically, we predict that the proposed direct and indirect associations of health literacy with behaviors will hold when individuals hold more liberal views. When political views are conservative, however, health literacy is predicted to have minimal or negative direct and indirect associations with protective behaviors as well as minimal or positive associations with risky behaviors. Political views are therefore hypothesized to moderate the associations of health literacy with these COVID-related beliefs, attitudes, and behaviors. Further, political views are hypothesized to moderate the mediational roles of accurate and inaccurate beliefs, concern for society, and governmental control attitudes on the relationships of health literacy with COVID-related behaviors.

We tested these hypotheses with surveys administered to residents of California, which reported the highest number of COVID-19 cases of all US states over the first year of the pandemic (February 15, 2020 to

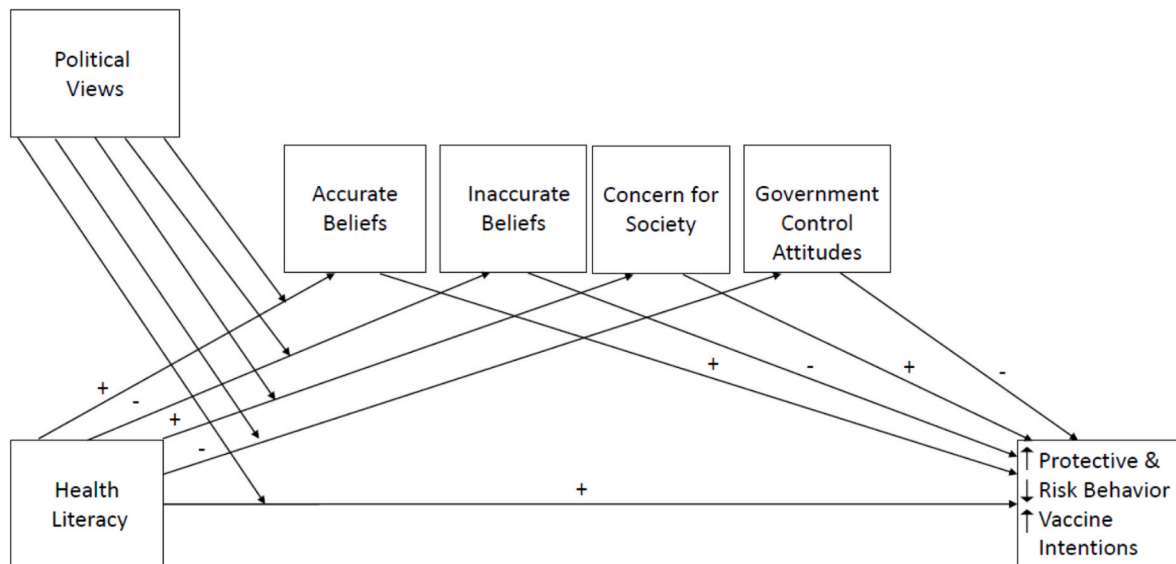


Fig. 1. Hypothesized model of moderated mediation relationships of political views, correct and incorrect COVID-19 beliefs, concern about COVID-related threats for society, and attitudes regarding excessive government control linking health literacy with COVID-19 protective behaviors, risk behaviors, and vaccine intentions.

February 14, 2021; [Worldometer, 2022](#)). We recruited residents from three diverse regions: The San Francisco Bay Area and the Los Angeles Area, both of which are largely urban regions; and the San Joaquin Valley and adjacent mountain communities, which include mid-sized cities, farming communities, and rural towns.

We conducted the survey at two timepoints. We launched the first survey in June 2020, approximately three months after the World Health Organization (WHO) declared COVID-19 a pandemic (March 11) and the California governor issued statewide shelter-in-place orders (March 19). During the survey period, average case and mortality rates in California were 3029 new COVID-19 cases and 71 COVID-19 deaths per day ([Worldometer, 2022](#)). Guidelines were beginning to allow many business sectors such as restaurants and gyms to re-open. No COVID-19 vaccines had been developed at this time. We launched the survey again in February 2021, one year after COVID-19 first appeared in California (January 25, 2020). Case and mortality rates in California at this time averaged 11,867 new cases and 451 deaths per day. Non-essential businesses had been closed since November 15, 2020 and stay-at-home orders issued in early December had been lifted (January 25, 2021). COVID-19 vaccinations for frontline healthcare workers and nursing home residents began on December 14, 2021, with roll out to other priority populations on January 13, 2021.

In testing the hypothesized roles of political views, we used a measure gauging conservative-to-liberal views rather than political parties because political party members vary in these views. In California, 74% of Republicans report being conservative and 26% report being moderate or liberal whereas 65% of Democrats report being liberal and 35% as moderate or conservative; Independents and unaffiliated voters tend to report being moderate (44%) rather than conservative (27%) or liberal (29%; [Public Policy Institute of California, 2022](#)). We developed bespoke measures of COVID-related beliefs, attitudes, and behaviors due to the absence of published measures at studyonset. We report internal consistency analyses of these measures, along with the health literacy measure, as evidence of psychometric quality.

2. Methods

2.1. Participants and procedure

Members of Qualtrics research panels were screened using age and zip codes to recruit equivalent numbers of adults from the Los Angeles Area, San Joaquin Valley and adjacent mountain communities, and San Francisco Bay Area. Participants completed an online survey described as examining the impacts of the COVID-19 pandemic and received monetary compensation from Qualtrics. The survey included measures of political views, health literacy, accurate and inaccurate beliefs about COVID-19, COVID-19-related concerns for society, attitudes about governmental efforts to control the COVID-19 spread, protective and risky health behaviors, and COVID-19 vaccine intentions. Qualtrics data managers provided quality-control services, eliminating responders with unreasonably short completion times or exhibiting straight-lining in responses. For the 2020 sample, we recruited 721 participants from June 8 to June 15; 669 (92.8%) completed all survey measures and their data were included in these analyses. For the 2021 sample, we recruited 626 participants from February 3 to February 12; 611 (97.6%) completed all survey measures. The university's Institutional Review Board approved this study.

2.2. Measures

For measures with multiple items, we averaged ratings to generate scores and then standardized them with transformations into *z* scores. For two measures that included items rated from 1 to 5 and an item with 3 response options (e.g., *no*, *not sure*, *yes*), the latter item responses were weighted as 1, 3, and 5, respectively so that they contributed proportionately to the measure score.

2.3. Political views

We assessed political views with the item, "How do you rate your political views?" Ratings ranged from 1 = *extremely conservative* to 4 = *neutral* to 7 = *extremely liberal*. For descriptive purposes, we also asked participants to indicate their political party. Substantial mean differences in political views between political party affiliations that are in line with California's political orientation profiles (with Democrats being the most liberal, Other and unaffiliated votes tending to be moderate, and Republicans being the most conservative) support the construct validity of this measure: Democrats $M = 5.26$ ($SD = 1.37$, $N = 686$), Other (Independents, other, or no affiliation) $M = 4.181$ ($SD = 1.258$, $N = 265$), and Republicans $M = 2.93$ ($SD = 1.50$, $N = 295$); $F(2, 1244) = 303.51$, $p < .0001$. Similar one-item measures are traditionally used to assess political ideology ([Jost et al., 2003](#)).

2.3.1. Health literacy

We assessed health literacy with items adapted from prior measures ([Chew et al., 2004](#); [Morris et al., 2006](#)): "How often do you need to have someone help you when you read instructions, pamphlets, or other written material from your doctor or pharmacy?" (reverse-scored); "How confident are you filling out medical forms by yourself?"; "How often do you feel confused when you read descriptions of medications or medical procedures" (reverse-scored); and "How confident do you feel in helping others understand written medical information?". Participants responded using 5-point scales ranging from *never* to *always* for the first item and *not at all confident* to *very much confident* for the other items.

2.3.2. Accurate COVID-19 beliefs

Four items assessed COVID-19 beliefs that health officials generally endorsed as accurate at the time of the surveys: "If you already have a problem with your lungs, you're more likely to be infected with COVID-19"; "If you already have a problem with your lungs, you're more likely to have a severe reaction if you become infected with COVID-19"; "COVID-19 can be spread through the air when people cough and sneeze"; and "COVID-19 can be spread by touching contaminated surfaces, objects, and people". Ratings ranged from 1 = *not true at all* to 5 = *very true*.

2.4. Inaccurate COVID-19 beliefs

We used six items to assess beliefs that health officials generally regarded as inaccurate at the time of the surveys: "Medications are available that can prevent or cure COVID-19"; "COVID-19 cannot be transmitted in hot climates"; "Antibiotics will help people recover from COVID-19"; "COVID-19 is spread through mosquito bites"; and "If you have recovered from COVID-19, you are protected from a second infection". Ratings ranged from 1 = *not true at all* to 5 = *very true*.

2.5. Concern for society

A measure of concerns about community and societal welfare during the COVID-19 pandemic included five items: "What level of financial threat do you think COVID-19 poses to your local community?"; "What level of health threat do you think COVID-19 poses to your local community?" (for these two items, 1 = *not at all a threat* to 5 = *a very high threat*); "I feel that I am contributing to the greater good by preventing myself or others from getting COVID-19"; "The number of COVID-19 cases that have reported in my country worries me"; and "The number of COVID-19 cases that have reported worldwide worries me" (for the latter three items, 1 = *strongly disagree* to 5 = *strongly agree*).

2.6. Governmental control attitudes

A measure of attitudes that governmental policies to control COVID-

19 spread were excessive and over-controlling included five items: “I am upset at the thought that my Federal government would force people to stay home against their will”, “It makes me angry that the Federal government would tell me where I can go and what I can do, even with the threat of COVID-19 infection and spread”, “The COVID-19 outbreak has been contained and is or will soon be over for my country”, and “The media has exaggerated the extent of the COVID-19 outbreak” (all rated from 1 = *strongly disagree* to 5 = *strongly agree*); and “Do you think that the public health measures put in place in your region to contain the spread of COVID-19 are too extreme?” (response options: *No* = 1, *Somewhat* = 3, *Yes* = 5).

2.6.1. COVID-19 protective behaviors

To assess COVID-19 protective behaviors, a stem of, “In the past week, when you went into a public setting or visited people outside your home, how often did you ...” was followed by six behavior descriptors: (1) use a face mask or covering; (2) stay at least six feet away from other people; (3) avoid touching your face; (4) use sanitizers to wipe off highly-touched surfaces (shopping cars, doorknobs, etc.) before touching them yourself; (5) wash your hands immediately after returning home or leaving the place; and (6) change your clothes immediately after returning home.” Ratings ranged from 1 = *never* to 5 = *always*.

2.7. COVID-19 risk behaviors

To assess COVID-19 risk behaviors, a stem of, “In the past week, how often did you ...” was followed by six items: (1) go into a store; (2) attend a school or workplace; (3) visit friends or family members who live close by; (4) visit friends of family members who live more than 15 min away; (5) attend a public event or gathering; and (6) go to a public setting such as a park, restaurant, or café where other people were close by. (Response options: 1 = *not at all* to 5 = *6 or more times*).

2.8. Vaccine intentions

The June 2020 survey assessed vaccine intentions with the items, “I intend to receive a vaccine for COVID-19 if and when it becomes available” (1 = *strongly disagree* to 5 = *strongly agree*) and “In the event that a vaccine is developed, do you intend on being vaccinated against COVID-19?” (1= *no*, 3 = *not sure*, 5= *yes*); $r = 0.70$. In the February 2021 survey, the latter item was revised to reflect the development of vaccines: “Now that a vaccine has been developed, do you intend on being vaccinated against COVID-19?”

2.9. Statistical analyses

We used G-Power 3.1.5 (Faul et al., 2007) to estimate a sample size with 90% power to detect small effects ($f^2 = 0.02$) at $p < .05$ (two-tailed) with 15 predictors, which is the number of predictors in the full moderated mediation model with one moderator and four mediators. The recommended sample size is 528, indicating that our samples of 611 participants in 2020 and 668 participants in 2021 provided sufficient power to detect small effects in our analyses. Measure item ratings were averaged so that a missing value on any item was replaced by the average of the other item ratings. Missing values occurred only for selected demographic and personal characteristic variables (Table 1) and for one 2020 participant on the protective behaviors measure. Imputations of missing observations were not conducted so as to provide the most accurate information on the demographic and personal characteristics and because the missing observation for protective behavior had negligible impacts on the results.

Two sets of psychometric analyses tested internal consistencies of the health literacy and COVID-19 beliefs, attitudes, and behaviors measures with the 2020 sample data. We first tested a measure’s dimensional structure with a principal-components analysis of the correlation matrix

Table 1
Demographic and personal characteristics.

	June 2020 Sample (N = 669)	February 2021 Sample (N = 611)
Age (years)-N	669	611
Mean ± SD	41.97 ± 17.32	34.47 ± 17.84
Gender-N	669	611
Female	52.3%	44.2%
Male	46.9%	54.8%
Other	0.8%	1.0%
Race/Ethnicity-N	669	611
Asian	20.1%	12.3%
Hispanic/Latino	10.9%	14.9%
Non-Hispanic White	63.3%	66.8%
Other	5.8%	6.0%
Annual Household Income -N	663	610
\$30,000 or less	16.3%	20.0%
\$30,001 to \$60,000	21.3%	17.7%
\$60,001 to \$80,000	11.6%	11.3%
\$80,001 to \$135,000	28.7%	24.6%
\$135,000 or more	22.0%	26.4%
Education-N	669	610
Less than High School	1.3%	2.4%
High School/GED	9.6%	8.7%
Some College/Vocational School	29.7%	24.5%
Bachelor’s Degree	29.6%	30.0%
Graduate Degree	29.1%	34.4%
Political Party-N	655	592
Democrat	48.7%	62.0%
Republican	27.9%	18.9%
Independent/Other	6.0%	5.4%
Unaffiliated	17.4%	13.7%
Diagnosed/Hospitalized with COVID	1.3%/0.6%	15.4%/10.3%
Family member diagnosed/died	5.4%/2.1%	30.9%/16.4% ^b
Working in a COVID-19 high risk job	11.2% ^a	26.2% ^b
Living with person in COVID-19 high-risk job	11.7%	16.6% ^b

^a N = 668.

^b N = 610.

that extracted components with Eigenvalues > 1.00 and a direct oblimin rotation should the analysis yield more than one component. Next, we calculated Cronbach’s α for the measure items (r for vaccine intentions).

We used SPSS 27 and the PROCESS macro (Hayes, 2022) to test the moderated and mediated relationships specified in the proposed model. The main analyses included two phases. First, we used PROCESS Model 1 to conduct moderation analyses testing political views as a moderator of the relationships of health literacy with accurate beliefs, inaccurate beliefs, concern for society, government control attitudes, protective behavior, risk behavior, and vaccine intentions. Second, we used PROCESS Model 8 to test moderated mediation analyses to test whether the moderated associations of political views with the relationships of health literacy with the behaviors were mediated by accurate beliefs, inaccurate beliefs, concern for society, and government control attitudes. We first conducted preliminary analyses testing moderated mediation for the full set of four mediators. To facilitate interpretability, the final sets of analyses included only the mediators for which moderated mediation was significant.

3. Results

Table 1 presents the sample demographics and personal characteristics. The samples included comparable proportions of males and females; about two-thirds were Non-Hispanic White and one-half were below the state’s median household income of \$78,672 (U.S. Census Bureau, 2022). Most participants had at least some college-level or vocational education.

For the 2020 sample, the breakdown of political party affiliations was generally comparable to the general state profile of 46.5% Democrat, 24.1% Republican, and 23.3% Unaffiliated or Independent (Public

Policy Institute of California, 2022). The 2021 sample included more Democrats and fewer Republicans and other/unaffiliated voters relative to the state profile. In the 2020 sample, fewer than 6% of participants had been diagnosed with COVID-19, had been hospitalized with COVID-19, and had family members who had been diagnosed with or died from COVID-19. The 2021 sample reported higher rates, with approximately 15% having diagnoses, 10% being hospitalized, 31% having a family member diagnosed with COVID-19, and over 16% having a family member who died of COVID-19. The proportions of participants working in jobs deemed as at high risk for COVID-19 exposure or living with someone with a high-risk job were also higher in the 2021 sample than in the 2020 sample.

Table 2 presents the zero-order correlations of variables and statistics from principal-components analyses of the relevant measures. The latter yielded Kaiser-Meyer-Olkin Measure of Sampling Adequacy statistics indicating acceptable inter-correlation for structure detection; for all measures, Bartlett tests of sphericity were significant; $\chi^2 > 704.830, p < .0001$. Each analysis extracted one principal component with items coefficients of 0.48–0.88. Cronbach’s α ranged from 0.73 to 0.87. Taken together, these analyses support the internal consistency of these measures.

The correlations demonstrate distinctiveness across variables; e.g., accurate beliefs and inaccurate beliefs were only weakly (negatively) correlated across both samples. Higher health literacy was associated with lower levels of inaccurate beliefs, government control attitudes, and COVID-19 risk behaviors in both samples. It was positively associated with accurate beliefs and concern for society only in the 2020 sample and weakly associated with higher protective behavior and vaccine intentions in both samples.

3.1. Political views as a moderator of health literacy relationships with COVID-19 beliefs and attitudes

Table 3 presents the PROCESS Model 1 analyses testing political views as a moderator of the relationships of health literacy with the

Table 2
Correlations among main variables and principal components analysis (PCA) statistics.

Variable	1	2	3	4	5	6	7	8	9
1. Liberal Political Views	–	–.173**	.221**	.206**	.324**	–.082*	.070	.208*	.225**
2. Health Literacy	–.067	–	.063	–.554**	.038	–.393**	.115**	–.483**	.182**
3. Accurate Beliefs	.141**	.318**	–	.154**	.566**	–.067	.326**	.054	.311**
4. Inaccurate Beliefs	–.025	–.519**	–.241**	–	.100*	.651**	–.018	.652**	–.025
5. Concern for Society	.317**	.151**	.567**	–.194**	–	–.224**	.449**	.040	.439**
6. Govt Control Attitudes	–.325**	–.283**	–.388**	.550**	–.556**	–	–.097*	.533**	–.275**
7. Protective Behaviors	.113**	.152**	.335**	–.138**	.461**	–.265**	–	–.116**	.282**
8. Risk Behaviors	–.019	–.319**	–.250**	.422**	–.312**	.4118**	–.312**	–	–.102*
9. Vaccine Intentions	.225**	.234**	.329**	–.310**	.410**	–.430**	.250**	–.284**	–
2020 Sample <i>M</i>	4.327	4.320	3.833	1.826	3.964	2.352	3.876	1.489	4.043
2020 Sample <i>SD</i>	1.624	0.770	0.856	0.817	0.943	0.812	0.840	0.546	1.210
2021 Sample <i>M</i>	4.638	4.011	3.863	2.425	4.162	2.633	3.986	1.875	4.178
2021 Sample <i>SD</i>	1.702	0.880	0.869	1.141	0.907	0.926	0.832	0.932	1.197
PCA KMO	.686	.671	.879	.732	.819	.804	.820	.820	.820
PCA Factor loadings	.755–.801	.615–.826	.584–.839	.671–.880	.745–.874	.495–.805	.478–.834		
PCA Eigenvalue	2.479	2.284	3.503	3.094	3.327	2.949	3.323		
PCA % variance	61.964	57.093	58.831	61.872	66.544	49.148	55.386		
α/r	.793	.734	.853	.815	.873	.768	.812		.642

Note: Correlations above the diagonal = 2020 sample; below the diagonal = 2021 sample. For liberal political views, scale ranges from 1 (extremely conservative) to 7 (extremely liberal); for other variables, scores range from 1 to 5. KMO=Kaiser-Meyer-Olkin Measure of Sampling Adequacy. For the 2020 analyses of protective behavior, *N* = 668.

representational belief, concern, and attitude variables. As predicted, more liberal political views were associated with more accurate beliefs about COVID-19, greater concern for society, and lower levels of excessive government control attitudes for both 2020 and 2021 samples. Political views were not associated with inaccurate beliefs in 2020 and more liberal views were weakly associated with more inaccurate beliefs in 2021.

As predicted, higher health literacy was associated with more accurate beliefs, less inaccurate beliefs, greater concern for society, and more accepting government control attitudes in both samples. Political views moderated these relationships in all but one case; i.e., the relationship of health literacy with accurate beliefs in 2021. As predicted, all significant moderation effects were due to relatively weaker or nonsignificant relationships of health literacy with the outcome variables for participants with more conservative views and for relatively stronger, significant relationships for participants with more liberal views.

3.2. Political views as a moderator of health literacy relationships with COVID-related behaviors

Table 4 presents the PROCESS Model 1 analyses testing political views as a moderator of the relationships of health literacy with protective behavior, risk behavior, and vaccine intentions. Political views were not associated with protective or risk behaviors in the 2020 sample whereas more liberal views were associated with higher levels of protective and risk behaviors in the 2021 sample. More liberal views were associated with greater vaccine intentions in both years. As predicted, higher health literacy was associated with more protective behavior, less risk behavior, and greater vaccine intentions in both samples and these relationships were moderated by political views. In four of the six analyses (all three behaviors for the 2020 sample and protective behaviors for the 2021 sample), the relationships of health literacy with the behavioral variables were not significant for participants with more conservative views, significant for participants with moderate views, and significant and strongest for participants with more liberal views.

Table 3

PROCESS model 1 of political views as a moderator of the relationship of health literacy with COVID-19 representational beliefs, concerns, and attitudes.

	June 2020 Sample (N = 669)				February 2021 Sample (N = 611)			
	Effect	SE	t	95% CI [LL, UL]	Effect	SE	t	95% CI [LL, UL]
Accurate Beliefs								
Political Views	.126	.039	3.222**	[.049, .202]	.231	.040	5.827***	[.153, .308]
Health Literacy	.354	.039	9.095***	[.278, .431]	.102	.039	2.644*	[.026, .178]
PV x HL	.117	.043	2.761**	[.034, .201]	-.019	.038	-0.506	[-.094, .056]
Conservative	.230	.060	3.844***	[.112, .347]	.120	.055	2.178*	[.012, .228]
Moderate	.344	.039	8.792***	[.267, .421]	.100	.038	2.610**	[.025, .175]
Liberal	.456	.054	8.492***	[.352, .564]	.080	.054	1.480	[-.026, .187]
Inaccurate Beliefs								
Political Views	.004	.028	0.128	[-.052, .059]	.087	.036	2.392*	[.016, .158]
Health Literacy	-.455	.028	-16.065***	[-.511, -.400]	-.545	.035	-15.411***	[-.614, -.475]
PV x HL	-.162	.031	-5.233***	[-.223, -.101]	-.219	.035	-6.429***	[-.287, -.150]
Conservative	-.284	.044	-6.520***	[-.369, -.198]	-.344	.050	-6.830***	[-.443, -.205]
Moderate	-.441	.028	-15.495***	[-.497, -.385]	-.567	.035	-16.135***	[-.636, -.498]
Liberal	-.599	.039	-15.248***	[-.676, -.522]	-.790	.050	-15.874***	[-.887, -.692]
Concern for Society								
Political Views	.290	.039	7.385***	[.213, .367]	.333	.037	9.094***	[.261, .405]
Health Literacy	.188	.039	4.796***	[.111, .265]	.080	.036	2.233*	[.010, .150]
PV x HL	.139	.043	3.239***	[.055, .223]	.082	.035	2.315*	[.012, .151]
Conservative	.041	.060	0.684	[-.077, .159]	.005	.051	0.090	[-.095, .104]
Moderate	.176	.039	4.470***	[.099, .253]	.008	.035	2.479*	[.018, .157]
Liberal	.311	.054	5.724***	[.204, .417]	.171	.050	3.411***	[.073, .270]
Govt Control Att								
Political Views	-.279	.037	-7.470***	[-.352, -.205]	-.220	.041	-5.411***	[-.299, -.140]
Health Literacy	-.333	.037	-8.942***	[-.406, -.260]	-.426	.040	-10.782***	[-.504, -.309]
PV x HL	-.229	.041	-5.631***	[-.309, -.149]	-.281	.039	-7.174***	[-.358, -.204]
Conservative	-.091	.057	-1.583	[-.203, .022]	-.168	.056	-2.991**	[-.279, -.058]
Moderate	-.314	.037	-8.373***	[-.387, -.240]	-.455	.039	-11.570***	[-.532, -.377]
Liberal	-.537	.052	-10.389***	[-.638, -.435]	-.741	.056	-13.313***	[-.850, -.631]

Note. PV=Political Views, higher values reflect more liberal beliefs. HL=Health Literacy. Govt Control Att = . Excessive government control attitudes. Values for conservative, moderate, and liberal political views = -1SD, 0 (mean), and +1SD, respectively. *p < .05, **p < .01, ***p < .001.

Table 4

PROCESS model 1 of political views as a moderator of the relationship of health literacy with COVID-19 protective behaviors, risk behaviors, and vaccine intentions.

	June 2020 Sample (N = 669)				February 2021 Sample (N = 611)			
	Effect	SE	t	95% CI [LL, UL]	Effect	SE	t	95% CI [LL, UL]
Protective Behavior								
Political Views	.067	.041	1.609	[-.015, .148]	.103	.040	2.572*	[.024, .181]
Health Literacy	.177	.041	4.269***	[.095, .258]	.116	.039	2.976**	[.039, .193]
PV x HL	.186	.045	4.108***	[.097, .275]	.078	.039	2.013*	[.002, .153]
Conservative	-.020	.064	-0.317	[-.145, .105]	.045	.056	0.805	[-.064, .154]
Moderate	.161	.042	3.858***	[.079, .242]	.124	.039	3.197**	[.048, .200]
Liberal	.341	.057	5.951***	[.229, .454]	.203	.055	3.700***	[.095, .311]
Risk Behavior								
Political Views	.040	.027	1.495	[-.013, .093]	.111	.041	2.719**	[.031, .191]
Health Literacy	-.242	.027	-8.999***	[-.295, -.189]	-.497	.040	-12.499***	[-.575, -.419]
PV x HL	-.212	.029	-7.200***	[-.270, -.154]	-.225	.039	-5.707***	[-.302, -.147]
Conservative	-.018	.041	-0.438	[-.099, .063]	-.291	.057	-5.132***	[-.402, -.179]
Moderate	-.224	.027	-8.283***	[-.277, -.171]	-.520	.040	-13.150***	[-.597, -.442]
Liberal	-.430	.037	-11.527***	[-.504, -.357]	-.749	.056	-13.377***	[-.859, -.639]
Vaccine Intentions								
Political Views	.186	.040	4.687***	[.108, .264]	.269	.038	7.023***	[.194, .344]
Health Literacy	.274	.040	6.894***	[.196, .351]	.208	.037	5.576***	[.135, .281]
PV x HL	.190	.043	4.380***	[.105, .275]	.074	.037	2.010*	[.002, .147]
Conservative	.073	.061	1.191	[-.047, .192]	.140	.053	2.631*	[.035, .244]
Moderate	.257	.040	6.451***	[.179, .336]	.216	.037	5.812***	[.143, .288]
Liberal	.442	.055	8.036***	[.334, .550]	.291	.053	5.546***	[.188, .394]

Note. For the 2020 analysis of protective behavior, N = 668. PV=Political Views, higher values reflect more liberal beliefs. HL=Health Literacy. Values for conservative, moderate, and liberal political views = -1SD, 0 (mean), and +1SD, respectively. *p < .05, **p < .01, ***p < .001.

For risk behavior and vaccine intentions in the 2021 sample, the relationships with health literacy were weakest for more conservative views, stronger for moderate views, and strongest for more liberal views.

3.3. Moderated mediation analyses

3.3.1. COVID-19 protective behavior

Preliminary analyses testing political views as a moderator of health literacy and mediating variables with COVID-19 protective behavior revealed that, of the mediators (accurate beliefs, inaccurate beliefs,

concern for society, and government control attitudes), moderated mediation was significant only for concern for society. Table 5 presents the results of the final PROCESS Model 8 testing moderated mediation. With the 2020 sample, the analysis revealed a direct, positive association of concern for society with protective behavior. Compared to the Model 1 moderation analysis for protective behavior (Table 4), this moderated-mediation model also yielded no direct relationship of political views with protective behavior and it yielded a significant but relatively weaker direct relationship of higher health literacy with higher protective behavior. Similarly, the Political Views × Health Literacy interaction and the conditional direct relationships of health literacy with protective behavior remain significant but relatively weaker for those with moderate and liberal levels of political views; as in the Model 1 analysis, the relationship of health literacy with protective behavior was not significant for those with more conservative views. The index for moderated mediation was significant, with mediation significant for moderate and liberal views and not significant for conservative views. The predicted patterns of mediation, therefore, held for participants with moderate and liberal political views, but they did not hold for participants with more conservative views.

For the 2021 sample, inclusion of concern for society as a mediator again revealed direct links of higher concern for society and higher health literacy with more protective COVID-19 behavior and no direct relationship of political views with protective behavior. Further, its inclusion led to a nonsignificant Political Views × Health Literacy interaction effect on protective behavior indicating that, while the pattern of conditional direct effects was similar to that observed with the 2020 sample, the differences in the strength of conditional direct effects did not achieve statistical significance. The pattern of moderated mediation was similar to that observed with the 2020 sample, with significant moderation for moderate and liberal political views but not for conservative views; however, the index of moderated mediation fell shy of statistical significance with the lower CI equating to 0.

3.4. COVID-19 risk behavior

Preliminary Model 8 analyses for COVID-19 risk behavior revealed significant moderated mediation for inaccurate beliefs, concern for society, and government control attitudes, but not for accurate beliefs. Table 6 presents the results of the Model 8 analyses with the three variables demonstrating significant moderated mediation. With the 2020 sample, more inaccurate beliefs, less concern for society, and higher attitudes of excessive government control were directly linked with more risk behavior. The inclusion of the mediator variables revealed a direct relationship of political views with risk behavior with

more liberal views associated with higher levels of risk behavior, and a direct link of health literacy with higher health literacy associated with lower risk behavior. These direct relationships were qualified by a significant Political Views × Health Literacy interaction. The conditional direct relationships of higher health literacy with lower risk behavior (Table 4) were reduced with the inclusion of the mediators but remained significant for moderate and liberal views; the direct relationship was not significant for conservative views. Inaccurate beliefs mediated the relationships of health literacy with risk behaviors at all levels of political views, with significant moderated mediation indicating differences across levels of political views: mediation was weakest for conservative views, stronger for moderate views, and strongest for liberal views. For both concern for society and excessive government control attitudes, significant moderated mediation was due to nonsignificant mediation for conservative views and significant mediation for moderate and liberal views; in both cases, mediation was stronger for liberal views than for moderate views.

For the 2021 sample, inaccurate beliefs and government control attitudes had direct, positive relationships with risk behavior whereas concern for society did not have a direct link with risk behavior. The direct links of political views and health literacy with risk behavior remained significant with the inclusion of the mediating variables. The Political Views × Health Literacy interaction effect and all three conditional direct relationships of higher health literacy with lower risk behavior (Table 4) were reduced with the inclusion of the mediators but remained significant. Inaccurate beliefs and government control attitudes exhibited significant moderation whereas concern for society did not. For inaccurate beliefs and government control attitudes, indirect effects (mediation) showed the same pattern of increasingly stronger mediation effects from conservative to moderate to liberal views.

3.5. Vaccine intentions

Preliminary Model 8 analyses for vaccine intentions revealed significant moderated mediation for concern for society and government control attitudes with the 2020 sample and with inaccurate beliefs and government control attitudes with the 2021 sample; moderated mediation effects of accurate beliefs were not significant in either analysis. The final analyses included inaccurate beliefs and concern for society to facilitate comparisons the two samples (Table 7).

With the 2020 sample, all three mediators had significant direct relationships with vaccine intentions in the predicted directions; the direct link of more liberal political views with higher intentions observed in the Model 1 analysis was no longer significant. The direct link of health literacy and the conditional direct relationships of higher health literacy

Table 5

PROCESS model 8 of moderated mediation for the relationship of health literacy with COVID-19 protective behavior with the moderating effects of political views indirectly mediated by concern for society.

	June 2020 Sample (N = 669)				February 2021 Sample (N = 611)			
	Effect	SE	t	95% CI [LL, UL]	Effect	SE	t	95% CI [LL, UL]
Protective Behavior								
Concern for Society	.448	.037	12.048***	[.375, .521]	.482	.040	12.088***	[.403, .560]
Political Views	-.063	.039	-1.603	[-.140, .014]	-.057	.038	-1.500	[-.133, .018]
Health Literacy	.093	.038	2.432*	[.018, .168]	.078	.035	2.208*	[.009, .147]
PV x HL	.124	.041	2.999**	[.043, .205]	.038	.035	1.100	[-.030, .107]
CDE: Conservative	-.039	.058	-0.667	[-.152, .075]	.042	.050	0.852	[-.055, .140]
CDE: Moderate	.082	.038	2.143*	[.007, .157]	.082	.035	2.330	[.013, .150]
CDE: Liberal	.203	.053	3.805***	[.098, .307]	.121	.050	2.423	[.023, .328]
IE: Concern Soc	.062	.025		[.016, .114]	.039	.021		[-.000, .081]
CIE: Conservative	.018	.035		[-.053, .085]	.002	.030		[-.060, .060]
CIE: Moderate	.079	.021		[.039, .119]	.042	.018		[.008, .077]
CIE: Liberal	.139	.028		[.087, .196]	.082	.024		[.037, .132]

Note. For the June 2020 analysis of protective behavior, N = 668. PV=Political Views, higher values reflect more liberal beliefs. HL=Health Literacy. CDE=Conditional direct effects of health literacy on protective behavior at the level of political views. IE: Concern Soc = Indirect effect through concern for society—Index of Moderated Mediation. CIE = Conditional indirect effect of health literacy on protective behavior through concern for society at the level of political views. Bolded values reflect significant CDE and CIE. Values for conservative, moderate, and liberal political views = -1SD, 0 (mean), and +1SD, respectively. *p < .05, **p < .01, ***p < .001.

Table 6

PROCESS model 8 of moderated mediation for the relationship of health literacy with COVID-19 risk behavior, with the moderating effects of political views indirectly mediated by incorrect COVID beliefs, concern for society, and government control attitudes.

	USA 2020 Sample (N = 669)				USA 2021 Sample (N = 611)			
	Effect	SE	t	95% CI [LL, UL]	Effect	SE	t	95% CI [LL, UL]
Risk Behavior								
Inaccurate Beliefs	.171	.039	4.345***	[.094, .248]	.402	.050	8.070***	[.304, .499]
Concern for Society	-.113	.028	-3.992***	[-.168, -.057]	.034	.041	0.831	[-.046, .114]
Govt is Controlling	.123	.034	3.649***	[.057, .189]	.227	.045	5.083***	[.139, .315]
Political Views	.107	.027	4.018***	[.055, .159]	.115	.038	3.006**	[.040, .190]
Health Literacy	-.102	.030	-3.474**	[-.160, -.045]	-.184	.041	-4.537***	[-.264, -.104]
PV x HL	-.141	.028	-5.008***	[-.196, -.085]	-.076	.035	-2.146*	[-.145, -.006]
CDE: Conservative	.046	.040	1.166	[-.032, .124]	-.114	.050	-2.271*	[-.213, -.016]
CDE: Moderate	-.090	.029	-3.084**	[-.148, -.033]	-.192	.041	-4.682***	[-.272, -.111]
CDE: Liberal	-.227	.041	-5.598***	[-.307, -.147]	-.269	.058	-4.609***	[-.384, -.154]
IE: Inaccurate Beliefs	-.028	.011		[-.052, -.008]	-.088	.020		[-.208, -.075]
CIE: Conservative	-.048	.019		[-.089, -.016]	-.138	.034		[-.208, -.075]
CIE: Moderate	-.075	.024		[-.123, -.029]	-.228	.039		[-.307, -.152]
CIE: Liberal	-.102	.032		[-.165, -.040]	-.317	.053		[-.424, -.216]
IE: Concern for Society	-.016	.008		[-.035, -.003]	.003	.005		[-.005, .014]
CIE: Conservative	-.005	.010		[-.025, .014]	.000	.004		[-.009, .007]
CIE: Moderate	-.020	.009		[-.039, -.006]	.003	.004		[-.006, .012]
CIE: Liberal	-.035	.013		[-.063, -.012]	.006	.008		[-.010, .024]
IE: Govt Control Att	-.028	.013		[-.057, -.007]	-.064	.020		[-.107, -.029]
CIE: Conservative	-.011	.009		[-.032, .004]	-.038	.016		[-.072, -.012]
CIE: Moderate	-.039	.015		[-.070, -.011]	-.103	.027		[-.160, -.054]
CIE: Liberal	-.066	.026		[-.120, -.019]	-.168	.046		[-.263, -.085]

Note. PV=Political Views, higher values reflect more liberal beliefs. HL=Health literacy. CDE=Conditional direct effects of health literacy on protective behavior at the level of political views. IE:=Indirect Effect through the mediator—Index of Moderated Mediation. CIE = Conditional indirect effect of health literacy on protective behavior through the mediator at the level of political views. Govt Control Att = Excessive government control attitudes. Bolded values reflect significant CDE and CIE. Values for conservative, moderate, and liberal political views = -1SD, 0 (mean), and +1SD, respectively. *p < .05, **p < .01, ***p < .001.

Table 7

PROCESS Model 8 of Moderated Mediation for the Relationship of Health Literacy with COVID-19 Vaccine Intentions with the Moderating Effects of Political Views Indirectly Mediated by Incorrect COVID Beliefs, Concern for Society, and Government Control Attitudes.

	June 2020 Sample (N = 669)				February 2021 Sample (N = 611)			
	Effect	SE	t	95% CI [LL, UL]	Effect	SE	t	95% CI [LL, UL]
Vaccine Intentions								
Inaccurate Beliefs	-.131	.058	-2.250*	[-.245, -.017]	.171	.050	3.430**	[.073, .268]
Concern for Society	.246	.042	5.884***	[.164, .328]	.339	.041	8.283***	[.259, .420]
Govt Controlling	-.160	.050	-3.219**	[-.258, -.063]	-.202	.045	-4.518***	[-.290, -.114]
Political Views	.071	.039	1.804	[-.006, .148]	.097	.035	2.451*	[.022, .172]
Health Literacy	.114	.044	2.527*	[.029, .200]	.188	.041	4.633***	[.108, .268]
PV x HL	.098	.041	2.360*	[.016, .179]	.027	.035	0.769	[-.042, .097]
CDE: Conservative	.011	.059	0.854	[-.104, .126]	.163	.050	3.235**	[.064, .262]
CDE: Moderate	.106	.043	2.443*	[.021, .191]	.191	.041	4.658***	[.110, .271]
CDE: Liberal	.201	.060	3.354**	[.083, .319]	.218	.058	3.742***	[.104, .333]
IE: Inaccurate Beliefs	.021	.013		[.000, .051]	-.037	.014		[-.068, -.012]
CIE: Conservative	.037	.021		[-.001, .083]	-.059	.022		[-.105, -.019]
CIE: Moderate	.058	.031		[-.001, .119]	-.097	.032		[-.161, -.034]
CIE: Liberal	.078	.042		[-.001, .163]	-.135	.045		[-.223, -.047]
IE: Concern Soc	.034	.015		[.009, .067]	.028	.015		[.000, .058]
CIE: Conservative	.010	.020		[-.030, .048]	.034	.015		[-.039, .043]
CIE: Moderate	.043	.014		[.019, .073]	.030	.013		[.006, .057]
CIE: Liberal	.076	.020		[.041, .119]	.058	.019		[.025, .097]
IE: Govt Control Att	.037	.015		[.011, .072]	.057	.019		[.023, .098]
CIE: Conservative	.015	.012		[-.005, .042]	.034	.015		[.009, .067]
CIE: Moderate	.050	.019		[.016, .092]	.092	.027		[.040, .147]
CIE: Liberal	.086	.032		[.027, .155]	.150	.044		[.065, .241]

Note. PV=Political Views, higher values reflect more liberal beliefs. HL=Health Literacy, CDE=Conditional direct effects of health literacy on protective behavior at the level of political views. IE:=Indirect Effect through the mediator—Index of Moderated Mediation. CIE = Conditional indirect effect of health literacy on protective behavior through the mediator at the level of political views. Bolded values reflect significant CDE and CIE. *p < .05, **p < .01, ***p < .001.

with higher vaccine intentions were reduced with the inclusion of the mediators but remained significant for moderate and liberal views; the direct relationship was not significant for conservative views. Inaccurate beliefs did not exhibit significant mediated moderation. For both concern for society and government control attitudes, significant moderated mediation was due to non-significant mediation for conservative views and significant mediation for moderate and liberal views; in both cases, mediation was stronger for liberal views than for moderate

views.

With the 2021 sample, all three mediators had significant, direct relationships with vaccine intentions in the predicted directions. Liberal political views and health literacy had positive, direct links with vaccine intentions. The conditional direct relationships of higher health literacy with higher vaccine intentions remained significant and were equivalent across political views. Health literacy had significant, indirect relationships with vaccine intentions through inaccurate beliefs and

government control attitudes that varied significantly as a function of political views. For each of these two mediators, the indirect relationship was weakest for conservative views, stronger for moderate views, and strongest for liberal views. The moderated mediation effect of concern for society was not significant.

4. Summary

Overall, the findings of the moderation and moderated mediation analyses exhibited substantial consistency with the hypothesized model. For example, Fig. 2 illustrates the pattern of findings regarding the predicted model paths for vaccine intentions. All predicted paths were significant except for the direct path of accurate beliefs with vaccine intentions; the moderated mediation effects for accurate beliefs in both samples; inaccurate beliefs in the 2020 sample only; and concern for society in the 2021 sample only.

5. Discussion

The COVID-19 pandemic provided unique opportunities to examine processes through which people interpret and respond to an unfamiliar health threat and make decisions about whether to engage in atypical behaviors such as social distancing, wearing face masks, and using sanitizers. The present findings contribute evidence of the associations of health literacy with health beliefs, attitudes, and behaviors and how the social context can shape those associations and create boundary conditions for when health literacy might promote adaptive outcomes. They also provide insights into values, beliefs, and concerns operating within the process of interpreting health information that could shape decisions and actions. Within the context of a pandemic that demanded rapid acquisition of accurate knowledge, appreciation of societal risks and the need for restrictive governmental policies, and protective behaviors adoption, health literacy emerged as an asset and its associations with behavior were mediated by accurate and inaccurate beliefs, concern for society, and government control attitudes. Importantly, however, these benefits of health literacy varied according to political

views.

There was considerable consistency in the moderating role of political views on the relationships between health literacy and belief, attitude, and behavior variables with the California samples surveyed in June 2020 and February 2021. The patterns of findings were consistent with the direct and mediated relationships delineated in our proposed model for participants with liberal views and, to a lesser extent, participants with moderate views. However, these relationships were weaker or absent for participants with conservative views. From a public health perspective, it appears that health literacy might have been an asset in promoting adaptive COVID-19 beliefs, attitudes, and behaviors for more liberal residents but less so for more conservative residents. These findings converge with findings that, in the US, conservative media downplaying of the COVID-19 risks undermines accurate COVID-19 beliefs, concerns about societal risks, endorsements of governmental policies, and protective behaviors (Hart et al., 2020; Moon et al., 2021). It is plausible that, relative to more liberal participants, conservative participants had greater exposure to conservative media and information and even those high in health literacy were likely to endorse the COVID-19 beliefs, policies, and behaviors promoted by conservative media at that time.

The evidence that conservative political views motivate cynicism about COVID-19 risks and, in turn, risky behaviors is striking given well-established tendencies for conservative beliefs to motivate protective behavior when confronting threats, especially infectious illnesses (Terzizzi et al., 2013). Those with conservative beliefs show stronger behavioral immune responses to illness cues, which heighten motivations to protect oneself from infection. In the US, political affiliations appear to have over-ridden these tendencies in response to COVID-19 and selective media consumption is likely a driving factor of this phenomenon. It should be noted, however, that links of conservative values and risk perceptions could be nuanced across situations and particularly with risks that are linked with political values; for example, values related to conservatism are associated with higher perceived risks of HPV vaccination (Kahan et al., 2010) and tendencies to discount risks of smoking (Ofori-Parku, 2020).

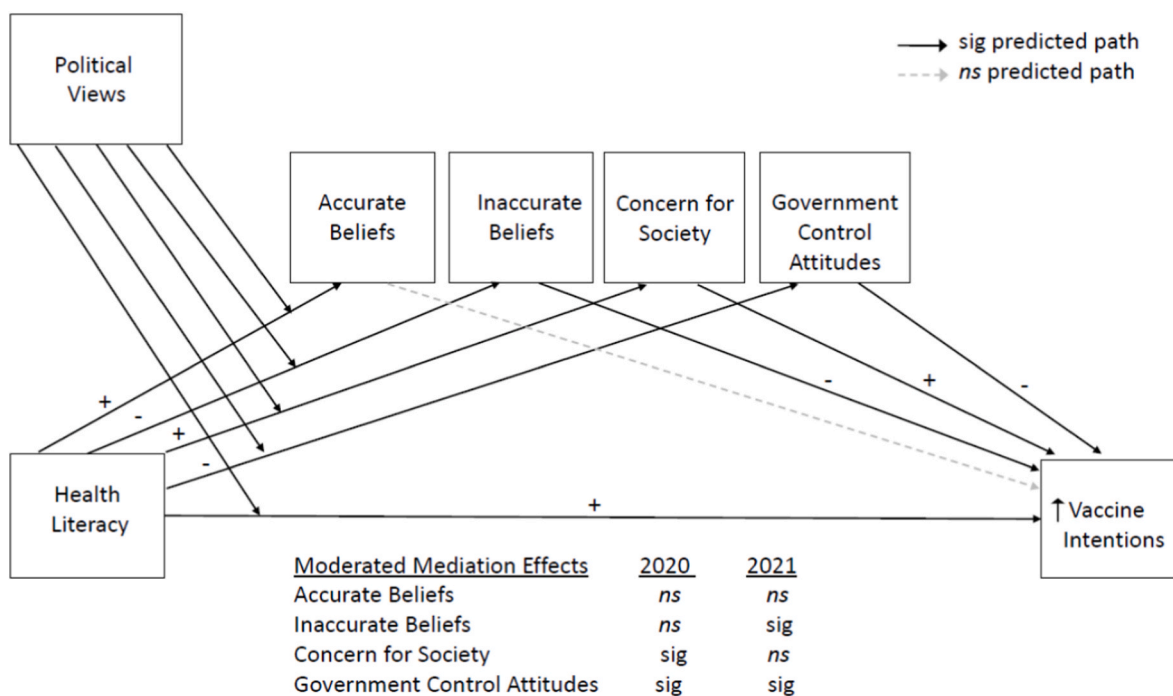


Fig. 2. Moderated mediation model depicting the significant (sig) and non-significant (ns) hypothesized paths obtained in the analyses testing the relationships of political views health literacy, correct COVID-19 beliefs, incorrect COVID-19 beliefs, concern about COVID-related threats for society, and excessive government control attitudes with vaccine intentions.

Interestingly, inaccurate beliefs and accurate beliefs were only modestly (negatively) correlated and they had different patterns of associations with behaviors and vaccine intentions. The findings suggest the importance of targeting both types of beliefs to motivate adaptive beliefs and behaviors, and the rapidity with which their relative importance in motivating behaviors can shift over time. Yet educational efforts face significant barriers with media consumption biases and misinformation spread through many channels (Tasnim et al., 2020). The findings underscore the need to embed training in media literacy along with health literacy within educational and public health systems (Ecker et al., 2022).

5.1. Limitations

The findings should be interpreted within the context of several study limitations. First, the study relied on cross-sectional data to test for mediation, which assumes cause-effect relationships. Given that political views and health literacy are ingrained facets that are unlikely to have been altered by the COVID-related factors in our model, there is sound rationale that the cross-sectional analyses are unlikely to be undermined by reverse-temporal or -causal influences although third variables cannot be ruled out. For the two analyses testing beliefs and attitudes as moderated mediators of the relationships of political views and health literacy with protective and risk behaviors, however, additional caution is warranted given that people can infer their beliefs and attitudes from their behaviors and alter their beliefs and attitudes to be in line with their behavior. It is recognized that cross-sectional analyses can be useful in identifying potential causal mechanisms, and particularly when theory and reasoning support the temporal process (e.g., Shrout, 2011). The findings can inform further research utilizing longitudinal and experimental designs to test the hypothesized model. Second, given that the study sampled only residents of three regions of California, the findings might not generalize to residents in other regions of the world, particularly given the extent to which COVID-19 beliefs and behaviors became highly politicized in the US. Finally, the study began shortly after the emergence of the pandemic when no published COVID-19 measures were available, thus necessitating the development of new measures of COVID-related constructs. As a reciprocal strength, the study provides psychometric evidence of their internal consistency and sensitivity to detect predicted relationships. However, the accurate beliefs item regarding the potential for COVID-19 to spread through touching contaminated surfaces, objects, and people was, by early 2021, beginning to be partially challenged by emerging findings that COVID-19 does not spread through touching contaminated surfaces. The accurate beliefs measure should be revised accordingly and in line with current evidence and changes due to vaccinations and new variants.

6. Conclusions

To conclude, findings from two surveys of California residents revealed that political views moderated the associations of health literacy with COVID-19 beliefs, attitudes, and behaviors; health literacy was linked with COVID-19 beliefs, attitudes, and behaviors as predicted for respondents with more liberal views but had weak or no links for those with more conservative views. These findings contribute new evidence of processes through which health literacy can lead to adaptive behaviors and how social and political contexts can shape those processes. Further research on COVID-19 beliefs and behavior can examine how these contextual influences and processes change as the pandemic evolves.

Credit author statement

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Methodology, Investigation, Writing – original draft preparation, Writing – review & editing; Alexandra Robbins-Hill: Conceptualization, Methodology, Writing – original draft preparation. Imrinder Toor: Methodology, Investigation; Data curation. Paul M. Brown: Conceptualization, Methodology, Investigation, Data curation, Writing – original draft preparation, Writing – review & editing.

Data availability

Data will be made available on request.

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References

- Aharon, A.A., Nehama, H., Rishpon, S., Baron-Epel, O., 2017. Parents with high levels of communicative and critical health literacy are less likely to vaccinate their children. *Patient Educ. Counsel.* 100, 768–775. <https://doi.org/10.1016/j.pec.2016.11.016>.
- Al Sayah, F., Johnson, S.T., Vallance, J., 2016. Health literacy, pedometer, and self-reported walking among older adults. *Am. J. Publ. Health* 106, 327–333. <https://doi.org/10.2105/AJPH.2015.302901>.
- Babicz, M.A., Woods, S.P., Matchanova, A., Medina, L.D., Podell, K., Walker, R.L., Avci, G., 2021. How did individual differences in neurocognition and health literacy influence the initial uptake and use of health-related information about COVID-19? *J. Clin. Exp. Neuropsychol.* 43, 497–513. <https://doi.org/10.1080/13803395.2021.1937579>.
- Bailey, S.C., Serper, M., Opsasnick, L., Persell, S., O'Conor, R., Curtis, L.M., Zheng, P., 2020. Changes in COVID-19 knowledge, beliefs, behaviors, and preparedness among high-risk adults from the onset to the acceleration phase of the US outbreak. *J. Gen. Intern. Med.* 35, 3285–3292. <https://doi.org/10.1007/s11606-020-05980-2>.
- Berkman, N.D., Sheridan, S.L., Donahue, K.E., Halpern, D.J., Crotty, K., 2011. Low health literacy and health outcomes: an updated systematic review. *Ann. Intern. Med.* 155, 97–107. <https://doi.org/10.7326/0003-4819-155-2-201107190-00005>.
- Chew, L.D., Bradley, K.A., Boyko, E.J., 2004. Brief questions to identify patients with inadequate health literacy. *Fam. Med.* 36, 588–594. PMID:15343421.
- Coriou, A., Moran, C., Campbell, T., Geller, A.C., 2020. Barriers and facilitators of adherence to social distancing recommendations during COVID-10 among a large international sample of adults. *PLoS One* 15, e0239795. <https://doi.org/10.1371/journal.pone.0239795>.
- Ecker, U.K.H., Lewandowsky, S., Cook, J., et al., 2022. The psychological drivers of misinformation belief and its resistance to correction. *Nat. Rev. Psychol.* 1, 13–29. <https://doi.org/10.1038/s44159-021-00006-y>.
- Faul, F., Erdfelder, E., Lang, A.G., Buchner, A., 2007. GPower 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav. Res. Methods* 39, 175–191. <https://doi.org/10.3758/BF03193146>.
- Gollwitzer, A., Martel, C., Brady, W.J., Pärnamets, P., Freedman, I.G., Knowles, E.D., Van Bavel, J.J., 2020. Partisan differences in physical distancing are linked to health outcomes during the COVID-19 pandemic. *Nat. Human Behav.* 4, 1186–1197. <https://doi.org/10.1038/s41562-020-00977-7>.
- Hart, P.S., Chinn, S., Soroka, S., 2020. Politicization and polarization in COVID-19 news coverage. *Sci. Commun.* 42, 679–697. <https://doi.org/10.1177/1075547020950735>.
- Hayes, A.F., 2022. *Introduction to Moderation, Mediation, and Conditional Process Analysis: A Regression-Based Approach*, third ed. Guilford Press, ISBN 9781462549030.
- Institute of Medicine, 2004. *Health Literacy: A Prescription to End Confusion*. National Academy Press, Washington DC. <https://doi.org/10.17226/10883>.
- International Union for Health Promotion and Education, 2018. *IUHPPE Position Statement on Health Literacy: a practical vision for a health literate world*. *Glob. Health. Promot.* 25, 79–88. <https://doi.org/10.1177/1757975918814421>.
- Jost, J.T., Glaser, J., Kruglanski, A.W., Sulloway, F.J., 2003. Political conservatism as motivated social cognition. *Psychol. Bull.* 129, 339–375. <https://doi.org/10.1037/0033-2909.129.3.339>.
- Kahan, D.M., Braman, D., Cohen, G.L., Gastl, J., Slovic, P., 2010. Who fears the HPV vaccine, who doesn't, and why? An experimental study of the mechanisms of cultural cognition. *Law Hum. Behav.* 34, 501–516. <https://doi.org/10.1007/s10979-009-9201-0>.
- Latkin, C.A., Dayton, L., Strickland, J.C., Colon, B., Rimal, R., Boodram, B., 2020. An assessment of the rapid decline of trust in US sources of public information about COVID-19. *J. Health Commun.* 25, 764–773. <https://doi.org/10.1080/10810730.2020.1865487>.
- Lee, Y.J., Boden-Albala, B., Jia, H., Wilcox, A., Bakken, S., 2015. The association between online health information-seeking behaviors and health behaviors among Hispanics in New York City: a community-based cross-sectional study. *J. Med. Internet Res.* 17, e261. <https://doi.org/10.2196/jmir.4368>.
- Lee, S.H., Lee, K.H., Chang, S.J., 2018. Do health literacy and self-care behaviours affect quality of life in older persons with lung cancer receiving chemotherapy? *Int. J. Nurs. Pract.* 24 <https://doi.org/10.1111/ijn.12691>.

- Leventhal, H., Bodnar-Deren, S., Breland, J.Y., Gash-Converse, J., Phillips, L.A., Leventhal, E., Cameron, L.D., 2012. Modeling health and illness behavior: the approach of the Common-Sense Model. In: Baum, A., Revenson, T., Singer, J. (Eds.), *Handbook of Health Psychology*, second ed. Psychology Press, Hoboken, pp. 3–36. <https://doi.org/10.1016/B978-0-80586-461-8>.
- McDougall, J.A., Banegas, M.P., Wiggins, C.L., Chiu, V.K., Rajput, A., Kinney, A.Y., 2018. Rural disparities in treatment-related financial hardship and adherence to surveillance colonoscopy in diverse colorectal cancer survivors. *Cancer Epidemiol. Biomarkers Prev.* 27, 1275–1282. <https://doi.org/10.1158/1055-9965.EPI-17-1083>.
- Moon, W., Atkinson, L., Kahlor, L.A., Yun, C., Son, H., 2021. U.S. Political partisanship and COVID-19: risk information seeking and prevention behaviors. *Health Commun.* <https://doi.org/10.1080/10410236.2021.1912948>.
- Morris, N.S., MacLean, C.D., Chew, L.D., Littenberg, B., 2006. The single item literacy screener: evaluation of a brief instrument to identify limited reading ability. *BMC Fam. Pract.* 7, 21–28.
- Ofori-Parku, S., 2020. Fifty years after surgeon general's report: cultural cognition, biased assimilation, and cigarette smoking risk perceptions among college students. *Health Risk Soc.* 22, 156–176. <https://doi.org/10.1080/13698575.2020.1769566>.
- O'Connor, R., Opsasnick, L., Benavente, J.Y., Russell, A.M., Wismer, G., Wolf, M.S., 2020. Knowledge and behaviors of adults with underlying health conditions during the onset of the COVID-19 U.S. outbreak: the Chicago COVID-19 Comorbidities Survey. *J. Commun. Healthc.* 45, 1149–1157. <https://doi.org/10.1007/s10900-020-00906-9>.
- Polite, B.N., Cipriano-Steffens, T.M., Liao, C., Miller, E.L., Arndt, N.L., Hahn, E.A., 2019. Investigation of a multimedia, computer-based approach to improve knowledge, attitudes, self-efficacy, and receptivity to cancer clinical trials among newly diagnosed patients with diverse health literacy skills. *Cancer* 125, 2066–2075. <https://doi.org/10.1002/ncr.31991>.
- Public Policy Institute of California, 2022. California voter and party profiles. June 16. <https://www.ppic.org/publication/california-voter-and-party-profiles/>.
- Shrout, P.E., 2011. Commentary: mediation analysis, causal process, and cross-sectional data. *Multivariate Behav. Res.* 46, 852–860. <https://doi.org/10.1080/00273171.2011.606718>.
- Tasnim, S., Hossain, M.M., Mazumder, H., 2020. Impact of rumors or misinformation on COVID-19 in social media. *J. Prev. Med. Public Health* 53, 171–174. <https://doi.org/10.3961/jpmph.20.094>.
- Terrizzi, J.A., Shook, N.J., McDaniel, M.A., 2013. The behavioral immune system and social conservatism: a meta-analysis. *Evol. Hum. Behav.* 34, 99–108. <https://doi.org/10.1016/j.evolhumbehav.2012.10.003>.
- United Nations Department of Economic and Social Affairs, 2022. Everyone Included: Social Impact of COVID-19. June 16. <https://www.un.org/development/desa/dspd/everyone-included-covid-19.html>.
- U.S. Census Bureau, 2022. Quick facts. June 16. <https://www.census.gov/quickfacts/fact/table/CA/INC110220>.
- Veldwijk, J., van der Heide, I., Rademakers, J., Schuit, A.J., de Wit, G.A., Uiters, E., Lambooi, M.S., 2015. Preferences for Vaccination: does health literacy make a difference? *Med. Decis. Making* 35, 948–958. <https://doi.org/10.1177/0272989X15597225>.
- Wolf, M.S., Serper, M., Opsasnick, L., O'Connor, R.M., Curtis, L., Benavente, J.Y., et al., 2020. Awareness, attitudes, and actions related to COVID-19 among adults with chronic conditions at the onset of the US outbreak: a cross-sectional survey. *Ann. Intern. Med.* 173, 100–109. <https://doi.org/10.7326/M20-1239>.
- Worldometer, 2022. COVID-19 Coronavirus Pandemic. June 24. <https://www.worldometers.info/coronavirus/>.
- Yamamoto, N., Jiang, B., Wang, H., 2021. Quantifying compliance with COVID-19 mitigation policies in the U.S.: a mathematical modeling study. *Infect. Dis. Model.* 6, 503–513. <https://doi.org/10.1016/j.idm.2021.02.004>.