










## RESEARCH ARTICLE

# Trust in COVID-19 public health information

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**Abstract**

Understanding the factors that influence trust in public health information is critical for designing successful public health campaigns during pandemics such as COVID-19. We present findings from a cross-sectional survey of 454 US adults—243 older (65+) and 211 younger (18–64) adults—who responded to questionnaires on human values, trust in COVID-19 information sources, attention to information quality, self-efficacy, and factual knowledge about COVID-19. Path analysis showed that trust in direct personal contacts ( $B = 0.071$ ,  $p = .04$ ) and attention to information quality ( $B = 0.251$ ,  $p < .001$ ) were positively related to self-efficacy for coping with COVID-19. The human value of self-transcendence, which emphasizes valuing others as equals and being concerned with their welfare, had significant positive indirect effects on self-efficacy in coping with COVID-19 (mediated by attention to information quality; effect = 0.049, 95% CI 0.001–0.104) and factual knowledge about COVID-19 (also mediated by attention to information quality; effect = 0.037, 95% CI 0.003–0.089). Our path model offers guidance for fine-tuning strategies for effective public health messaging and serves as a basis for further research to better understand the societal impact of COVID-19 and other public health crises.

## 1 | INTRODUCTION

Public trust in government and medical institutions plays an important role during pandemics such as COVID-19 (Bangerter et al., 2012; Imai et al., 2020; Lunn et al., 2020; van der Bles et al., 2020). At the same time, the massive scale at which the internet has been used to inform and to keep people employed and connected with peers amid strict physical distancing during COVID-19 is unprecedented (Limaye et al., 2020; World Health Organization, 2021). But the use of social media as a

source of health information is a relatively novel phenomenon that often (Brown-Johnson et al., 2018) unfortunately results in users obtaining inaccurate information that undermines public trust. The free flow of information on social media tends to reduce the information deficit (Wynne, 1993) left in the public's understanding of health information furnished by public institutions (Stephens et al., 2018; Xie, He, et al., 2020). Such deficits, though, are vulnerable to being replaced by misinformation and conspiracy theories (Schaeffer, 2020). For example, during the initial phase of the pandemic, about

one-fourth of popular COVID-19-related content on Twitter and YouTube contained misinformation (Kouzy et al., 2020; Li et al., 2020), including fraudulent preprint publications disguised as legitimate scientific research (Henrina et al., 2021). Besides misinformation, unverified and contradictory information about COVID-19 on social media can fuel anxiety and foster distrust of credible health information (Wong et al., 2021).

The global health crisis created by COVID-19 thus started an “infodemic,” a vast quantity of disinformation—inaccurate information that is known by the source to be inaccurate (Fallis, 2015)—intended to undermine the public health response (World Health Organization, 2020). Attitudes toward COVID-19 best practices and public trust in government and medical institutions were shaped along partisan lines by the news media (E. Zhao et al., 2020). Demographic factors, and attitudinal factors such as human values also influence how people receive health communication and take preventative measures during pandemics (Bish et al., 2011; Bish & Michie, 2010). However, few studies have examined how demographic factors may be related to trust in public health information, to self-efficacy related to COVID-19, and to factual knowledge about COVID-19.

In this study, we therefore model interrelationships among demographic factors (age, gender, and educational attainment), human values, trust in sources of COVID-19-related health information, self-efficacy related to COVID-19, and factual knowledge about COVID-19. An empirically based understanding of how the various constituent elements of the public health information ecosystem are related to each other has implications for public trust and the effectiveness of public health campaigns. In the rest of this paper, we use the terms misinformation and disinformation interchangeably to simplify the discussion.

## 2 | BACKGROUND

Traditional mass media rely on individuals with specialized knowledge and responsibilities related to information verification (Limaye et al., 2020). Despite having such editorial gatekeeping measures in place, the mass media have played an active role in spreading health misinformation since before the advent of social media (e.g., Begg et al., 1998). Being obligated to report statements made by public officials, mass media have nevertheless given airtime to polarizing statements by political figures, unsubstantiated and xenophobic conspiracy theories about the origins of COVID-19 (Hotez, 2021), and misinformed opinions—often either overly alarming or overly optimistic—by public figures with greater public following than scientists (Tagliabue et al., 2020). Mass

media have spread health misinformation about COVID-19 (Simonov et al., 2020) and vaccines in general even while publishing it for the purposes of debunking it (Tsfati et al., 2020), or by publishing unvetted and misinterpreted scientific research (Motta & Stecula, 2021; Tagliabue et al., 2020) sometimes with a sensationalist slant (The Lancet Infectious Diseases, 2020). During COVID-19, however, the mass media played an important role in the dissemination and amplification of disinformation originating in social media (World Health Organization, 2020; Zarocostas, 2020) motivated by round-the-clock news cycles and ideologically compromised editorial practices (Corner, 2017). Partisan bias in the news coverage of COVID-19 further amplified disinformation (Anwar et al., 2020) including appeals to unscientific and potentially hazardous “cures” (e.g., injecting bleach into the body, or, using hydroxychloroquine) (Yamey & Gonsalves, 2020), and opportunistic misinterpretation of the Vaccine Adverse Events Reporting System (VAERS; Motta & Stecula, 2021) database to spin anti-vaccine conspiratorial narratives. Disinformation spread through the nexus of mass media and social media has resulted in societal harms such as panic buying that has impacted the availability of essential medicines (Badell-Grau et al., 2020).

According to Pluye et al. (2019), the internet has become a common first source for healthcare information for individuals, yet the complexity of health topics and vast number of unfamiliar sources make it challenging to find reliable information (Chi et al., 2020). In general, the quality of online health information about COVID-19 has remained low on account of the novelty of COVID-19 and the consequent lack of journalistic expertise on the disease (Fan et al., 2020), delayed removal of health misinformation because of the large volume of posts and fear of backlash against censoring of user posts (Gisondi et al., 2022; Morrow et al., 2022), inadequate content moderation and labeling of inaccurate information on social media (Morrow et al., 2022), and the algorithmic bias toward incentivizing sensationalist content about COVID-19 vaccines (Burki, 2020). In addition, the speed with which information is created and spread online makes detecting misinformation practically impossible (Singh et al., 2021). A yet evolving scientific understanding of COVID-19 means that distinguishing between misinformation and credible novel information has remained a moving target, which has hindered public trust and conformance with mitigating measures (Limaye et al., 2020). Given the many advantages and disadvantages of social media for key stakeholders—patients, clinicians, and scientists (Cuello-Garcia et al., 2020)—there is a need to better understand the relationships among social media, and people's self-efficacy and factual knowledge with respect to COVID-19. Both high self-efficacy—people's beliefs regarding their ability to exercise

their knowledge and capabilities in specific situations (Bandura, 1982; Maddux & Gosselin, 2011)—and factual knowledge with respect to COVID-19 are vital for a successful global fight against the pandemic.

Health interventions increasingly encourage individuals to seek out information about medical conditions in order to feel empowered (Costello & Veinot, 2020). Besides traditional mass media and social media, direct personal contacts such as friends and family—relationships increasingly mediated by social media (Chambers, 2013)—also function as important sources of information, especially for older adults (Fisher et al., 2005; Ramanadhan & Viswanath, 2006). Such personal relationship networks facilitate exchange of health information because their members often share similarly relevant life experiences (Arcury et al., 2012). Such a network of contacts is built from common experiences and serves to reduce stress among individuals as well as provide information and resources (Walker et al., 2017). However, as the number of people, especially older adults, who use social media continues to increase (Pew Research Center, 2021), there is a latent threat to trust in such personal networks because of misinformation on the internet and on social media (Wong et al., 2021).

The abundance of disinformation about COVID-19 in the media is detrimental to achieving a timely end to the pandemic. However, the media ecosystem is constituted by the people who receive and use the information, and therefore examining the potential effects of demographic and psychosocial characteristics is critical to paint a clear picture. Among demographic characteristics, age is positively correlated with susceptibility to misinformation (Brashier & Schacter, 2020). Educational attainment has been positively correlated with trust in both state-run and private health institutions as sources of COVID-19 information (Latkin et al., 2020), but US adults reliant on social media for news tend to have lower levels of educational attainment (Mitchell et al., 2020). Here, we build on Schwartz's (1992) value theory, a widely adopted theory from social psychology. Human values can be understood as "guiding principles in people's lives" (Schwartz, 2007, p. 173), and may influence people's response to public health messaging and attitudes toward safe health behaviors (such as social distancing, mask use, and vaccinating). Schwartz provides an elaborate theoretical framework for understanding human values that, at the highest level of abstraction, he boils down to two value dimensions. The first value dimension involves where an individual places their focus—on themselves (self-enhancement) or on others (self-transcendence). The second value dimension addresses people's approach to change—whether they avoid it (conservation) or embrace it (openness to change).

According to Coelho et al. (2021), people who value self-enhancement and normative values such as tradition show less fear of COVID-19 and favor a reopening of the economy; whereas people who prioritize self-transcending, humanitarian values show greater fear of COVID-19 and prioritize people's health. Some prior research indicates that self-transcendence can enhance the receptivity of messages targeted to induce positive health behavior changes (Kang et al., 2018) and that self-transcendence can improve perceptions of well-being (Hwang et al., 2019) as well as motivate people to donate to charities related to healthcare (Castelo et al., 2021).

In this ecosystem of people, health information, and media technologies, trust emerges as a key mediator of the relationship between perceived information quality and the usage of information (Kelton et al., 2008). Trust is a social mechanism via which humans deal with the perceived instability and unpredictability of a complex world (Luhmann, 1979) and becomes a need when there is insufficient information (Etienne, 2021). Both because of mis- and disinformation about COVID-19, as well as because of the emergent nature of our medical and scientific understanding of the disease everyday life, business, governance, and public discourse have become more complex since the pandemic began (Bratianu, 2020; Gubrium & Gubrium, 2021; Pereira et al., 2021; Uhl-Bien, 2021). From this perspective, the media play an important role in providing access to information in a complex world and, thus, in enabling trust as a mechanism to reduce and manage complexity (Luhmann, 1979). Motivated by the need to understand the role of trust in society's collective response to COVID-19, we posed the following research questions as part of a larger NSF-funded project aimed at studying trust in public health information during COVID-19. *RQ1*: What factors influenced trust in public health information about COVID-19 across different media, as well as attention to information quality? *RQ2*: How do trust and attention to information quality relate to self-efficacy and factual knowledge about COVID-19?

### 3 | METHODS

This study was approved by the Institutional Review Board of the University of Texas at Austin. Informed consent was obtained prior to any data collection. This study employed a cross-sectional survey design. We used Prime Panels (Chandler et al., 2019; Verma et al., 2021) to recruit participants online. We collected data in five batches between June 26 and July 20, 2020, monitoring for data quality (see Section 3.3 for details) after each batch. We used stratified sampling by age to ensure a sufficient number of older adult participants,

TABLE 1 Participants' demographics ( $N = 454$ )

Demographic category	Participants, $n$ (%)		
	Overall	Older adults	Younger adults
Gender			
Female	289 (63.7)	147 (60.5)	142 (67.3)
Male	165 (36.3)	96 (39.5)	69 (32.7)
Total	454 (100)	243 (100)	211 (100)
Educational attainment			
High school or less	91 (20.0)	47 (19.3)	44 (20.9)
Some college	160 (35.2)	78 (32.1)	82 (38.9)
Bachelor's degree	126 (27.8)	70 (28.8)	56 (26.5)
Graduate degree	77 (17.0)	48 (19.8)	29 (13.7)
Total	454 (100)	243 (100)	211 (100)
Political leaning			
1 (conservative)	96 (21.1)	56 (23.0)	40 (19.0)
2	76 (16.7)	45 (18.5)	31 (14.7)
3	154 (33.9)	75 (30.9)	79 (37.4)
4	67 (14.8)	34 (14.0)	33 (15.6)
5 (liberal)	61 (13.4)	33 (13.6)	28 (13.3)
Total	454 (100)	243 (100)	211 (100)
Racioethnicity			
Hispanic	25 (5.5)	4 (1.6)	21 (10.0)
Non-Hispanic American Indian or Alaskan native	4 (0.9)	2 (0.8)	2 (0.9)
Non-Hispanic Asian	12 (2.6)	7 (2.9)	5 (2.4)
Non-Hispanic Black	30 (6.6)	11 (4.5)	19 (9.0)
Non-Hispanic White	363 (80.0)	210 (86.4)	153 (72.5)
Non-Hispanic two or more races	13 (2.9)	4 (1.6)	9 (4.3)
Non-Hispanic other	7 (1.5)	5 (2.1)	2 (0.9)
Total	454 (100)	243 (100)	211 (100)

given the degree to which online panel participants generally skew younger than the overall population (Chandler et al., 2019) and given the degree to which COVID-19 has disproportionately impacted older adults (Xie, Charness, et al., 2020). Thus, we attempted to recruit roughly equal numbers of older (65+) and younger (18–64) adults (Verma et al., 2021). We obtained 669 responses from 397 (59.3%) adults aged 18–64 years and from 272 (40.7%) adults aged 65+ years. We screened the responses based on data quality to arrive at a final sample of  $N = 454$  participants for the analysis, including 243 participants aged 65+ and 211 participants aged 18–64. Since we had more than the

recommended minimum of 20 cases per variable of interest for path analysis the size difference between the two age-category subsamples is unlikely to impact the outcome of the analysis (Stage et al., 2004). The ages of participants in the final sample ranged from 18 to 87 years ( $M = 57.3$ ,  $SD = 17.7$ ). The sample's demographic characteristics are summarized in Table 1.

### 3.1 | Instruments and measurements

**Media trust:** We asked participants “How much trust do you have in COVID-19 health information that you receive from”: and participants reported their trust in mass media (“newspapers, TV, radio, etc.”), social media (“Facebook, Twitter, Instagram, etc.”), and direct personal contacts (“in person, telephone, email, etc.”) as sources of COVID-19 health information on 5-point Likert-type items ranging from 1 (“No Trust”) to 5 (“Complete Trust”).

**Attention to information quality:** To assess how people evaluate online health information, we adapted a fact sheet published by the NIH (Office of Dietary Supplements, 2011) into a battery of six Likert-type items. We asked participants to indicate the extent to which they paid attention (1 = “Not at All” to 5 = “To an Extremely Large Extent”) to the following aspects of online sources of COVID-19 health information: original source of information; reliability of original source; currency of information; whether or not the information could be corroborated by other sources; whether the information came with supporting evidence; and whether there was a commercial interest in the information. Based on exploratory factor analysis, we retained the first five items and removed the last item—attention to commercial interests—from the analysis. Cronbach  $\alpha$  for the 5-item scale was .88; we used the mean of the five items in the analysis.

**COVID-19 related self-efficacy:** Bandura (1982) defines self-efficacy as one's “judgments of how well [they] can execute courses of action required to deal with prospective situations” (p. 122). To assess perceived self-efficacy about coping with COVID-19, we asked participants to report the degree to which they agreed (1 = “Disagree Completely” to 5 = “Agree Completely”) with the following three statements: “I know whom to contact if I'd like to get the COVID-19 test,” “I know what the typical symptoms of COVID-19 are,” and “I know the recommended practices and measures that I need to take when I exhibit COVID-19 symptoms.” This section of the survey also included two attention checks: one instructional manipulation check (Kane & Barabas, 2019; Oppenheimer et al., 2009), and one item that was repeated to check for response consistency.

Cronbach  $\alpha$  for this three-item scale was .76. We used the mean of the three items in the analysis.

*Factual knowledge about COVID-19:* We displayed five verified facts about COVID-19 sourced from the US CDC and the World Health Organization (Centers for Disease Control and Prevention, 2020; World Health Organization, 2021) to gauge participants' factual knowledge about COVID-19. Each claim was followed by three options: "True," "False," and "Unsure." We calculated each participant's overall score on factual knowledge as the number of items marked true leading to scores in the range 0–5.

*Portrait values questionnaire (PVQ):* We included a gender-neutral version of Schwartz's 21-item PVQ (Schwartz, 2007) to measure participants' orientations across 10 universally recognized basic human values. To simplify the path analysis, we obtained two condensed value scores by subtracting scores on two conceptually opposed pairs of values as Schwartz (2005) has suggested: openness to change (as opposed to conservation) as the difference between stimulation and security (Cronbach  $\alpha = .69$ ); and self-transcendence (as opposed to self-enhancement) as the difference between universalism and achievement (Cronbach  $\alpha = .67$ ). Schwartz (2012) defines openness to change as a set of values that converge on independent thinking and acting, and on embracing change, whereas conservation refers to values that prioritize order, self-restriction, preservation of traditions, and a general resistance to change. Schwartz (2012) defines self-transcendence as a set of values that foreground concerns about the interests and welfare of others, whereas its conceptually opposed value of self-enhancement as a set of values that drive concerns about focusing on one's own interests, success, and dominance in social groups.

*Demographic questionnaire:* We asked participants to specify their age, gender identity, educational attainment, race, ethnicity, and political leaning. Given the unrepresentative distributions typically found in online panels in terms of age, racioethnicity (an aggregation of race and ethnicity), and political leaning (Chandler et al., 2019), stratified sampling is necessary to study any of these variables. As explained above, we chose to conduct stratified sampling based on age; as a result, we used racioethnicity and political leaning as control variables in the path analysis.

*eHealth literacy:* We used the eHEALS scale (Office of Dietary Supplements, 2011) to measure participants' eHealth literacy as a control variable in the path analysis, given that it could serve as a potential confounder.

### 3.2 | Pilot testing

We pilot-tested the survey with three older adults (two female and one male) recruited from within the authors'

established relationships with local community partners. Each pilot test participant was compensated with an Amazon gift card. We conducted cognitive interviews (Beatty & Willis, 2007; Drennan, 2003; Ingersoll-Dayton, 2011; Jobe & Mingay, 1990) over the phone with participants to determine usability issues in the survey. We asked participants to think aloud as they interacted with each page of the survey. Each interview lasted approximately 45 min and helped us identify and fix accessibility issues such as clicking fatigue and font illegibility.

### 3.3 | Data validation

*Age validation:* We compared each participant's self-reported age with that in the age data provided by Prime Panels. For each participant, we allowed for a  $\pm 1$  year age difference between the two data sets. Of the 669 responses collected, 52 responses (7.8%) failed this validation test.

*Missing data:* Eleven responses (1.6%) were incomplete or had missing fields.

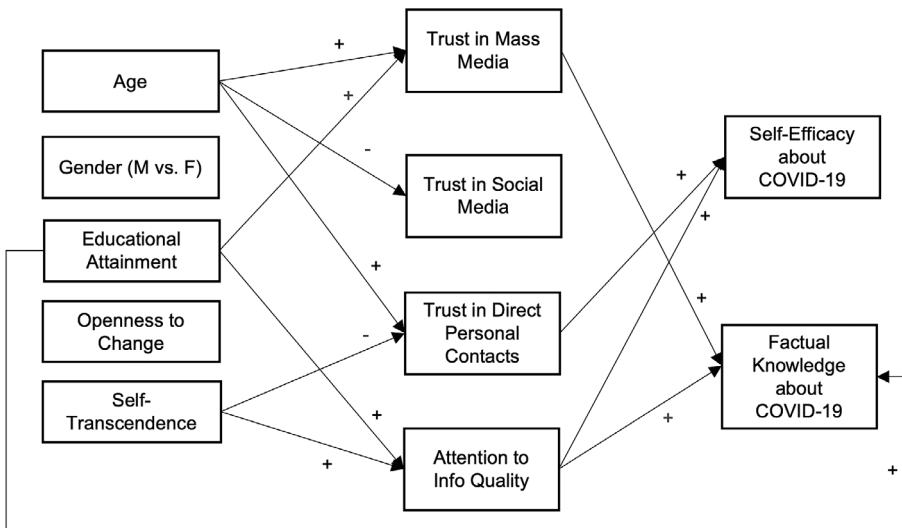
*Attention checks:* 114 participants (17%) failed at least one of the two attention checks.

*Careless responders:* Checking for long-string responses (where any section with five or more items was marked with the same option) and a survey response time cutoff (spending less than 2 s per item on a given page), we identified 81 (12.1%) careless responses (Curran, 2016; Huang et al., 2012; Meade & Craig, 2012).

Thus, out of 669 responses, 195 (29.1%) failed one or more of the validation criteria, leaving us with 474 responses. To simplify analysis, we designated "Prefer not to answer" responses to demographic items as missing data, and thus removed another 20 responses, bringing our final sample size to  $N = 454$ .

### 3.4 | Data analysis

To test all of the relationships implicated in our research questions at once, we conducted path analysis using Mplus version 8.2 (Muthén & Muthén, 2017). In the path model, we specified age, educational attainment, gender, and human values as predictor variables. Mediating variables included trust in the three types of media sources and attention to information quality. Outcome variables included self-efficacy about COVID-19 and factual knowledge about COVID-19. Control variables included racioethnicity, political leaning, and eHealth literacy. The selection of predictor, mediating, outcome, and control variables was informed by the relevant literature, our research questions, and limitations in collecting representative data using online panels.



**FIGURE 1** Path analysis model for factors affecting trust in the media, attention to information quality, self-efficacy and factual knowledge related to COVID-19. (For the purpose of clarity, only statistically significant paths are illustrated in the figure. See complete results in Tables 2 and 3)

Figure 1 shows the estimated path model, where the relationships between the predictors and the mediating variables correspond to RQ1 and the relationships between the mediating variables and the outcome variables correspond to RQ2. In addition to the main effects of age, educational attainment, gender, and human values, we included two-way interaction terms between (a) age and human values, (b) age and gender, (c) age and educational attainment, (d) human values and gender, and (e) human values and educational attainment. Following Cohen et al. (2003) interaction terms were created by multiplying the mean-centered scores of continuous variables (age, educational attainment, and human values) with the categorical variable (i.e., gender).

## 4 | RESULTS

Estimates of the unstandardized coefficients in the path model (Figure 1) are presented in Tables 2 and 3.

In terms of main effects, path analysis results showed that age was positively related to trust in mass media ( $B = 0.014$ ,  $p = .001$ ), negatively related to trust in social media ( $B = -0.011$ ,  $p = .004$ ), and positively related to trust in direct personal contacts ( $B = 0.010$ ,  $p = .008$ ). These findings imply that older age is associated with greater trust in the mass media and direct personal contacts and is negatively associated with trust in social media. Educational attainment was positively related to trust in mass media ( $B = 0.162$ ,  $p = .003$ ), positively related to attention to information quality ( $B = 0.183$ ,  $p < .001$ ), and positively related to factual knowledge about COVID-19 ( $B = 0.079$ ,  $p = .047$ ). Self-transcendence was negatively related to trust in direct personal contacts ( $B = -0.272$ ,  $p = .009$ ) and positively related to attention to information quality ( $B = 0.195$ ,

$p = .02$ ). Gender and openness to change did not have any significant main effect on the mediating or outcome variables. As for the effects of the mediating variables on the outcomes, trust in mass media ( $B = 0.07$ ,  $p = .045$ ) and attention to information quality ( $B = 0.191$ ,  $p < .001$ ) were positively related to factual knowledge about COVID-19. Trust in direct personal contacts ( $B = 0.071$ ,  $p = .04$ ) and attention to information quality ( $B = 0.251$ ,  $p < .001$ ) were positively related to self-efficacy for COVID-19.

To estimate and test indirect effects, 1,000 bootstrap samples were created and 95% bias-corrected CIs of the indirect effects were created (MacKinnon et al., 2006). As reported in Table 4, age had a significant positive indirect effect on factual knowledge mediated by trust in mass media (effect = 0.001, 95% CI 0.000–0.003), and a significant positive indirect effect on self-efficacy mediated by trust in direct personal contacts (effect = 0.001, 95% CI 0.000–0.002). Educational attainment had a significant positive indirect effect on factual knowledge mediated by trust in mass media (effect = 0.011, 95% CI 0.000–0.033) and attention to information quality (effect = 0.035, 95% CI 0.015–0.069), as well as a significant positive indirect effect on self-efficacy mediated by attention to information quality (effect = 0.046, 95% CI 0.022–0.080). Self-transcendence had a significant negative indirect effect on self-efficacy mediated by trust in direct personal contacts (effect =  $-0.019$ , 95% CI  $-0.057$  to  $-0.001$ ), and a significant positive indirect effect on self-efficacy mediated by attention to information quality (effect = 0.049, 95% CI 0.001–0.104). Self-transcendence also had a significant positive indirect effect on factual knowledge mediated by attention to information quality (effect = 0.037, 95% CI 0.003–0.089).

Figures 2–5 illustrate the significant two-way interaction effects. Age and self-transcendence had a significant

TABLE 2 Estimates of unstandardized coefficients between predictors and mediators ( $N = 454$ )

	Trust in mass media			Trust in social media			Trust in direct personal contacts			Attention to information quality		
	<i>B</i>	<i>SE</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>p</i>
Intercept	3.236	0.078	<.001	2.115	0.068	<.001	2.915	0.071	<.001	4.005	0.058	<.001
Control variable												
Racioethnicity <sup>a</sup>	0.123	0.137	.37	0.116	0.12	.34	0.115	0.124	.35	-0.119	0.102	.24
Political leaning	.31	0.042	<.001	0.05	0.037	.17	0.07	0.038	.07	0.085	0.031	.007
eHealth literacy	-0.058	0.077	.45	-0.13	0.067	.054	-0.079	0.07	.26	-0.295	0.057	<.001
Main effect												
Age	0.014	0.004	.001	-0.011	0.004	.004	0.01	0.004	.008	0.001	0.003	.86
Gender (M vs. F)	-0.132	0.117	.26	-0.116	0.102	.25	0.064	0.106	.54	-0.011	0.087	.9
Educational attainment	0.162	0.055	.003	-0.014	0.048	.77	0.057	0.05	.26	0.183	0.041	<.001
Openness to change	-0.204	0.107	.06	0.163	0.093	.08	-0.016	0.097	.87	-0.056	0.08	.48
Self-transcendence	-0.145	0.116	.21	-0.184	0.101	.07	-0.272	0.105	.009	0.195	0.086	.02
Two-way interaction												
Age × openness to change	0.001	0.005	.88	0.004	0.004	.38	0.001	0.004	.73	0.002	0.003	.51
Age × self-transcendence	0.016	0.005	.002	0.004	0.004	.36	0.007	0.005	.14	0.001	0.004	.81
Age × gender	-0.01	0.007	.2	-0.011	0.007	.08	-0.021	0.007	.002	-0.007	0.006	.19
Age × educational attainment	-0.004	0.003	.26	-0.007	0.003	.02	0.000	0.003	.99	0.005	0.003	.052
Openness to change × gender	0.081	0.183	.66	0.051	0.16	.75	-0.305	0.166	.06	-0.225	0.136	.1
Openness to change × educational attainment	0.075	0.095	.42	-0.126	0.083	.13	0.049	0.086	.56	0.056	0.07	.43
Self-transcendence × gender	-0.036	0.192	.85	-0.072	0.168	.67	0.123	0.174	.48	-0.014	0.143	.92
Self-transcendence × education	-0.085	0.09	.34	-0.147	0.078	.06	-0.128	0.081	.12	-0.084	0.067	.21
<i>R</i> <sup>2</sup>	0.191			0.170			0.072			0.159		

<sup>a</sup>Minority versus non-Hispanic White.

interaction effect on trust in mass media (Figure 2). Age was positively related to trust in mass media among individuals with higher self-transcendence (for self-transcendence at  $M + 1 SD$ ,  $B = 0.024$ ,  $p < .001$ ) but not among those with lower self-transcendence (for self-transcendence at  $M - 1 SD$ ,  $B = 0.005$ ,  $p = .36$ ). Older adults with higher self-transcendence had more trust in mass media than did their younger counterparts.

Age and education had a significant interaction effect on trust in social media (Figure 3). Age was negatively related to trust in social media, and this effect was greater among individuals with higher education (for education at the graduate level,  $B = -0.022$ ,  $p = .001$ ) than among

those with lower education (for high school or less,  $B = -0.001$ ,  $p = .87$ ). Older adults with higher education had the lowest level of trust in social media.

Age and gender had a significant interaction effect on trust in direct personal contacts (Figure 4). Age was positively related to trust in direct personal contacts among females ( $B = 0.010$ ,  $p = .008$ ), but that relationship was not statistically significant for males ( $B = -0.011$ ,  $p = .06$ ). Gender and openness to change had a significant interaction effect on self-efficacy: openness to change was negatively related to self-efficacy for males ( $B = -0.241$ ,  $p = .008$ ) but not for females ( $B = 0.019$ ,  $p = .78$ ) (Figure 5). Males with higher openness to change had lower self-efficacy for COVID-19.

TABLE 3 Estimates of unstandardized coefficients between mediators and outcomes

	Self-efficacy about COVID-19			Factual knowledge about COVID-19		
	<i>B</i>	<i>SE</i>	<i>p</i>	<i>B</i>	<i>SE</i>	<i>p</i>
Intercept	3.014	0.19	<.001	3.737	0.218	<.001
Control variable						
Racioethnicity <sup>a</sup>	0.034	0.084	.68	−0.411	0.097	<.001
Political leaning	−0.035	0.027	.2	0.009	0.031	.77
eHealth literacy	−0.131	0.049	.007	−0.137	0.056	.014
Main effect						
Age	0.001	0.003	.84	−0.001	0.003	.64
Gender (M vs. F)	0.024	0.072	.74	−0.014	0.082	.86
Educational attainment	0.026	0.035	.45	0.079	0.04	.047
Openness to change	0.019	0.066	.78	−0.013	0.076	.86
Self-transcendence	0.000	0.072	.996	0.127	0.083	.12
Two-way interaction						
Age × openness to change	0.002	0.003	.47	0.003	0.003	.4
Age × self-transcendence	−0.006	0.003	.06	0.003	0.004	.36
Age × gender	−0.007	0.005	.11	0.003	0.005	.53
Age × educational attainment	0.000	0.002	.87	0.001	0.002	.7
Openness to change × gender	−0.259	0.112	.02	−0.016	0.129	.9
Openness to change × educational attainment	−0.077	0.058	.19	−0.045	0.067	.5
Self-transcendence × gender	0.111	0.118	.34	0.187	0.135	.17
Self-transcendence × educational attainment	−0.088	0.055	.11	−0.018	0.063	.78
Mediator						
Trust in mass media	0.026	0.030	.38	0.07	0.035	.045
Trust in social media	0.016	0.036	.66	−0.029	0.042	.48
Trust in direct personal contacts	0.071	0.034	.04	−0.06	0.039	.12
Attention to information quality	0.251	0.039	<.001	0.191	0.045	<.001
<i>R</i> <sup>2</sup>	0.192			0.177		

<sup>a</sup>Minority versus non-Hispanic White.

TABLE 4 Indirect effects based on unstandardized coefficients

Predictor	Mediator	Outcome	Indirect effect	
			Estimate	95% CI
Age	Trust in mass media	Factual knowledge	0.001	(0.000, 0.003)
	Trust in direct personal contacts	Self-efficacy	0.001	(0.000, 0.002)
Educational attainment	Trust in mass media	Factual knowledge	0.011	(0.000, 0.033)
	Attention to information quality	Factual knowledge	0.035	(0.015, 0.069)
	Attention to information quality	Self-efficacy	0.046	(0.022, 0.080)
Self-transcendence	Trust in direct personal contacts	Self-efficacy	−0.019	(−0.057, −0.001)
	Attention to information quality	Self-efficacy	0.049	(0.001, 0.104)
	Attention to information quality	Factual knowledge	0.037	(0.003, 0.089)



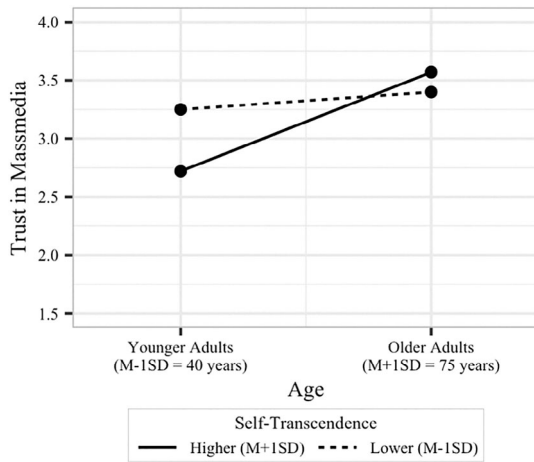


FIGURE 2 Two-way interaction: age × self-transcendence → trust in mass media

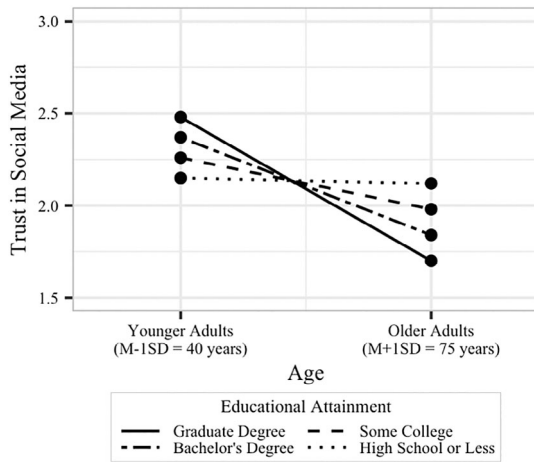


FIGURE 3 Two-way interaction: age × educational attainment → trust in social media

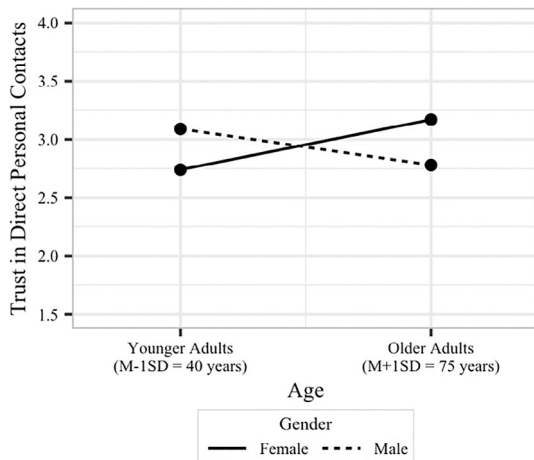


FIGURE 4 Two-way interaction: age × gender → trust in direct personal contacts

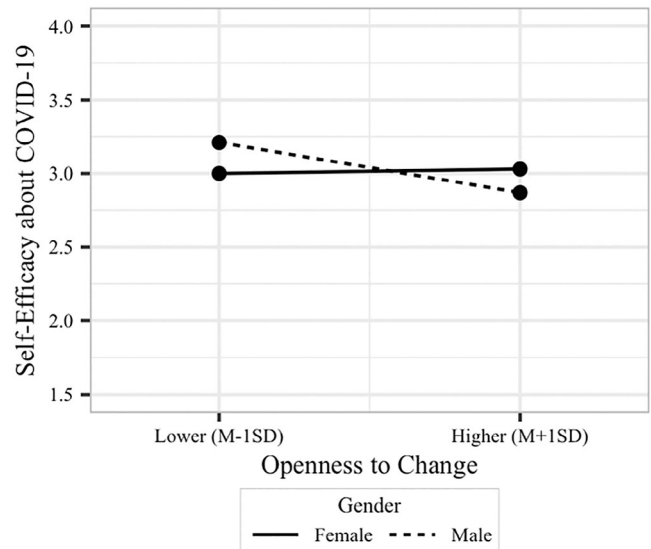


FIGURE 5 Two-way interaction: gender × openness to change → self-efficacy for COVID-19

## 5 | DISCUSSION

The design of our study was driven by two research questions: (RQ1) What factors influenced trust in public health information about COVID-19 across different media, as well as attention to information quality, and (RQ2) how do trust and attention to information quality relate to self-efficacy and factual knowledge about COVID-19? Our questions were motivated by our concern about the abundance of COVID-19 related misinformation on social media and the mass media (Anwar et al., 2020; Fan et al., 2020; Kouzy et al., 2020; Li et al., 2020; Simonov et al., 2020; World Health Organization, 2020; Yamey & Gonsalves, 2020; Zarocostas, 2020).

For RQ1, we found that age, educational attainment, and self-transcendence had significant influence on trust in mass media, social media, and direct personal contacts as sources of COVID-19 health information, as well as on attention to information quality.

As Figure 1 shows, compared with younger adults, older adults had higher trust in mass media and direct personal contacts and lower trust in social media as sources of health information about COVID-19. Lower trust in social media among older adults and the growing proportion of US older adults using social media (Pew Research Center, 2021) could create further challenges, as has been outlined in prior research (Abd-Alrazaq et al., 2020; Chakraborti & Roberts, 2020; Mattingly & Hogue, 2020; Stephens et al., 2018; Wong et al., 2021; Xie, He, et al., 2020). Older adults' online health information seeking behaviors remain understudied in the health information literature (Zhao et al., 2022). Given that older adults have been the most vulnerable to severe

disease from SARS-CoV-2, the disparity in this group's trust in traditional information sources (mass media and direct personal contacts) and social media needs further investigation. These findings call for an adaptable public health messaging strategy that tailors messages to the medium of communication to persuade a diverse population. An effective and persuasive strategy for public health messaging is vital for increasing COVID-19 vaccine uptake and thus for shortening the duration of the pandemic status of the disease (James et al., 2021), as well as for improving adherence to preventive behaviors (Bokemper et al., 2022).

Educational attainment was positively associated with trust in mass media and with attention to information quality (Figure 1). Attention to information quality was, in turn, positively related to factual knowledge about COVID-19. Further, as Figure 3 shows, the gap in trust in social media between older and younger adults increased with educational attainment, although this observation may be an artifact of the cohort effect, because younger adults are more likely to use and trust social media as both Figures 1 and 3 show. Thus, our findings resonate with prior work which has argued for the need for public health officials to employ a wide range of media (Fridman et al., 2020). The novelty of SARS-CoV-2 and COVID-19 put pressure on people as they evaluated and comprehended emerging information about the disease. As a consequence of the information overload and anxiety, Wang et al. (2021) argue, people could increase their reliance on a heuristic mode of thinking that is parsimonious in its use of cognitive resources, but at the same time makes them vulnerable to subtle “nudges” delivered via the multiple information channels. However, higher levels of education are predictive of a generally better ability to discern the accuracy of information online (Allcott & Gentzkow, 2017). Therefore, continued investment in education programs is important to prepare society against deleterious effects of crises of information quality and overload in the future.

Self-transcendence—behaviors and attitudes characterized by having an understanding and appreciation for the welfare of others (Schwartz, 2007)—is negatively associated with trust in direct personal contacts and positively associated with attention to information quality (Figure 1). The preceding finding could potentially be explained by the drive for self-transcendent individuals to seek authoritative sources of health information from beyond their personal networks to ensure welfare at the societal level. People who value self-enhancement (as opposed to self-transcendence), on the other hand, reported more trust in their personal contacts to obtain information about COVID-19. A self-enhancement orientation resonates with the notion of investing in and

tapping into one's social capital to further their own interests. Such social capital is primarily invested in small personal networks of *particular* others who know and interact closely with each other (Delhey et al., 2011; Siisiäinen, 2000). Close relationships with others facilitate a shared and an emotionally and motivationally harmonious understanding of the world (Andersen & Przybylinski, 2018). The social capital invested in one's personal network affords people access to a transactive memory which is defined as a “mechanism through which groups collectively encode, store, and retrieve knowledge” (Zimmer & Henry, 2017, p. 8). Transactive memory systems facilitate the identification and designation of “local experts” that are highly accessible and perceived as sources of high-quality information (Zimmer & Henry, 2017), enhancing the appeal of personal relationship networks especially among people with a self-enhancement orientation. Further research is needed to investigate how the individual's “trust radius” (Delhey et al., 2011) could be increased to be inclusive of unknown others (including public health experts and the broader community) as trusted individuals, and thus to foster greater civic cooperation, which is critical during public health crises.

Concordance between the values represented by messages and the values held by the message recipients is highly likely to elicit an empathetic response to the messaging (Dennison, 2020) as well as a positive response to media literacy campaigns (Chambers et al., 2022). Given our finding that the value of self-transcendence is positively associated with greater factual knowledge about COVID-19 (mediated by attention to information quality), we argue that public health messages should target not only people who value self-transcendence but also people who value self-enhancement (e.g., by centering the self as a beneficiary of mask use). Gender did not have significant main or indirect effects, but it interacted with age and openness to change. Older females had more trust in direct personal contacts than did older males, and the trend reversed for younger adults (Figure 4). Openness to change seemed to affect self-efficacy among males more than it did for females (Figure 5). Prior research explains this finding as a result of a cohort effect, given the changing roles and employment status of mothers over time (Stern et al., 2012). Even though our analyses did not reveal a main or indirect effect of gender on trust in the different COVID-19 information channels, gender has been found to determine health information behavior, particularly in the assessment of trustworthiness of information and information sources (Rowley et al., 2017). Due to systemic inequities in the demographic make-up of the healthcare system women have been disproportionately exposed to

SARS-CoV-2 and a multitude of stresses related to the pandemic (Connor et al., 2020). Emotional and mental stress can lead people to regress to a heuristic mode of ingesting information, thus becoming more vulnerable to being persuaded by ideologically or politically motivated messaging (Wang et al., 2021). Therefore, further research is needed to better assess how gender and gender roles may be implicated as factors in health information behavior.

In response to RQ2, we found that factual knowledge about COVID-19 was directly positively associated with trust in mass media as a source of COVID-19 health information, attention to COVID-19 health information quality, and educational attainment. The positive association between trust in mass media and factual knowledge about COVID-19 (Figure 1) corroborates similar findings from Bridgman et al. (2020) and further emphasizes the need to ensure that mass media remain trustworthy and to use mass media effectively for messaging campaigns during large-scale health crises. Given that trust in mass media was lower among younger adults efforts to increase the trustworthiness of mass media—such as enhancing procedural norms in the media professions and making mass media more dialogical and interactive for the audience (Collins, 2009)—should be focused on younger adults. The positive association between educational attainment and accuracy of factual knowledge was also observed in a study in Germany, which also found higher education to be predictive of perceived severity of COVID-19 and of compliance with behavioral regulations with some variation across gender identities (Rattay et al., 2021).

Self-efficacy related to COVID-19—being confident about whom to contact, what symptoms to look for, what recommended practices to carry out in case of illness—is positively associated with trust in direct personal contacts and with attention to information quality. A positive perception of self-efficacy about COVID-19 has a direct influence on people's observance of behavioral precautionary measures such as masking and social distancing (Chong et al., 2020). Self-efficacy has a positive impact on the mental health and subjective well-being of young adults (Cattellino et al., 2021) and on healthy aging among adults (Wu & Sheng, 2019). These findings, in concert with our model (Figure 1), suggest that having trustworthy direct personal contacts is important for harboring a healthy sense of self-efficacy in coping with health crises, for healthy aging, and for better overall psychological well-being in the face of public health crises.

As Figure 1 shows, valuing self-transcendence is indirectly positively associated with factual knowledge about COVID-19 mediated by attention to information quality. Together, these findings corroborate prior research

(e.g., Castelo et al., 2021; Hwang et al., 2019; Kang et al., 2018) indicate that public health professionals should diversify how they frame information and advice about COVID-19 to appeal to individuals and groups along a continuum of dispositions along the self-enhancement–self-transcendence dimension of human values.

Our path model (Figure 1) uniquely captures the complex interplay of various factors in the COVID-19 health information ecosystem, and it corroborates existing research on the role of demographic factors in influencing trust in public health information (Brashier & Schacter, 2020; Chung, 2013; Lang et al., 2021; Latkin et al., 2020; Stern et al., 2012).

The COVID-19 pandemic has not only been a public health crisis, but also an information crisis (Xie, He, et al., 2020) which has increased uncertainty and has been detrimental to trust in the media (Gottfried & Liedke, 2021) and public health institutions (Hamilton & Safford, 2021). Decreased trust in media and in public health institutions as well as other government institutions are also correlated with adherence to conspiracy theories (Bruder & Kunert, 2022; Kalam & Ulya, 2020). At the same time, using Luhmann's (1979) theorization of trust, the complexity created by the social and economic repercussions of the pandemic (Bratianu, 2020; Gubrium & Gubrium, 2021; Pereira et al., 2021; Uhl-Bien, 2021) has heightened the need for trust. Because preventive health behaviors were one of the polarizing forces during this pandemic, it is important to emphasize that trust—combined with a healthy perception of behavioral control, or self-efficacy—is needed to effect positive change in health behaviors, especially among younger adults (Deng et al., 2021). The heightened need for trust during a time when trust in the media and public health institutions has declined suggests that we need to take a two-pronged strategy to improve the situation: mitigate factors that diminish trust in information and improve the information environment to increase trust in public health institutions. Our path model reinforces the fact that trust in traditional mass media, rather than social media, is still critical—if not more important—for ensuring an accurately informed public.

## 6 | LIMITATIONS

Our findings represent a temporally and socio-politically situated cross-section of the US during data collection which was focused specifically on the COVID-19 pandemic. We collected data during the summer of 2020, when the pandemic caseload was peaking across the US and the 2020 US presidential election campaign was in

full swing. As such, it is important to consider these results within their context in terms of the stage of the pandemic and local and national politics (Greer et al., 2020). Besides, because of scoping constraints, our study did not explore the role of anti-science views, “culture wars,” and Christian nationalism in shaping attitudes toward preventive behaviors and COVID-19 vaccines (Perry et al., 2020; Whitehead & Perry, 2020).

In addition, the generalizability of our findings across the US population could be impacted by two limitations common to much interrogative social science research: obtaining representative samples, and self-selection bias in online crowdwork marketplaces. We mitigated the potential impact of non-representativeness by publishing our survey on Prime Panels, which promises a more nationally representative pool of participants by aggregating multiple online panels (Chandler et al., 2019). Specifically, we chose to collect a stratified sample in terms of age given the disproportionate impacts of COVID-19 on older adults (Xie, Charness, et al., 2020). Whereas many other studies oversample younger adults based upon limitations in online subject pools, we intentionally oversampled older adults (Verma et al., 2021). Further, during our validation process, we found that the data provided by older adults was of higher quality, and thus led to a larger proportion of valid responses. Future studies could stratify on other factors such as race/ethnicity or political leaning. Given biases commonly found in online datasets, it is important for some studies to intentionally oversample rather than always undersampling groups that are harder-to-study-online (Verma et al., 2021).

## 7 | CONCLUSIONS

Oliphant (2021) asserts that the changing information realities of the 21st century, including the COVID-19 pandemic, call for renewed focus on humans as the heart of information science inquiry. Our path model (Figure 1) presents significant relationships among demographic factors, human values, trust in the media and direct personal contacts, and self-efficacy for and factual knowledge about COVID-19. Compared with younger adults, older adults have more trust in mass media and direct personal contacts, and less trust in social media for COVID-19 health information. Educational attainment has a positive relationship with trust in mass media and attention to information quality. The negative association between age and trust in social media is most pronounced for those with high educational attainment. That relationship, in combination with the positive relationship between education and attention to information quality, suggests that emphasis on information literacy in

public health campaigns holds the promise of making people more judicious consumers of health information on social media. Such emphases in public policy could improve people's ability to evaluate the quality of information and thus create a demand for high quality health information available online. The improved ability of users to evaluate and thus demand quality health information is likely to drive social media companies to take measures to improve the quality of health information on, and therefore the trustworthiness of, their platforms.

Despite the growth and prominence of social networking platforms during the previous two decades, mass media and direct personal contacts are still very influential in shaping the public's understanding of the COVID-19 pandemic. Our findings reiterate the importance of education, information literacy, and personal networks in increasing the public's self-efficacy in coping with public health crises. The human value of self-transcendence is negatively associated with trust in direct personal contacts, and positively associated with attention to information quality. In essence, people with high self-enhancement (or low self-transcendence) invest more trust in their direct personal contacts to obtain COVID-19 health information, and they pay less attention to the quality of information obtained.

Our path model offers guidance for fine-tuning the effectiveness of public health messaging by providing a framework built on relationships among age, education, human values, type of media source, information literacy, and self-efficacy for and factual knowledge about the pandemic. Given the direct positive impacts of trust in direct personal contacts and attention to information quality, and the indirect effect of human values on self-efficacy and factual knowledge, it is important for public health institutions to craft public health messages that will be trusted by members of diverse populations with diverse beliefs. We believe that the directional relationships among the various constituents of the health information landscape presented by our model will generate refined hypotheses that can be instrumental in furthering research on the short- and long-term societal impacts of COVID-19 as well as future public health crises.

## CONFLICT OF INTEREST

We have no known conflicts of interest to disclose.

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