Framing Effects on US Adults’ Reactions to COVID-19 Public Health Messages: Moderating Role of Source Trust

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Abstract
Increasing politicization of health guidance and fluctuating trust in public health institutions have challenged effective coronavirus disease 2019 (COVID-19) public health communication in the United States. Applying the extended parallel process model, this research reports findings from two online survey experiments conducted at different points in the pandemic regarding two advocated risk reduction behaviors. Analyses test US adults’ emotional and argument strength reactions to experimental tweets attributed to the Centers for Disease Control (CDC) and Prevention which vary with regards to advocated behavior (social distancing; vaccination), emotional appeal, wellbeing orientation (individual vs. collective), and content frame (health vs. economic outcomes). Trust in the CDC is treated as a potential moderator. Results of path analyses indicated that emotional appeal and content frame had little impact on emotional or cognitive responses to the social distancing tweets, though unvaccinated adults with low trust in the CDC experienced greater hope and fear responses to tweets emphasizing collective benefits of vaccination. Hope reactions in both studies predicted greater perceived response efficacy for the advocated behavior, particularly among those with low CDC trust, while message annoyance undermined efficacy among low trust participants. Particularly among adults with low trust in the CDC, fear reactions led to reduced efficacy. Perceived efficacy of vaccination predicted greater intention to receive a COVID-19 vaccine, controlling for prior intention. Messages which inspire hope with regards to risk reduction behaviors and include sound arguments may be more motivating than fear-appeal messages, particularly among individuals with low levels of trust in public health institutions.

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Introduction
Social media has been an important tool used by public health advocates to disseminate health information about coronavirus disease 2019 (COVID-19) throughout the pandemic. Early in the pandemic, messages centered on encouraging social distancing and mask wearing, but later turned to vaccination. Messages urging behavioral compliance have varied. Some focused on benefits of reducing susceptibility to severe outcomes, while others more on civic responsibility, framing behaviors as a moral imperative. These messages triggered negative reactions among some segments of the United States population, spurring disinformation campaigns and forcing social media companies to intervene to control the flow of information that could undermine public health (Lerman, 2020).

In the United States, more than one million deaths were attributed to COVID, with the US ranking ninth worldwide in case fatality rate per 100,000 (Johns Hopkins University of Medicine, 2022). As of April 2022, an estimated 318,000 US deaths would have been prevented via recommended vaccination, representing at least half of the US adult COVID-19 death toll since vaccines became widely available (Brown School of Public Health and Microsoft AI for Health, 2022). Moreover, rates of vaccine-preventable deaths diverge along political lines—particularly concentrated among counties that voted for then-President Trump over President Biden, underscoring the influence of mass media and interpersonal messaging (Simmons-Duffin & Nakajima, 2022).

Understanding both message design and subsequent audience reactions can help public policy messages more closely target desired behavior. Using the extended parallel process model (EPPM) as a framework, this article presents findings from two survey experiments. The first study assesses US adults’ reactions to tweets encouraging social distancing early in the pandemic, while the second evaluates unvaccinated US adults’ reactions to messages encouraging COVID-19 vaccination later in the pandemic. Across two studies, messages utilizing an individual versus collective wellbeing orientation, fear versus humor, and credibility of the source, are used to advance proposals for messaging strategies public health officials can use during the COVID-19 pandemic and future public health emergencies.

The EPPM
During the COVID-19 pandemic, the emotional content of messages varied. Some used a fear-based approach, drawing attention to the severe outcomes related to non-compliance with COVID-19 mitigation strategies and vaccination. Others used humor to grab attention and avoid defensive reactions. The EPPM holds that attention and compliance to a message depend on two constructs: perception of threat and perception of efficacy (Witte, 1992). Perception of threat construct is comprised of perceived severity of the outcome and personal susceptibility to the threat. Perceived response
efficacy (whether the intended behavior will reduce the threat) and self-efficacy (whether the individual is able perform the intended behavior) comprise the efficacy construct. High perception of threat coupled with high perception of efficacy can result in message acceptance and compliance. High perception of threat and low perceived efficacy, however, can result in message avoidance strategies, denial, and counter-arguing. The model has served as a framework for researchers interested in exploring the most effective ways to convey health information (Maloney et al., 2011). With regard to COVID-19, each of the EPPM constructs was found to be related to intention to become vaccinated in a nationally representative survey of US adults conducted just prior to vaccine availability (Salmon et al., 2021), though that study assessed existing perceptions and not reactions to persuasive messages.

While much of the research within the EPPM framework has focused on fear messaging, humor is being explored as a mechanism for maintaining attention to and recall of messages and combatting counter-arguing (Blanc & Brigaud, 2014; Borden & Suggs, 2019; Gulas & Weinberg, 2006; Lewis et al., 2013; Mukherjee & Dube, 2012; Nabi, 2016). Fear has been shown to increase perceptions of risk and susceptibility to negative outcomes (Ruiter et al., 2014), while humor can cause people to trivialize the message, as well as the subsequent severity and threat (Moyer-Guse et al., 2011). Research is mixed on the efficacy of fear messaging and whether health messages that warn of negative outcomes related to noncompliance with prescribed behavior can be effectively communicated using humor or other more neutral message frames.

### Cognitive Reactions

Researchers have demonstrated that message development strategies can be utilized to mitigate psychological reactance effects and influence behavioral changes. Reactance occurs when messages trigger a perceived threat to personal freedom and a subsequent effort to regain self-autonomy (Brehm, 1966). For example, Sprengholz et al. (2021) demonstrated that mandated vaccinations increased people’s intention to not get the vaccine. Moreover, some seem to have been overwhelmed with communication related to COVID-19, leading to fatigue and triggering a perception that personal freedom is threatened (Ball & Wozniak, 2021). To overcome these effects, research has focused on messaging strategies that target expected reactant behavior. Strategies that seek to modulate anger responses seem to be the most promising in changing attitudes around vaccination (Featherstone & Zhang, 2020).

On the other hand, perceiving sound, strong arguments in a persuasive message promotes message acceptance (Petty & Cacioppo, 1986). Strong arguments are defined as claims or evidentiary statements which are perceived by an audience to be of high quality and which elicit favorable thoughts about the message and its persuasive target (Bleakley et al., 2015; Petty & Cacioppo, 1986). Reasons offered for a COVID-19 risk reduction behavior (e.g., social distancing; vaccination) that are seen as particularly sound should espouse greater perceptions of COVID-19 threat and/or efficacy of the behavior; although it is difficult to foresee which particular claims an audience will judge to be strong versus weak a priori.
Individual Versus Collective Orientation

Many have approached vaccination as a personal responsibility; one that provides protection against severe outcomes, but also provides health and economic benefits to society. In fact, many public health messages around COVID-19 have focused on protective steps individuals can take, while other messages have promoted a societal benefit gained by practicing prescribed personal interventions. These pro-social messages have focused on moral responsibility toward others and have been shown to be effective in encouraging efforts to slow viral spread (Everett et al., 2020). Such messages have also been shown to be perceived as more persuasive (Kelly & Hornik, 2016; Luttrell & Petty, 2021). Other researchers demonstrated that individualized gain-framed messages increase intention to adopt self-care behavior, while loss-framed messages increased perception of COVID-19 risk (Gantiva et al., 2021). Conversely, study respondents assumed others would be more likely to respond positively to messages that were focused on the economy. Messages encouraging personal mitigation behavior related specifically to one’s immediate social circle were more effective than those that target society as a whole (Banker & Park, 2020; Miyajima & Murakami, 2021). However, it is not yet clear whether emphasizing individual or collective benefits of COVID-19 vaccination would be more effective overall, or whether either wellbeing frame might be more effective with differing emotional frames (e.g., fear vs. hope). Of additional interest is how individual or collective framing may interact with trust in the message source to impact message reactions.

Source Trust and Credibility

Trust in health authorities also plays a role in how people perceive messaging around COVID-19. Research has found that trust in the Centers for Disease Control (CDC) and other government agencies varies across demographic groups, with education level, age, and race all serving as contributing factors (Jamison et al, 2019; Kowitt et al., 2017). One survey documented that Americans with greater trust in the CDC endorsed misinformation about COVID-19 at lower rates, and had greater knowledge of COVID-19 treatment, common symptoms, and the virus’ spread (Dhanani & Franz, 2021). Moreover, greater trust in the CDC was predictive of greater intention to receive a COVID-19 vaccine in a November 2020 survey (Salmon et al., 2021). In other research, source expertise increased perception of trustworthiness among those who were vaccine hesitant (Xu et al., 2021).

The politicized nature of discourse around COVID-19 has also led many to distrust health authorities. For example, National Institute of Allergy and Infectious Diseases Director Anthony Fauci was commonly derided in many circles for his advocacy of mask wearing, social distancing, and vaccination. To combat negative perceptions of health authorities, Ma and Miller (2021) encouraged COVID-19 health messengers to focus on the threat of the disease itself and not on warning messages or draw attention to the message source. The latter were shown to trigger negative reactance. Other research has shown a correlation between trust in health experts and likelihood of
taking protective measures (Ahluwalia et al., 2020). What is less understood is whether individuals with low trust in the CDC experience different emotional or cognitive reactions to the same risk reduction messages from the CDC?

This Research

While individuals who trust public health institutions are likely easier to convince of the necessity and efficacy of risk reduction behavior, it is less clear how best to communicate with the segment of the public that has low trust in such institutions, yet this audience is particularly critical to target due to their lower rates of compliance (Gratz et al., 2021; Salmon et al., 2021; Szilagyi et al, 2021). Through two online survey experiments, this study applies the EPPM to examine reactions to social media public health messaging strategies among segments of the US public with low versus high trust in the CDC. Specifically, the experiments investigate effects of stressing benefits to the wellbeing of the individual him/herself or for the collective public, several emotional appeals (e.g., fear; humor; Study 1), and two different content frames (i.e., health; economy; Study 2) on US adults’ emotional reactions and perceptions of COVID threat and efficacy of advocated risk reduction behaviors (social distancing; vaccination).

Study 1

The first study investigates the effects of tweet frame (individual vs. collective wellbeing) and emotional appeal (neutral, fear, humor) on US adults’ perceived threat of COVID-19 and efficacy of social distancing during an early month of the COVID-19 pandemic (April, 2020). The CDC is portrayed as the source of each experimental tweet, and level of trust in the CDC is examined as a moderator of message effects. The following set of hypotheses and research questions guided the study:

H1: US adults who view a message with a fear appeal will experience greater fear reactions, compared to those who view a humorous or neutral message.
RQ1: Do US adults’ hopeful reactions and argument strength assessments vary based on the emotional appeal in a CDC tweet encouraging social distancing?
RQ2: Do US adults’ emotional and cognitive reactions to CDC tweets encouraging social distancing vary based on whether the message is framed around individual or collective wellbeing?
H2: US adults with greater trust in the CDC will experience stronger fear and hope reactions to and perceive stronger arguments in CDC tweets encouraging social distancing, while low trust participants will experience greater annoyance.
H3: US adults who experience greater fear reactions and perceive strong arguments will report greater threat assessments of COVID-19.
H4: US adults who experience greater annoyance reactions will report less personal threat due to COVID-19.
RQ3: How do US adults’ hopeful reactions to CDC tweets encouraging social distancing effect their perceptions of COVID-19 threat and social distancing efficacy?

RQ4: Are relationships between US adults’ emotional and cognitive reactions to CDC tweets encouraging social distancing and perceptions of COVID-19 threat and social distancing efficacy moderated by level of trust in the CDC?

Methods

Experimental stimuli. Six experimental tweets (Table 1) were created using an online generator (Tweetgen.com). Each was attributed to the CDC Twitter account. The fear tweet statistic reflected the estimated mortality rate as of mid-April, 2020 (Johns Hopkins University, 2020).

Procedure. Participants were recruited to the online survey experiment on April 21, 2020, from the Mechanical Turk (MTurk) online crowdsourcing platform. MTurk respondents receive a nominal fee to participate in research (or other tasks). Any adults 18 and older living in the US was eligible to participate. The High Point University Institutional Review Board approved this study. Respondents were dropped from the final sample if they completed the survey in less than 4 minutes. Mean survey duration was 9 minutes 51 seconds ($SD = 6:40$), and informal piloting suggested reading the majority of questions required more than 4 minutes.

Consented participants answered demographic questions. Then, the survey program (Qualtrics) randomly assigned each participant to receive one of the experimental tweets. Finally, participants responded to the emotional and cognitive responses and EPPM items (i.e., susceptibility, severity, response efficacy, and self-efficacy) after viewing their respective tweets.

Measures

Demographics and political ideology. At the start of the survey, participants indicated their age, gender, race and ethnicity, educational attainment, and household income. One item asked the extent to which participants had been practicing social distancing between March and April 2020, from (1) not at all to (5) a lot. They also reported political ideology through one item: “Regardless of how you may vote, what do you usually consider yourself?” Response options were collapsed into three categories: (1) Republican = Republican/conservative ($n = 122$) and Independent, but lean Republican/conservative ($n = 30$); (2) Democrat = Democrat/liberal ($n = 171$) and Independent, but lean Democrat/liberal ($n = 34$); (3) Independent/other = Independent/no party affiliation ($n = 82$) and Other party ($n = 3$).

Trust in CDC. After viewing the respective tweets, participants reported their perceptions that “the source of the message is trustworthy” and “the source of the message is reliable” (5-point scales from “not at all” to “a lot,” $r = .83$, $p < .001$). These items were averaged together ($M = 3.79$, $SD = 1.06$) and dichotomized for a measure of low ($3$ or lower; $n = 137$) versus high trust in the CDC ($3.5$ or higher; $n = 305$).
Table 1. Study 1 Tweet Contents.

| Variables | Individual wellbeing frame | Collective wellbeing frame |
|-----------|-----------------------------|---------------------------|
| Fear      | Keep yourself healthy! Your chance of dying from COVID-19 is $34 \times$ higher than from flu. Stay home when you can and keep at least 6 ft away from others if you have to go out. Stay home and healthy! | We are all in this! 15% of our older neighbors who get COVID-19 could die from it. Stay home when you can and keep at least 6 ft away from others if you have to go out. Stay home and save lives! |
| Humor     | What do you call someone who never takes off their sweatpants, leaves their home, or gets a haircut. . .? Healthy! Keep yourself healthy by staying home when you can and keeping at least 6 ft away from others if you have to go out. | What do you call someone who never takes off their sweatpants, leaves their home, or gets a haircut. . .? A team-player! Save others' lives by staying home when you can and keeping at least 6 ft away from others if you have to go out. |
| Neutral   | Keep yourself healthy! Commit to social distancing to stop the spread of COVID-19. Stay home when you can and keep at least 6 ft away from others if you have to go out. Stay home and stay healthy! | We are all in this together! Commit to social distancing to stop the spread of COVID-19. Stay home when you can and keep at least 6 ft away from others if you have to go out. Stay home and save lives! |

**Emotion reactions.** Participants indicated how much they felt several emotions after reading the tweet, using a 5-point response scale (1 = not at all to 5 = a lot; adapted from Bleakley et al., 2015). The queried emotions included: (1) fear about getting COVID-19 ($M=2.74$, $SD=1.33$), (2) fear about others getting COVID-19 ($M=3.09$, $SD=1.26$), (3) hopeful that we can stop the spread of COVID-19 ($M=3.59$, $SD=1.14$), and (4) “annoyed that this tweet was telling me what to do” ($M=1.85$, $SD=1.22$). A single fear emotion scale was created by calculating the mean of the two fear items ($r=.74$; $M=2.91$, $SD=1.21$).

**Argument strength.** Five items were used to measure perceived argument strength (adapted from Bleakley et al., 2015), each on a 5-point scale (e.g., “The tweet gave me good reasons to do social distancing,” $\alpha=.91$, $M=3.71$, $SD=1.00$).

**EPPM constructs (dependent variables).** EPPM items were adapted from Witte (1992) and used 7-point Likert response scales (1 = strongly disagree to 7 = strongly agree). The four constructs, each measured with three survey items, included: perceived susceptibility to COVID-19 (e.g., “I am at risk for getting COVID-19”; $\alpha=.84$; scale $M=4.07$, $SD=1.51$); perceived severity of COVID-19 (e.g., “I believe that COVID-19 can kill me”; $\alpha=.85$; scale $M=4.88$, $SD=1.56$); social distancing self-efficacy (e.g., “I am able to protect myself from getting COVID-19”; $\alpha=.76$; scale $M=4.83$, $SD=1.22$); and perceived response efficacy of social distancing (e.g., “Social distancing is effective in preventing COVID-19”; $\alpha=.82$; scale $M=5.56$, $SD=1.23$).
**Statistical analysis.** Stata 14.2 was used to conduct analyses. Differences in sample characteristics between low trust and high trust respondents were assessed using chi square analyses. Path analysis using the structural equation modeling (SEM) command in STATA was used to test paths from the experimental conditions to the emotional and argument strength responses, and from the emotional and argument strength responses to the EPPM constructs. Wald statistics assessed whether paths were significantly different between low trust versus high trust participants. The individual well-being-framed neutral appeal message was excluded as the referent group, and post-estimation tests compared relative effects on emotional and argument strength responses between the other experimental conditions. Rate of prior social distancing was included as a covariate in the model. All equations were estimated simultaneously (using maximum likelihood), and error terms for the mediator and dependent variables were correlated. Goodness of fit statistics indicated acceptable model fit (RMSEA = 0.047; CFI = 0.978; TLI = 0.922).

**Results**

**Sample.** The final sample for this analysis consisted of 442 adults (additional study participants viewed unrelated experimental messages and were not included here). Table 2 shows sample characteristics and characteristics of respondents with low trust in the CDC (\(n = 137\)) and high trust in the CDC (\(n = 305\)). Notably, 64% had a Bachelor degree or more education. Participants with lower trust in the CDC were more likely to be Republican and higher trust individuals were more likely to be Democrat. Higher trust respondents reported higher rates of social distancing.

**Analyses.** Main results are presented in separate tables for clarity, although analyses were conducted simultaneously. H1 and RQ1 and RQ2 addressed emotional and argument strength reactions variations based on the emotional appeal and wellbeing frame of the tweets, while H2 predicted that reactions would be stronger among participants with greater trust in the CDC. As shown in Table 3, there were few differences based on the experimental manipulations within the tweets. Compared to the neutral message framed around individual wellbeing, high trust participants experienced less fear emotion and lower argument strength if they viewed the humor-individual message. Notably, these paths between low and high trust participants were not statistically different from each other, based on the Wald tests. However, low trust participants reported lower rates of fear emotion and weaker argument strength compared to higher trust participants for the referent tweet (neutral-individual), suggesting differing levels of these reactions across the board.

H3 and H4 and RQ3 addressed how participants’ emotional and cognitive reactions to the tweet related to their experiences of threat to COVID-19 (susceptibility; severity) and efficacy in social distancing (self-efficacy; response efficacy), while RQ4 asked whether relationships were moderated by trust in the CDC. Table 4 displays these results from the path analysis. Hopeful emotional responses to the tweets were associated with lower perceived susceptibility (high trust only), and greater
The relationship with self-efficacy was moderated such that the relationship was stronger for low trust participants. Fear emotions were related to greater susceptibility and severity (H3), and less self-efficacy (low trust only). These relationships were not significantly moderated by trust based on Wald tests.

When participants reported greater annoyance in response to the tweets, they reported that COVID-19 was less severe (H4) and reported lower response efficacy (low trust only; Wald $p < .05$). Participants who perceived stronger arguments for social distancing in the tweets felt less susceptible (high trust only; Wald $p < .05$) and

### Table 2. Study 1 Final Sample Characteristics.

| Variables                      | All participants (N=442) | Low CDC trust (N=137) | High CDC trust (N=305) |
|--------------------------------|--------------------------|-----------------------|------------------------|
| Age (%)                        |                          |                       |                        |
| 18–29 years                    | 28.5                     | 30.7                  | 27.5                   |
| 30–39 years                    | 26.7                     | 27.0                  | 26.6                   |
| 40–49 years                    | 18.3                     | 18.2                  | 18.4                   |
| 50 years or older              | 26.5                     | 24.1                  | 27.5                   |
| Race/ethnicity (%)             |                          |                       |                        |
| White/non-Hispanic             | 69.7                     | 67.2                  | 70.8                   |
| Black/non-Hispanic             | 5.2                      | 6.6                   | 4.6                    |
| Asian                          | 10.0                     | 8.0                   | 10.8                   |
| Hispanic/any race              | 12.7                     | 15.3                  | 11.5                   |
| Other or multiple race         | 1.4                      | 1.5                   | 1.3                    |
| Refused/missing                | 1.2                      | 1.5                   | 0.09                   |
| Female (%)                     | 50.0                     | 47.4                  | 51.1                   |
| Political ideology             |                          |                       |                        |
| Republican/leans Republican    | 34.4                     | 43.8                  | 30.2                   |
| Democrat/leans Democrat        | 46.4                     | 34.3                  | 51.8                   |
| Independent/other              | 19.2                     | 21.9                  | 18.0                   |
| Education (%)                  |                          |                       |                        |
| Technical/vocational school or less | 11.8         | 8.8                   | 13.1                   |
| Some college or associates degree | 24.0         | 30.7                  | 21.0                   |
| Bachelor degree                | 43.7                     | 45.3                  | 43.0                   |
| Graduate school or degree      | 20.6                     | 15.3                  | 23.0                   |
| Household income (%)           |                          |                       |                        |
| Less than $35,000              | 24.0                     | 27.0                  | 22.6                   |
| $35,000–$74,999                | 36.9                     | 37.2                  | 36.7                   |
| $75,000–$99,999                | 18.6                     | 16.8                  | 19.3                   |
| $100,000 or more               | 20.6                     | 19.0                  | 21.3                   |
| Prior social distancing, $M$ (SD) | 4.36 (0.99)    | 4.04 (1.20)           | 4.50 (0.85)            |

Note. N=442. Bold values indicate proportions that are significantly different at $p < .05$. CDC = Centers for Disease Control.
that COVID-19 was more severe (low trust only; Wald \( p < .10 \)). Argument strength was also positively associated with self-efficacy and response efficacy among high trust participants. Among low trust participants, the full model \( R^2 \) was .45, while the model \( R^2 \) was .26 for high trust participants.

**Discussion**

In this study, the emotional appeal of the tweets did not have strong effects on the emotional or argument strength reactions of participants, regardless of their level of trust in the CDC. In fact, neutrally-framed messages—those containing less emotionally-framed encouragement to practice social distancing—produced roughly equivalent levels of fearful and hopeful emotional reactions among participants. Neutral messages also were perceived as containing relatively strong arguments for socially distancing, particularly among those with high trust in the CDC (message source). In the midst of a global pandemic, any health message may espouse fearful reactions, including those meant to be humorous. Likewise, if the messages advocate an action that could help avoid risk of infection, any message may make participants feel hopeful, regardless of emotional appeal.

On the other hand, emotional reactions were related to the EPPM threat and efficacy constructs in notable ways. Hopeful reactions predicted greater self and response efficacy, particularly among adults with low trust in the CDC. Fear was related to a greater sense of threat of COVID-19, as would be expected from the EPPM tenets. Response efficacy in social distancing was undermined by annoyance at being told what to do among those with low trust in the CDC, and perceiving strong arguments only predicted perceived severity among this group.

As the pandemic wore on, the question of how to frame the risks associated with COVID-19 became more prominent. Societal discourse emphasized not only the public health implications of the pandemic, but also the risks of continued or ongoing shutdowns and travel restrictions to the national economy and individuals’ financial wellbeing. Study 1 showed no discernible pattern of effects based on the individual or collective wellbeing framing for messages emphasizing health outcomes; however, it stands to reason that framing messages around individual or collective wellbeing might be more impactful in the context of an economy appeal. The economy is inherently a collective phenomenon; thus, people may more readily appreciate the effects of individual decisions on a critical shared resource such as the economy, compared to health outcomes. A national vaccine acceptance study conducted in April, 2021 found that among political conservatives, getting people back to work was the top reported priority (i.e., above health benefits associated with vaccination; El-Mohandes et al., 2021). In the later stages of the pandemic, several effective COVID-19 vaccines also became available, and many health advocacy messages were focused on vaccination as a primary risk reduction behavior. Prior research has shown persuasive advantage in emphasizing others’ wellbeing when advocating uptake of an avian flu vaccine (Kelly & Hornik, 2016).
### Table 3. Impacts of Tweet Conditions on Emotions, Reactance, and Argument Strength Perceptions (Study 1).

| Tweet features (appeal: frame) | Hopeful emotion  | Fear emotion  | Annoyed emotion | Argument strength |
|-------------------------------|------------------|---------------|-----------------|------------------|
|                               | \( b \) (SE \( b \)) | CI \( b \)   | \( b \) (SE \( b \)) | CI \( b \)   | \( b \) (SE \( b \)) | CI \( b \)   |
| **Neutral: individual (constant)** |                |               |                 |                 |                |               |
| Low trust                     | 2.65 (0.46)***  | [1.75, 3.55]  | 2.10 (0.47)***  | [1.17, 3.03]  | 3.73 (0.48)***  | [2.80, 4.67]  | 1.87 (0.38)***  | [1.13, 2.62]  |
| High trust                    | 3.38 (0.36)***  | [2.68, 4.09]  | 3.32 (0.40)***  | [2.55, 4.10]  | 3.56 (0.38)***  | [2.81, 4.31]  | 3.20 (0.26)***  | [2.70, 3.70]  |
| **Neutral: collective**        |                |               |                 |                 |                |               |                |               |
| Low trust                     | -0.19 (0.42)    | [-1.02, 0.63] | -0.31 (0.44)    | [-1.17, 0.54] | -0.02 (0.44)    | [-0.88, 0.84] | -0.38 (0.35)   | [-1.07, 0.31] |
| High trust                    | -0.09 (0.20)    | [-0.48, 0.29] | -0.28 (0.22)    | [-0.71, 0.15] | -0.15 (0.21)    | [-0.57, 0.26] | -0.27 (0.14)†  | [-0.55, 0.01] |
| **Fear: individual**           |                |               |                 |                 |                |               |                |               |
| Low trust                     | -0.70 (0.38)†   | [-1.46, 0.03] | -0.30 (0.39)    | [-1.07, 0.47] | -0.22 (0.40)    | [-1.00, 0.55] | -0.22 (0.32)   | [-0.84, 0.40] |
| High trust                    | -0.12 (0.20)    | [-0.52, 0.28] | -0.01 (0.22)    | [-0.44, 0.44] | -0.02 (0.22)    | [-0.45, 0.41] | -0.01 (0.15)   | [-0.29, 0.27] |
| **Fear: collective**          |                |               |                 |                 |                |               |                |               |
| Low trust                     | -0.30 (0.41)    | [-1.10, 0.50] | -0.24 (0.42)    | [-1.06, 0.59] | 0.08 (0.42)     | [-0.75, 0.91] | -0.16 (0.34)   | [-0.82, 0.50] |
| High trust                    | -0.04 (0.20)    | [-0.42, 0.34] | 0.10 (0.22)     | [-0.32, 0.53] | 0.32 (0.21)     | [-0.09, 0.73] | 0.14 (0.14)    | [-0.14, 0.41] |
| **Humor: individual**         |                |               |                 |                 |                |               |                |               |
| Low trust                     | -0.13 (0.37)    | [-0.84, 0.59] | -0.47 (0.38)    | [-1.21, 0.27] | 0.38 (0.38)     | [-0.36, 1.12] | -0.39 (0.30)   | [-0.99, 0.20] |
| High trust                    | -0.27 (0.21)    | [-0.69, 0.14] | -0.61 (0.23)†   | [-1.07, -0.15] | 0.12 (0.23)     | [-0.32, 0.57] | -0.39 (0.15)*  | [-0.69, -0.10] |
| **Humor: collective**         |                |               |                 |                 |                |               |                |               |
| Low trust                     | -0.47 (0.39)    | [-1.24, 0.29] | -0.54 (0.40)    | [-1.33, 0.25] | 0.11 (0.41)     | [-0.68, 0.91] | -0.70 (0.32)*  | [-1.33, -0.06] |
| High trust                    | 0.16 (0.20)     | [-0.22, 0.55] | -0.40 (0.22)†   | [-0.83, 0.03] | -0.09 (0.21)    | [-0.51, 0.32] | -0.16 (0.14)   | [-0.43, 0.12] |
| Prior social distancing       |                |               |                 |                 |                |               |                |               |
| Low trust                     | 0.18 (0.08)*    | [0.02, 0.34]  | 0.18 (0.08)*    | [0.02, 0.35]  | -0.41 (0.09)*** | [-0.57, -0.24] | 0.36 (0.07)*** | [0.22, 0.49]  |
| High trust                    | 0.11 (0.07)     | [-0.03, 0.25] | -0.01 (0.08)    | [-0.16, 0.14] | -0.42 (0.08)*** | [-0.57, -0.27] | 0.21 (0.05)*** | [0.11, 0.31]  |

Note. \( N = 442 \). Values represent unstandardized coefficients from a structural equation model. Bold values indicate significant moderation (Wald test \( p < .05 \)); italic values represent Wald test \( p < .10 \). Model RMSEA = 0.04, CFI = 0.98.  
* \( p < .05 \). ** \( p < .01 \). *** \( p < .001 \). † \( p < .10 \).
| Variables              | Susceptibility | Severity | Self-efficacy | Response efficacy |
|------------------------|----------------|----------|---------------|-------------------|
|                        | b (SE b)       | CI b     | b (SE b)      | CI b              | b (SE b)         | CI b |
| Hopeful emotion        |                |          |               |                   |                  |
| Low trust              | −0.12 (0.12)   | [−0.35, 0.11] | −0.05 (0.11)  | [−0.27, 0.17]    | 0.61 (0.10)***  | [0.42, 0.81] |
| High trust             | −0.24 (0.08)** | [−0.40, −0.08] | 0.03 (0.08)   | [−0.13, 0.18]    | 0.19 (0.06)**  | [0.06, 0.31] |
| Fear emotion           |                |          |               |                   |                  |
| Low trust              | 0.41 (0.12)*** | [0.18, 0.64] | 0.44 (0.11)***| [0.22, 0.66]     | −0.21 (0.10)*   | [−0.41, −0.01]|
| High trust             | 0.51 (0.08)*** | [0.36, 0.66] | 0.41 (0.08)***| [0.26, 0.56]     | −0.10 (0.06)    | [−0.22, 0.02]|
| Annoyed emotion        |                |          |               |                   |                  |
| Low trust              | 0.01 (0.10)    | [−0.19, 0.20] | −0.27 (0.10)**| [−0.45, −0.08]   | 0.12 (0.09)     | [−0.05, 0.29] |
| High trust             | 0.10 (0.07)    | [−0.04, 0.24] | −0.15 (0.07)* | [−0.30, −0.01]   | 0.13 (0.06)*    | [0.01, 0.24] |
| Argument strength      |                |          |               |                   |                  |
| Low trust              | 0.23 (0.16)    | [−0.09, 0.54] | 0.39 (0.16)*  | [0.08, 0.69]     | −0.03 (0.14)    | [−0.30, 0.24] |
| High trust             | −0.29 (0.12)*  | [−0.52, −0.05] | 0.03 (0.12)   | [−0.20, 0.26]    | 0.21 (0.09)*    | [0.03, 0.40] |
| Prior social distancing|                |          |               |                   |                  |
| Low trust              | 0.06 (0.11)    | [−0.15, 0.327] | 0.18 (0.10)   | [−0.03, 0.39]    | 0.19 (0.09)*    | [0.01, 0.36] |
| High trust             | −0.07 (0.10)   | [−0.27, 0.12] | 0.02 (0.10)   | [−0.17, 0.22]    | 0.07 (0.08)     | [−0.08, 0.22] |

Note. N=440. Values represent unstandardized coefficients from a structural equation model. Bold values indicate Wald tests significant at $p < .05$. Italicized values indicate Wald test marginally significant at $p < .10$.

*p < .05. **p < .01. ***p < .001. †p < .10.
With these developments in mind, Study 2 was designed to examine whether US adults were more motivated to obtain a COVID-19 vaccine after exposure to messages stressing negative health outcomes or economic/financial outcomes, and whether these frames varied in efficacy based on a collective or individual orientation in the message.

**Study 2**

A second survey experiment was conducted later in the pandemic (June, 2021) to assess whether similar patterns exist for a different health behavior (COVID-19 vaccination), and to test impact of tweet conditions and reactions on behavioral intentions. A follow-up study was also warranted given the increased politicization of COVID-19 and associated health behaviors in the United States over the course of the pandemic, as well as possible corresponding changes in trust in the CDC during that time. The second study uses a similar approach to examine effects of tweet frame (individual vs. collective well-being) and content frame (public health vs. economy) on unvaccinated US adults’ perceived threat of COVID-19, efficacy of COVID-19 vaccination, and vaccination intentions. Specifically, the following hypotheses and research questions guided this study:

RQ1: Do unvaccinated US adults’ emotional and cognitive reactions to CDC tweets encouraging vaccination vary by the content frame of the message (health or economy)?

RQ2: Do unvaccinated US adults’ emotional and cognitive reactions to CDC tweets encouraging vaccination vary based on whether the message is framed around individual or collective well-being?

H1: Fearful and hopeful reactions and perceived argument will be stronger among unvaccinated US adults with a high level of trust in the CDC, while low trust adults will experience greater annoyance.

H2: Greater fear reactions to CDC tweets encouraging vaccination and stronger perceived arguments will be lead to greater COVID-19 threat perceptions.

H3: Greater annoyance reactions to CDC tweets encouraging vaccination will be associated with weaker COVID-19 threat perceptions.

RQ3: How do unvaccinated US adults’ hopeful reactions to CDC tweets encouraging vaccination effect their perceptions of COVID-19 threat and vaccination efficacy?

RQ4: Are relationships between unvaccinated US adults’ emotional and cognitive reactions to CDC tweets encouraging vaccination and perceptions of COVID-19 threat and vaccination efficacy moderated by level of trust in the CDC?

RQ5: Which EPPM constructs (susceptibility; severity, self-efficacy; response efficacy) are most predictive of unvaccinated US adults’ intentions to get a COVID-19 vaccine?

RQ6: Does level of trust in the CDC moderate relationships between EPPM constructs and intention to get a COVID-19 vaccine?
Methods

Experimental stimuli. As in Study 1, each of the four experimental tweets (Table 5) were attributed to the CDC as the source. In addition to encouraging vaccination against COVID-19, the tweets in the second study differed from those of the first study in several ways. Instead of testing emotional appeal as a factor, these tweets framed repercussions of the continuing pandemic around public/individual health or overall economy/individual finances. All tweets also included the same photo of the inside of a restaurant with caution tape surrounding the tables, with overlaid text saying “[You’re/We’re] not out of the woods! Get your COVID-19 vaccine today!”

Procedure. Procedures for Study 2 paralleled those of the first study, following IRB approval from [BLINDED]. Using the MTurk platform, participants who were at least 18 years of age and living in the US were invited to complete this 10-minute online survey. Recruitment took place between 18 June and 7 July, 2021. Both vaccinated and unvaccinated adults were eligible for the study, although the present analyses were conducted with unvaccinated participants only. Participants were dropped from the final sample if they completed the survey in less than 4 minutes or failed an attention check item. Cross-sectional survey questions were presented first, followed by the experimental tweet (randomly assigned), and dependent variables.

Measures

Demographics and political ideology. Participants indicated their age, gender, race and ethnicity, educational attainment, and household income at the start of the survey. One item asked whether participants had received at least one dose of a COVID-19 vaccine. Only data from those who responded “no” were included in the present analyses (n = 301). They were subsequently asked their intention to receive a COVID-19 vaccine (1 = definitely no to 7 = definitely yes; M = 3.27, SD = 2.02). Political ideology was again collapsed into three categories: (1) Republican = Republican/conservative (n = 91) and Independent, but lean Republican/conservative (n = 31); (2) Democrat = Democrat/liberal (n = 107) and Independent, but lean Democrat/liberal (n = 17); (3) Independent/other = Independent/no party affiliation (n = 52) and Other party (n = 3).

Trust in CDC. The same two items were used to measure trust in the CDC as the message source (r = .87, p < .001). These items were averaged together (M = 3.20, SD = 1.43) and dichotomized for a measure of low (3 or lower; n = 133) versus high trust in the CDC (3.5 or higher; n = 146). Participants were excluded from analyses if they responded that they did not know who the source was (n = 22).

Emotion reactions. Participants responded to the same set of four emotion items, tailored to ask about vaccination: (1) fear about getting COVID-19 (M = 2.52, SD = 1.38); (2) fear about others getting COVID-19 (M = 2.58, SD = 1.39); (3) annoyed the message was telling me what to do (M = 3.03, SD = 1.45); (4) hopeful we can stop the
spread of COVID-19 ($M=2.84, SD=1.35$). The two fear items ($r=.78, p<.001$) were averaged together for a global measure of fear emotion ($M=3.81, SD=1.87$).

**Cognitive reactions.** Four of the same five items measuring perceived argument strength were used ($\alpha=.92, M=2.82, SD=1.24$). An omitted item asked if the tweet made respondents consider health risks of not getting vaccinated, which would be unrelated to the economy tweets.

**EPPM constructs (dependent variables).** The same items were adapted to measure the EPPM constructs: perceived susceptibility to COVID-19 ($\alpha=.89$; scale $M=4.08, SD=1.70$); perceived severity of COVID-19 ($\alpha=.90$; scale $M=4.05, SD=1.88$); self-efficacy in obtaining a vaccine ($M=4.98, SD=1.69$); and perceived response efficacy of the vaccine ($\alpha=.89$; scale $M=4.24, SD=1.65$).

**Vaccine intention.** The final survey question queried vaccination intention again (Fishbein & Ajzen, 2010): “I will get a COVID-19 vaccine” (1=strongly disagree to 7=strongly agree; $M=3.48, SD=2.04$).

**Statistical analyses.** SEM procedures in Stata 14.2 tested paths from the experimental conditions to emotion and cognitive reactions, and from those reactions to EPPM constructs. The health message framed around individual well-being was omitted as the referent group. Intention to receive the COVID-19 vaccine at the start of the survey (pre-test) was included as a covariate in the analyses. Wald tests assessed differences in paths between participants with low versus high trust in the CDC. Goodness of fit statistics were acceptable (RMSEA=0.080; CFI=0.969; TLI=0.889).

**Results**

**Sample.** The final sample consisted of 279 unvaccinated adults with complete data who recognized the source of the message (CDC). Participants with lower trust in the CDC (message source) were more likely than high-trust participants to be older, White/non-Hispanic, Republican, and have less than a Bachelor degree (see Table 6 for sample characteristics).

**Analysis.** The unstandardized path coefficients between experimental conditions and emotional and cognitive reactions are presented in Table 7, by level of trust in the CDC. RQ1 and RQ2 asked about the impact of tweet content frame (health vs. economy) and wellbeing frame (individual vs. collective) on these reactions, while H1 predicted that level of trust in the CDC would moderate these relationships. As in Study 1, hopeful and fear emotions and perceived argument strength were higher for those with high trust in the CDC, compared to those with low trust (H1). Wald tests indicated these differences were significant. Emotional and cognitive reactions were largely consistent across the four experimental tweet conditions. However, low trust participants reported more hope when they viewed the collectively framed health
tweet (compared to the individual health tweet). In addition, low trust participants had greater fear reactions to collectively-framed tweets (health and economy), compared to the health-individual tweet. Wald tests were not significant.

Regarding relationships between emotional reactions and EPPM constructs (Table 8; H2 and H3 and RQ3 and RQ4), greater hope reactions were related to greater response efficacy for participants with low trust in CDC. Fear emotion predicted greater perceived susceptibility and severity (H2), regardless of CDC trust. Among low trust participants only, fear also related to lower response efficacy in vaccination (Wald $p < .05$).

High trust participants who experienced greater annoyance to the respective tweets reported lower perceived severity of COVID-19. On the other hand, low trust participants who experienced greater annoyance reported lower response efficacy of vaccination, and this relationship did show significant moderation (Wald $p < .05$). Perceived argument strength was not related to either threat construct in this study. However, high trust participants reported greater self-efficacy (Wald $p < .05$), and both low and high trust participants reported greater response efficacy when they perceived strong arguments in the respective tweets.

The final research questions asked how EPPM threat and efficacy constructs predicted posttest intentions to receive a COVID-19 vaccine (RQ5), and whether level of trust in the CDC moderated relationships between EPPM constructs and intention (RQ6; Table 9). Of the EPPM constructs, only response efficacy was related to intention to receive a COVID-19 vaccination. This relationship was not significantly moderated by level of trust in the CDC. Prior intention to receive a vaccine was moderated by level of trust such that prior intention was particularly predictive of posttest

### Table 5. Study 2 Tweet Contents.

| Variables | Individual wellbeing frame | Collective wellbeing frame |
|-----------|-----------------------------|---------------------------|
| Health    | Without a COVID-19 vaccine, you are still at risk. Vaccinated = a layer of protection against catching COVID-19, hospitalization, or death. Avoid catching the disease from someone with no symptoms. Vaccination helps ensure you are protected and can safely return to normal life. | Without a COVID-19 vaccine, you are still putting others at risk. Vaccinated = a layer of protection against spreading COVID-19 to others who face hospitalization, or death. Avoid unknowingly transmitting the disease from someone with no symptoms. Your vaccination helps us all return to normal life. |
| Economy   | Without a COVID-19 vaccine, you are still putting your livelihood at risk. Vaccinated = a layer of protection for getting or continuing a job. [You can safely return to work and life as normal. . . like returning to your favorite restaurant, attending concerts or movies, and traveling. | Without a COVID-19 vaccine, you are still putting our US economy at risk. More people vaccinated = more jobs and security for all, like our waiters, move theater workers, and travel attendants! Pitch in with your neighbors to get our economy on track and return to normal life. |
intention among low trust participants. The full model $R^2$ value was .76 for low trust participants and .53 for high trust participants (driven largely by the inclusion of prior intention).

**Discussion**

As in Study 1, the present findings indicated relatively little effect of the tweet conditions on participants’ emotional and cognitive reactions. However, these findings did suggest that unvaccinated adults with low trust in the CDC experienced stronger hopeful and fearful reactions to tweets encouraging COVID-19 vaccine uptake when the tweets were framed around collective wellbeing, rather than individual wellbeing. In a 2016 study of intentions to receive a hypothetical avian flu vaccine, Kelly and Hornik (2016) found higher intentions among respondents who received a message framed around the benefits of one’s vaccination to others in society. The authors argue that individuals may engage in more defensive processing of risk-related health messages when the messages emphasize personal risk. There may be a propensity to avoid consideration of unfavorable personal health outcomes, or individuals may consider themselves less at risk than others (i.e., a third person effect). Considering the implications of one’s actions for others may also spur a greater sense of moral obligation (Everett et al., 2020), perhaps triggering a greater emotional response in-turn.

Conversely, differences were not observed in annoyance reactions or argument strength based on the tweet conditions across either study. Participants experienced similar rates of annoyance and perceived equally strong arguments regardless of whether the tweet stressed economic or health risks of remaining unvaccinated (Study 2) and regardless of emotional appeal (Study 1). Yet, feeling annoyed at the attempted manipulation in the tweet predicted lower response efficacy for the advocated behavior among low trust adults in both studies. These findings suggest that health advocacy messages from institutions or individuals that an audience does not trust could be counterproductive—reducing perceptions that the advocated behavior is effective—if they espouse annoyance at being told what to do. Further research examining message features more or less likely to trigger feelings of manipulation or reactance in key audiences is critical, particularly given the significant relationship between response efficacy and intention to get vaccinated among low trust participants in Study 2.

In both studies, high trust participants reported stronger hopeful and fearful reactions and perceived stronger arguments in the tweets, compared to those with low trust in the CDC. It makes sense that individuals would be more easily moved by trusted sources, and that they would judge the arguments of figures or institutions that they trust as more sound (Nan, 2013). It is also possible that those who do not trust the source of the message do not attend as closely to the contents of the message or consider the strength of the particular arguments.

In both survey experiments, fearful reactions led to greater perceived threat among adults, regardless of their level of trust in the CDC. These patterns reflect a wealth of prior literature indicating that risk-based messages often promote fear of an unfavorable outcome, which heighten one’s sense of personal susceptibility to and severity of
that outcome (e.g., Ruiter et al., 2014). However, greater fear also predicted lower self-efficacy (Study 1) and lower perceived response efficacy among low trust participants (Study 2). EPPM theorists stress the critical role of efficacy in gaining message acceptance (Witte, 1992; Witte & Allen, 2000). Indeed, some evidence suggests targeting efficacy may be more crucial than threat perceptions in gaining message acceptance and motivating behavioral compliance (Ruiter et al., 2014). The findings of the present study support that pattern, as perceived response efficacy of vaccination was the only EPPM construct linked to intention to receive a COVID-19 vaccine, when controlling for prior intention. Thus, public health message designers should strive to particularly maximize positive emotions (like hope at ending the pandemic) and

| Variables                        | All participants (N=279) | Low CDC trust (N=133) | High CDC trust (N=146) |
|----------------------------------|--------------------------|-----------------------|------------------------|
| Age (%)                          |                          |                       |                        |
| 18–29 years                      | 30.5                     | 18.0                  | 41.8                   |
| 30–39 years                      | 36.6                     | 39.1                  | 34.2                   |
| 40–49 years                      | 15.4                     | 16.5                  | 14.4                   |
| 50 years or older                | 17.6                     | 26.3                  | 9.6                    |
| Race/ethnicity (%)               |                          |                       |                        |
| White/non-Hispanic               | 64.9                     | 76.7                  | 54.1                   |
| Black/non-Hispanic               | 12.9                     | 9.0                   | 16.4                   |
| Asian                            | 3.2                      | 3.8                   | 2.7                    |
| Hispanic/any race                | 14.7                     | 7.5                   | 21.2                   |
| Other or multiple race           | 3.2                      | 3.0                   | 3.4                    |
| Refused/missing                  | 1.1                      | 0                     | 2.1                    |
| Female (%)                       | 46.2                     | 49.6                  | 43.2                   |
| Political ideology               |                          |                       |                        |
| Republican/leans Republican      | 40.5                     | 51.9                  | 30.1                   |
| Democrat/leans Democrat          | 41.9                     | 21.1                  | 61.0                   |
| Independent/other                | 17.6                     | 27.1                  | 8.9                    |
| Education (%)                    |                          |                       |                        |
| High school diploma or less      | 9.3                      | 12.8                  | 6.2                    |
| Some college or associates degree| 26.5                     | 38.3                  | 15.8                   |
| Bachelor degree                  | 49.8                     | 35.3                  | 63.0                   |
| Graduate school or degree        | 14.3                     | 13.5                  | 15.1                   |
| Household income (%)             |                          |                       |                        |
| Less than $35,000                | 20.4                     | 19.5                  | 21.2                   |
| $35,000–$74,999                  | 49.5                     | 51.1                  | 47.9                   |
| $75,000–$99,999                  | 16.8                     | 12.0                  | 21.2                   |
| $100,000 or more                 | 13.3                     | 17.3                  | 9.6                    |
| Prior vaccination intention, M (SD)| **3.18 (0.12)**           | **2.08 (0.12)**        | **4.18 (0.16)**         |

*Note. N=279. Bold values indicate proportions that are significantly different at p < .05.*
### Table 7. Emotional Reactions to Experimental Tweets (Study 2).

| Tweet features (appeal: frame) | Hopeful emotion | Fear emotion | Annoyed emotion | Argument strength |
|-------------------------------|-----------------|--------------|-----------------|------------------|
|                               | b (SE b)        | Cl b         | b (SE b)        | Cl b             | b (SE b)        | Cl b             |
| **Health: individual** (constant) |                 |              |                 |                  |                 |                  |
| Low trust                     | 1.02 (0.20)***  | [0.62, 1.41] | 0.62 (0.21)***  | [0.39, 1.00]     | 3.37 (0.33)***  | [2.73, 4.02]     |
| High trust                    | 3.54 (0.28)***  | [2.98, 4.10] | 2.78 (0.26)***  | [2.28, 3.29]     | 2.47 (0.33)***  | [1.81, 3.12]     |
| **Health: collective**         |                 |              |                 |                  |                 |                  |
| Low trust                     | 0.64 (0.23)**   | [0.18, 1.10] | 0.67 (0.24)**   | [0.21, 1.14]     | 0.33 (0.38)     | [−0.42, 1.08]    |
| High trust                    | −0.03 (0.25)    | [−0.52, 0.45] | 0.33 (0.23)    | [−0.12, 0.77]    | 0.44 (0.29)     | [−0.14, 1.01]    |
| **Economic: individual**       |                 |              |                 |                  |                 |                  |
| Low trust                     | 0.32 (0.24)     | [−0.15, 0.79] | 0.39 (0.24)    | [−0.09, 0.87]    | −0.04 (0.39)    | [−0.81, 0.73]    |
| High trust                    | −0.28 (0.25)    | [−0.78, 0.21] | −0.06 (0.23)   | [−0.51, 0.39]    | 0.40 (0.30)     | [−0.19, 0.98]    |
| **Economic: collective**       |                 |              |                 |                  |                 |                  |
| Low trust                     | 0.37 (0.23)     | [−0.07, 0.82] | 0.63 (0.23)**  | [0.17, 1.09]     | 0.52 (0.37)     | [−0.22, 1.25]    |
| High trust                    | −0.46 (0.28)†   | [−1.00, 0.08] | −0.01 (0.25)   | [−0.50, 0.49]    | 0.10 (0.33)     | [−0.54, 0.74]    |
| **Prior intention**           |                 |              |                 |                  |                 |                  |
| Low trust                     | 0.29 (0.06)***  | [0.17, 0.40] | 0.32 (0.05)***  | [0.20, 0.43]     | −0.20 (0.09)‡   | [−0.38, −0.02]   |
| High trust                    | 0.04 (0.05)     | [−0.05, 0.14] | 0.08 (0.04)†   | [−0.01, 0.17]    | 0.03 (0.06)     | [−0.08, 0.14]    |

Note. N = 279. Values represent unstandardized coefficients from a structural equation model. Bold values indicate Wald tests significant at \( p < .05 \). Italicized values indicate Wald test marginally significant at \( p < .10 \). Model RMSEA = 0.07 and CFI = 0.97.

\* \( p < .05 \)  \*\* \( p < .01 \)  \*\*\* \( p < .001 \)  \‡ \( p < .10 \)
| Variables          | Susceptibility |          | Severity |          | Self-efficacy |          | Response efficacy |          |
|--------------------|----------------|----------|----------|----------|---------------|----------|-------------------|----------|
|                    | b (SE b) | CI b    | b (SE b) | CI b    | b (SE b) | CI b    | b (SE b) | CI b    |
| **Hopeful emotion**|        |          |          |          |        |          |          |        |
| Low trust          | -0.08 (0.14) | [-0.19, 0.36] | 0.12 (0.13) | [-0.14, 0.38] | 0.30 (0.19) | [-0.08, 0.67] | 0.45 (0.12)** | [0.21, 0.68] |
| High trust         | -0.02 (0.12) | [-0.25, 0.22] | 0.12 (0.10) | [-0.08, 0.33] | 0.13 (0.13) | [-0.11, 0.38] | 0.05 (0.08) | [-0.11, 0.21] |
| **Fear emotion**   |        |          |          |          |        |          |          |        |
| Low trust          | 0.63 (0.14)** | [0.35, 0.91] | 0.88 (0.13)** | [0.63, 1.14] | -0.36 (0.19)† | [-0.73, 0.01] | -0.24 (0.12)* | [-0.48, -0.01] |
| High trust         | 0.62 (0.13)** | [0.36, 0.89] | 0.70 (0.12)** | [0.47, 0.93] | 0.01 (0.14) | [-0.27, 0.29] | 0.11 (0.09) | [-0.07, 0.29] |
| **Annoyed emotion**|        |          |          |          |        |          |          |        |
| Low trust          | -0.02 (0.08) | [-0.18, 0.14] | -0.09 (0.07) | [-0.23, 0.06] | -0.02 (0.11) | [-0.23, 0.19] | -0.22 (0.07)** | [-0.35, -0.09] |
| High trust         | -0.08 (0.09) | [-0.26, 0.11] | -0.24 (0.08)** | [-0.40, -0.08] | 0.09 (0.10) | [-0.10, 0.29] | -0.03 (0.06) | [-0.15, 0.10] |
| **Argument strength** |        |          |          |          |        |          |          |        |
| Low trust          | -0.05 (0.18) | [-0.39, 0.30] | 0.14 (0.16) | [-0.18, 0.46] | -0.15 (0.24) | [-0.61, 0.32] | 0.48 (0.15)** | [0.19, 0.77] |
| High trust         | -0.14 (0.19) | [-0.52, 0.23] | 0.14 (0.17) | [-0.18, 0.47] | 0.49 (0.20)* | [0.09, 0.88] | 0.61 (0.13)** | [0.36, 0.86] |
| **Prior intention** |        |          |          |          |        |          |          |        |
| Low trust          | 0.23 (0.10)* | [0.03, 0.42] | 0.19 (0.09)* | [0.01, 0.37] | 0.05 (0.13) | [-0.21, 0.31] | 0.22 (0.08)** | [0.06, 0.38] |
| High trust         | 0.07 (0.06) | [-0.06, 0.20] | 0.06 (0.06) | [-0.05, 0.17] | -0.09 (0.07) | [-0.22, 0.04] | 0.08 (0.04)† | [-0.002, 0.17] |

Note. N=279. Values represent unstandardized coefficients from a structural equation model. Bold values indicate Wald tests significant at p < .05. Italicized values indicate Wald test marginally significant at p < .10. Model RMSEA = 0.07, CFI = 0.97. EPPM = extended parallel process model.

*p < .05. **p < .01. ***p < .001. †p < .10.
include strong arguments, if efficacy is a more important predictor of compliance with health risk reduction behaviors like vaccination. With regard to vaccination specifically, the present findings suggest messages that inspire hope and emphasize the effectiveness of vaccines for protecting the collective (public) health and greater US economy should be particularly effective with unvaccinated adults who have low levels of trust in the CDC.

### Limitations and Future Research

Findings should be interpreted in light of study limitations. The two samples, both drawn from the Mechanical Turk platform, may differ from the general US population in ways that reduce their generalizability. Additionally, while experiments tested overlapping constructs within messages encouraging two different risk reduction behaviors, each study used only one set of tweets. Follow-up research should be conducted with different operationalizations of these constructs, ideally extending tests to different modes of public health messaging. For example, video PSAs may be more emotionally provocative than brief tweets. Exploring the progression from cognitive reactions and intentions to actual behavior was also not possible in the present research. Finally, embedding the tweets within a survey created an artificial context for the tweets, reducing the ecological validity of the findings. For example, unvaccinated

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**Table 9. Effects of EPPM Constructs on Vaccination Intention (Study 2).**

| Variables     | Intention to get vaccine |   |
|---------------|--------------------------|---|
|               | $b$ ($SE_b$)             | CI $b$ |
| Susceptibility|                          |     |
| Low trust     | $-0.03 (0.07)$           | $[-0.16, 0.11]$ |
| High trust    | $-0.06 (0.10)$           | $[-0.25, 0.13]$ |
| Severity      |                          |     |
| Low trust     | $0.06 (0.07)$            | $[-0.07, 0.18]$ |
| High trust    | $0.07 (0.11)$            | $[-0.15, 0.28]$ |
| Self-efficacy |                          |     |
| Low trust     | $-0.04 (0.04)$           | $[-0.11, 0.03]$ |
| High trust    | $0.001 (0.08)$           | $[-0.15, 0.15]$ |
| Response efficacy |                    |     |
| Low trust     | $0.15 (0.05)^{**}$       | $[0.05, 0.25]$ |
| High trust    | $0.24 (0.12)^*$          | $[0.004, 0.47]$ |
| Prior intention|                         |     |
| Low trust     | $0.78 (0.05)^{***}$      | $[0.67, 0.88]$ |
| High trust    | $0.60 (0.06)^{***}$      | $[0.48, 0.72]$ |

Note. $N=279$. EPPM = extended parallel process model. Values represent unstandardized coefficients from a structural equation model. Bold values indicate Wald tests significant at $p < .05$.

$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$. 

include strong arguments, if efficacy is a more important predictor of compliance with health risk reduction behaviors like vaccination. With regard to vaccination specifically, the present findings suggest messages that inspire hope and emphasize the effectiveness of vaccines for protecting the collective (public) health and greater US economy should be particularly effective with unvaccinated adults who have low levels of trust in the CDC.
adults who encounter a message encouraging vaccination from a source they do not trust may ignore the message all-together in their everyday lives. Additional research should examine factors that impact attention to risk reduction messages and their arguments, particularly among audiences with low trust in public health institutions.

**Conclusion**

This study suggests that fear-based public health messages may not be the most effective messaging strategy for motivating risk reduction behavior in the context of COVID-19. Rather, inspiring hope that following health guidance can mitigate the ongoing pandemic and contribute to the greater good may be more motivating, particularly among individuals untrusting of public health institutions issuing the guidance. Results of this research also highlight the importance of testing messages with specific audiences prior to dissemination. For example, though impact of message annoyance on response efficacy was negligible for unvaccinated adults highly trusting of the CDC, this cognitive reaction predicted reduced response efficacy among those with less trust. Given the link between perceived response efficacy and vaccination intention, such a backlash could have unfavorable effects on a population segment that is already less likely to follow CDC guidance.

**Declaration of Conflicting Interests**

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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