



# The influence of gain-loss framing and its interaction with political ideology on social distancing and mask wearing compliance during the COVID-19 pandemic

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## Abstract

The COVID-19 pandemic has caused millions of cases and over half a million deaths in the United States. While health experts urge citizens to adopt preventative measures such as social distancing and wearing a mask, these recommended behaviors are not always followed by the public. To find a way to promote preventative measures, the present study examined the role of gain-loss framing of COVID-19 related messages on social distancing and mask wearing compliance. Moreover, the study also tested potential moderating effects on framing with three individual characteristics: political ideology, subjective numeracy, and risk attitude. A sample of 375 U.S. adult residents were recruited from Amazon Mechanical Turk. Each participant read either a gain or loss-framed message related to practicing protective behaviors during the COVID-19 pandemic. Participants also completed scales of preventative behaviors, risk attitude, subjective numeracy, political ideology, and other demographic variables. It was found that those who were more liberal, risk-averse and had greater subjective numeracy were more likely to wear a mask and/or follow social distancing. Furthermore, in the presence of demographic and psychological factors, the study found participants in the loss-framed condition than in the gain-framed condition were more likely to adopt both preventative measures, supporting the notion of loss aversion. Additionally, the framing effect was also moderated by political ideology on mask-wearing, with the effect being stronger in liberals than in conservatives. Collectively, the study implies message framing may be a useful means to promote preventative measures in the current pandemic.

**Keywords** COVID-19 · Mask wearing · Social distancing · Framing effect · Risk attitude · Political ideology · Subjective numeracy

The SARS-CoV-2 virus has created one of the deadliest pandemics in history. The World Health Organization (WHO) declared the coronavirus disease a pandemic on March 11th, 2020 (Shah & Farrow, 2020). After only 8 months, as of November 3rd, 2020, there have been about 9.2 million COVID-19 cases and over 230,000 reported deaths in the United States (Jennings, 2020). Health experts say that social distancing and wearing a mask are two of the most important preventative measures one can take to slow the spread of the infectious disease (Leung et al., 2020). However, these recommended behaviors are not always followed by the public. Not following social distancing guidelines is common (De

Witte, 2020), while the use of face masks has been controversial and even highly politicized (Kahane, 2021). Therefore, it is imperative to find a way to promote these preventative measures.

The primary goal of this study is to examine the effect of message framing on the behaviors of social distancing compliance and mask-wearing. Past research has found message framing could promote a variety of health behaviors (e.g., Rothman et al., 1993; Yang, 2018). Compared to other strategies such as educating thinking disposition and self-control (Xu & Cheng, 2021), framing can be operated more easily and quickly. Thus, the present study aims to further extend the work of framing to the preventative behaviors in the current pandemic. Moreover, to understand the framing effect in the COVID-19 pandemic more comprehensively, this study also attempts to identify potential variables (e.g., political ideology) that may moderate the effect of message framing.

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## Framing Effect and the COVID-19 Pandemic

Framing refers to how a message or question is presented to its audience. Often, the context of the message is not what matters most, but how it is said has the biggest impact (Ogbodo et al., 2020). The concept of message framing is an important aspect in health communication. The design of a message has the potential to alter an individual's perception of the message content and can therefore influence their behavior and attitude towards the subject (Fetter et al., 2019). Following past research (e.g., Fetter et al., 2019; Tversky & Kahneman, 1981), the present study will employ gain-loss framing, a popular framing paradigm, to examine the effect it has on preventative behaviors. Gain and loss framing specifically tap into emotional responses to messages (Tversky & Kahneman, 1981). Gain frames are typically positive and emphasize benefits while loss frames lean more negative and emphasize costs of a particular decision (Holton et al., 2014). An example of gain and loss-framed messages that were used in an Obesity-prevention program from Fetter et al. (2019) include "exercising regularly can help you lose weight" (gain) versus "not exercising regularly can make you gain weight" (loss).

A few studies have applied the gain-loss framing in the context of the COVID-19 pandemic.<sup>1</sup> In Hameleers (2020), participants chose hypothetical risk-averse or risk-seeking treatment programs when such programs were gain and loss framed. Specifically, in the gain condition, the risk-averse program was "65% of all contaminated people can be saved" whereas the risk-seeking program was "65% likelihood to save all contaminated people, and a 35% likelihood to save none of the contaminated people". In the loss condition, the programs adopted equivalent statistics but were presented with loss terms: "35% of all contaminated people will die" (risk-averse) vs. "a 65% likelihood that none of the contaminated people will die, and a 35% likelihood that all of the contaminated people will die" (risk-seeking). Consistent with the notion of the Prospect Theory, the study found that the risk-averse program was more favorable in the gain condition, whereas as the risk-seeking program was more preferred in the loss condition.

In another study on framing and the pandemic (Sanders et al., 2021), the authors framed the projected number of deaths in the United Kingdom (As many as 100,000 people could be saved by a well-managed extension to the lockdown vs. As many as 100,000 people could die without a well-managed extension to the lockdown) and asked participants to report their views on lockdown and intention to adhere public health guidelines. However, the study did not find any significant framing effect. By contrast, Gantiva et al.

(2021) expressed the self-care behaviors (hand washing, physical distance, and staying home) with a gain-loss framing manipulation and discovered that the gain-framed message was more effective in promoting such behaviors in residents in Columbia.

Given the inconclusive results from the past research, the present study aims to continue examining how framing can be used to promote health behaviors in the current pandemic. Due to the crucial role of mask-wearing and social distancing compliance in mitigating virus spread, the current work chooses to test the effect of gain-loss framing on these behaviors.

## Potential Moderators: Political Ideology, Subjective Numeracy, and Risk Attitude

While framing itself may change behaviors, past research has shown framing is subject to moderating effect. Thus, to depict the framing effect more precisely, the present study tests a few potential moderators. These moderators are common individual characteristics and were chosen based on two reasons. First, previous studies have found that these individual characteristics could moderate the effect of message framing. Second and more importantly, the potential moderators are closely related to behavioral and mental processes in the COVID-19 pandemic.

**Political Ideology** Political ideology is how someone identifies themselves on a spectrum, usually from having conservative (Republican-leaning) views to having liberal (Democratic-leaning) views. Framing may be moderated by political ideology. For instance, in a study where participants were asked to evaluate crime-reduction proposals, the effect of crime-related information framing (metaphorize crime as a beast vs. a virus) was moderated by political ideology, with Republicans showing less sensitivity to the framing effect (Thibodeau & Boroditsky, 2011). Furthermore, in the COVID-19 pandemic, political ideology has played a prominent role in health behaviors. For example, the results from a Gallup poll suggest that Democrats and Independents continuously see COVID-19 as a deadly virus. On the other hand, Republicans are 10 times more likely as Democrats to say the death count is overstated (Ritter, 2020). Ramos et al. (2020) argues that the difference in attitudes towards taking these preventative measures are due to the fundamental differences in normative principles and belief systems reflected by one's political ideology. Consistent with this notion, Xu and Cheng (2021) found that a more liberal view was related to a greater tendency to wear a mask and follow social distancing. In the same study, political ideology also moderated the positive effect of need for cognition and self-control on mask-wearing behavior, with the effect being more prominent in liberals than in

<sup>1</sup> Jordan et al. (2020) and Palm et al. (2021) also tested the framing effect on behaviors and attitudes in the COVID-19 Pandemic. However, these studies did not specifically employ the gain-loss framing.

conservatives. Together, given the powerful impact of political ideology in the current pandemic, the present study aims to empirically test whether political ideology moderates the framing effect on preventative measures. Following the studies described above, we predict that the framing effect was stronger in more liberal participants than in more conservative participants.

**Subjective Numeracy** Numeracy has two types: subjective and objective numeracy. Subjective numeracy pertains to the willingness and motivation to utilize numerical information, whereas objective numeracy taps into the actual operations (Peters & Bjälkebring, 2015). Greater numeracy has been found to be associated with making more advantageous decisions (the numeracy hypothesis raised in Sinayev & Peters, 2015). For example, participants with higher subjective and objective numeracy were more likely to select the later larger gains over the sooner smaller gains in intertemporal choices (Cheng, 2020). Similarly, participants with higher subjective and objective numeracy were able to select gamble options with higher expected values (Peters & Bjälkebring, 2015). In the pandemic, the public constantly receives numerical messages such as the number of positive cases and deaths, positivity rate, and projected cases in varying scenarios (e.g., with or without lockdown). Thus, how people comprehend and utilize numerical information may affect their choices on preventative measures. Moreover, past research has found that greater (objective) numeracy has been associated with reduced susceptibility to the framing effect (Peters & Levin, 2008; Peters, 2012), possibly because higher numerate participants were more likely to capture the gist of the message. Thus, the present study aims to examine whether numeracy also moderates the framing effect on preventative behaviors in this pandemic.

It is worth noting that past research mainly tested objective numeracy, particularly in the domain of framing effect. To advance the understanding of numeracy, the present study employs subjective numeracy (Fagerlin et al., 2007). Despite the conceptual difference, some studies found these two types of numeracy had a similar correlation with gamble choice, intertemporal choice, and how the public perceived the police (Cheng, 2020; Peters & Bjälkebring, 2015; Pham & Cheng, 2020). Taken together, following the numeracy hypothesis and the studies described above, we predict that subjective numeracy is positively associated with the behaviors of social distancing and mask-wearing. Additionally, we also predict that people with greater subjective numeracy are less susceptible to the framing effect.

**Risk Attitude** Risk attitude is closely related to health behaviors. For example, risk-averse (as opposed to risk-seeking) students on a college campus were less likely to engage in risky sexual behaviors that may result in STDs and unwanted

pregnancies (Whyte et al., 2017). As the pandemic poses a great risk on well-being, how people respond to risk may affect their relevant behaviors. For example, studies found that greater risk-averse (as opposed to risk-seeking) was related to decreased human mobility and travel intention (Chan et al., 2020; Luo & Lam, 2020), and to more social distancing and mask-wearing (Miguel et al., 2021; Xu & Cheng, 2021). Compared to those studies, the current study was performed at a later stage when the situation had largely changed (e.g., the U.S. election had been held and the initial promising vaccine results had been released to the public). However, given risk attitude is an intrinsic propensity, we expect to replicate the role of risk attitude in the present study: greater risk-averse is related to more preventative behaviors.

Furthermore, a recent study found risk attitude could influence the framing effect, with participants with a higher risk-seeking tendency (i.e., lower risk-averse tendency) being less prone to the gain-loss framing (Tabesh et al., 2019). As noted in the article, a possible reason was that a strong risk-seeking propensity (i.e., greater willingness to take an action) might dominate the situational uncertainties (i.e., different frames) and thus, people with such a propensity were less likely to be influenced by positive or negative situational contexts. Following this, the present study empirically tests the potential interaction between risk attitude and framing. Additionally, past research has shown risk attitude varies along with age, with older adults being more risk-averse than their counterparts (Best & Charness, 2015; Mather et al., 2012). More importantly, the current pandemic poses a significantly higher risk to older adults. For example, according to CDC (Centers for Disease Control and Prevention, 2021), the risk for hospitalization, severe illness and death caused by COVID-19 increases with age, with older adults at highest risk. Thus, in addition to the framing effect, we also test the interaction between risk attitude and age. Given the higher risk that older adults encounter in the current pandemic, we predict that risk attitude may play a more prominent role in older adults with regard to preventative behaviors.

## Overview

Inspired by the work done by Tversky and Kahneman, the framing effect has been popular in the domain of health communication. Following past research, the present study aims to examine whether message framing can affect the behaviors of mask-wearing and social distancing. These two behaviors are crucial preventative measures to protect individuals and mitigate virus spread, especially when vaccination is still in progress. Furthermore, the study also tests three important individual characteristics that might moderate the effect of framing. Together, we hope to elucidate the role of framing in the context of the COVID-19 pandemic, along with identifying

**Table 1** Descriptive statistics for race, education, and income

Variable	Category	Frequency	Percentage (%)
Education	Less than high school graduate	0	0
	High school graduate or equivalent	35	9.3
	Some college or associate degree	46	12.3
	Bachelor's degree	227	60.5
	Master's degree	65	17.3
	Doctoral degree	2	.5
Income (\$)	Under 9999	17	4.5
	10,000 – 24,999	41	10.9
	25,000 – 49,999	92	24.5
	50,000 – 74,999	131	34.9
	75,000 – 99,999	60	16.0
	100,000 – 149,999	29	7.7
	Over 150,000	5	1.3
Race	White or Caucasian	282	75.4
	Hispanic or Latinx	10	2.7
	Black or African American	34	9.1
	Asian or Asian American	47	12.6
	Other	1	.3

relevant psychological and demographic factors that are critical to preventative measures.

## Methods

### Participants

The study received IRB approval prior to data collection. A total of 375 participants (232 (males and 143 females) were recruited from Amazon Mechanical Turk (mTurk) on November 11th, 2020. These participants were adults, U.S. residents, and had a mTurk approval rating over 98%. Each participant received \$1.00 for compensation. With G\*Power 3.1.9, we conducted a sensitivity analysis to estimate the effect size that could be detected by our sample. We set  $\alpha = .05$  and power = .80. In consequence, the present sample size allowed us to detect an  $R^2$  as low as .05 in a linear regression reported below. In other words, the current sample size was sensitive enough to detect an effect size that was close to a small level (Cohen, 1988).

The present study collected a series of demographic variables, including age, gender, annual household income, education, and race. For age, it ranged between 21 and 69, with a mean of 34.73 and a standard deviation of 10.92. For the descriptive statistics of education, income and race, please refer to Table 1. As reported below, the study also measured participants' political ideology. As a result, the variable of political ideology ranged between 1 and 5, with a mean of 3.35 and a standard deviation of 1.03.

### Materials and Procedures

Participants responded to an online survey via Qualtrics. The following questionnaires were completed in the following order:

**Risk Attitude Scale** The present study employed the health/safety subscale of the Domain Specific Risk-Taking Scale (DOSPERT, Blais & Weber, 2006) to measure risk attitude (risk seeking vs. risk averse).<sup>2</sup> The risk attitude scale contains six items (e.g., Driving a car without a seat belt) and assesses risk attitude regarding behaviors and actions in the health and safety domains. Participants evaluated the likelihood of engaging in a potentially risky action or behavior with a 7-point Likert rating scale, with 1 as extremely likely and 7 as extremely unlikely. An average was taken across the six items, with a higher score indicating greater risk-averse. In the current sample, the reliability of the scale was .74.

**Subjective Numeracy Scale** The Subject Numeracy Scale (SNS, Fagerlin et al., 2007) was used to measure the perceived ability to perform various mathematical tasks and preference for the use of numerical information. The subjective numeracy scale consists of eight items. Example items include: "How good are you at working with percentages?". Each item was responded with a 7-point Likert rating scale, ranging from 1 = Not at all good/helpful to 7 = Extremely good/Always prefer.

<sup>2</sup> Blais and Weber (2006) suggested users should adopt different subscales depending on the testing domain. Following this, the present study adopts the health/safety subscale to represent risk attitude.



One item was reverse coded: “How often do you find numerical information to be useful?” using the scale 1 = Never to 7 = Very often. An average was taken across the entire scale, with a larger score indicating greater subjective numeracy. The reliability of the scale was .74.

**Political Ideology Scale** The scale of political ideology has four items (Inbar & Lammers, 2012). It asks participants to rate their political ideology in four domains (overall political orientation, social issues, economic issues and foreign policy) with a five-point Likert scale (1 = very conservative; 5 = very liberal). A larger value of this scale represented a more liberal ideology. The reliability of this scale was .89 in the present study. For descriptive statistics of political ideology, please refer to the Participants section.

**Gain and Loss Framed Messages** Participants were randomly assigned to read a message presented in either a gain or loss frame. The gain framed message was positive and highlighted the number of potential lives saved, while the loss framed message was negative and highlighted the number of potential lives lost. Each message began with a piece of background information regarding the projection of Covid-19 related deaths: “The Institute for Health Metrics and Evaluation (IHME) is an independent global health research center at the University of Washington. IHME has created COVID-19 projections that include a variety of forecasts, including cumulative COVID-19 deaths in the United States through the 1st of February, 2021”. The gain framed message followed with: “Health experts are saying that taking preventative measures such as social distancing and wearing a mask could save 130,000 lives between now and February 1st, 2021 in the United States”. The loss framed message followed with: “Health experts are saying that without practicing preventative measures such as social distancing and wearing a mask, 130,000 people could die between now and February 1st, 2021 in the United States”.

**Mask-Wearing Behavior** After reading the message, participants were asked to rate how they would behave in regard to mask-wearing in the next month. The future mask-wearing behavior was measured with one item: “Based on the previous statement about taking preventative measures, will you wear a mask when going out in public in the next month?” Participants responded with a Likert scale with 1 = Never and 7 = Always.

**Social Distancing Compliance** After answering the question about mask-wearing behavior, participants were asked how they would behave in regard to social distancing in the next month based on the message they read. A scale developed in previous studies (Xie et al., 2020; Xu & Cheng, 2021) was employed. With five items, the social distancing compliance

scale measured social distancing behaviors in five domains with a seven-point Likert scale. Specifically, the future social distancing behavior questions asked were (1) will go to church or attend other community activities; (2) will give handshakes, hugs or kisses when greeting; (3) will hold social gathering with friends; (4) will keep at least 6 ft from other people who are not from your household in both indoor and outdoor spaces (reverse coded); and (5) will go to events or gatherings the items measured In the present study, a lower score of this scale indicated that a participant was more likely to follow social distancing. The reliability of the scale was .86.

## Data Analysis

Data analyses were performed with SPSS 24.0. In addition to the descriptive statistics and zero-order correlations, hierarchical linear regressions were performed to exhibit the effect of frame, risk attitude and other variables on mask-wearing and social distancing, respectively. In each regression, age, gender, education, income, political ideology, subjective numeracy, risk attitude and frame entered the first block. In the second block, the interactions of frame\*political ideology, frame\*subjective numeracy, frame\*risk attitude, and risk attitude\*age were further added. To prevent multicollinearity, the variables of frame were dummy coded. The variables of political ideology, age, risk attitude, and subjective numeracy were mean centered.

## Results

In addition to the demographic variables and political ideology scales, the present study also employed the scales of mask-wearing, social distancing, subjective numeracy, and risk attitude. For mask-wearing behavior, it ranged between 1 and 7, with a mean of 5.77 and a standard deviation of 1.28. For social distancing compliance, it ranged between 1 and 7, with a mean of 3.59 and a standard deviation of 1.58. The subjective numeracy ranged between 1.88 and 6, with a mean of 4.39 and a standard deviation of .71. For risk attitude, the range was 1.83 and 7, and the mean and standard deviation were 4.84 and 1.01, respectively.

Table 2 exhibits the zero-correlations between mask-wearing, social distancing compliance, framing, and other variables of interest. The correlations displayed some initial evidence of framing. That is, compared to the gain condition, participants showed greater willingness to wear a mask and follow social distancing in the loss condition (for mask-wearing,  $r(373) = .20, p < .001$ ; for social distancing,  $r(372) = -.11, p = .028$ ). As for the relationship between preventative behaviors and individual characteristics, a more liberal political ideology was related to both greater mask-wearing ( $r(373) = .25, p < .001$ ) and social distancing compliance

**Table 2** Correlations between mask-wearing, social distancing compliance, framing and other variables

	SDC	Frame	HSRA	SNS	PI	Age	Gend	Inc	Edu
MW	-.39***	.20***	.28***	.25***	.25***	.06	-.05	.13*	-.02
SDC		-.11*	-.04	-.09	-.11*	-.17**	-.03	-.05	.33***
Frame			.02	.06	.07	-.04	-.07	.12*	.04
HSRA				.24***	.12*	-.07	.13*	.08	.09
SNS					.07	.17**	.003	.09	.12*
PI						-.18**	-.01	-.05	.01
Age							.14**	-.14**	-.15**
Gend								-.03	-.04
Inc									.29***

MW: mask-wearing behavior; SDC: social distancing compliance; Frame: 1 = gain, 2 = loss; HSRA: health/safety risk attitude; SNS: subjective numeracy; PI: political ideology; Gend: gender, 1 = males, 2 = females; Inc.: income; Edu: education. \*:  $p < .05$ ; \*\*:  $p < .01$ ; \*\*\*:  $p < .001$ .

( $r(372) = -.11, p = .042$ ). The behavior of mask-wearing was also related to greater risk averse attitude ( $r(373) = .28, p < .001$ ). Additionally, a stronger subjective numeracy was associated with greater willingness to wear a mask ( $r(373) = .25, p < .001$ ) but not following social distancing ( $r(372) = -.09, p = .074$ ). Interestingly, more education correlated with less social distancing ( $r(372) = .33, p < .001$ ).

As displayed in Table 2, the behaviors of mask-wearing and social distancing were significantly correlated ( $r(372) = -.39, p < .001$ ). The strength of the relationship was between moderate and strong levels (Cohen, 1988). To further elucidate the relationship between mask-wearing and social distancing, an exploratory factor analysis (EFA) was performed on the items of mask-wearing and social distancing.<sup>3</sup> As a result, there was only one factor whose eigenvalue was greater than 1 (the second largest eigenvalue was .81). This factor accounted for 56.8% of variance. Together with the correlation indicated above, the results of EFA suggested that mask-wearing and social distancing had shared behavioral construct. Table 3 displays the results of EFA.

Despite the share construct, it is worth noting that in the following regression analyses, we still separated the scales of mask-wearing and social distancing for a few reasons. For example, based on face validity and every life experience, mask-wearing and social distancing were distinct behaviors. Furthermore, there was substantial variance (43.2%) that could not be explained by the factor, indicating the EFA was not able to fully capture mask-wearing and social distancing behaviors. For more detailed interpretations of the EFA, as well as thoughts on the relationship between mask-wearing and social distancing, please refer to the Discussion part.

Although correlations generated meaningful results, we were mindful that the chance of having a type I error might get inflated with multiple simultaneous correlations being

performed. Hence, to further examine the effect of framing, risk attitude and other variables on mask-wearing and social distancing, we proceeded to regressions. In particular, we were interested in testing potential interactions with regressions. Table 4 demonstrates the results of the hierarchical linear regressions. For the effect of individual variables on mask-wearing and social distancing, the results were similar between zero-order correlations and regressions (block 1). For instance, political ideology and framing manipulation were associated with protective behaviors in both analyses. Beyond correlations, in block 2 of the hierarchical linear regressions, we tested interactions to specify the impact of moderating effect on framing. As a result, for mask-wearing, there was a significant interaction between framing and political ideology ( $B(SE) = .24(.12), p = .041$ ). Additionally, the interaction between risk attitude and age was significant for both mask-wearing ( $B(SE) = .01(.005), p = .010$ ) and social distancing ( $B(SE) = -.01(.007), p = .038$ ).

To unpack the interactions, the variables of political ideology, risk attitude and age were divided into a high group and a low group with median split. Figures 1-3 depicts the specific

**Table 3** Exploratory factor analysis on the relationship between mask-wearing and social distancing

Items	Factor & Loadings	Communalities
Mask-wearing	-.42	.17
Social distancing item 1	.69	.47
Social distancing item 2	.81	.65
Social distancing item 3	.74	.55
Social distancing item 4	.78	.61
Social distancing item 5	.70	.48
Eigenvalue	3.40	
Variance accounted for	56.8%	

Note. For the five items of the social distancing scale, please refer to the Methods section above

<sup>3</sup> This EFA analysis employed principal axis factoring but the conclusion remained same with principal component analysis.

**Table 4** Hierarchical linear regressions on mask-wearing and social distancing compliance

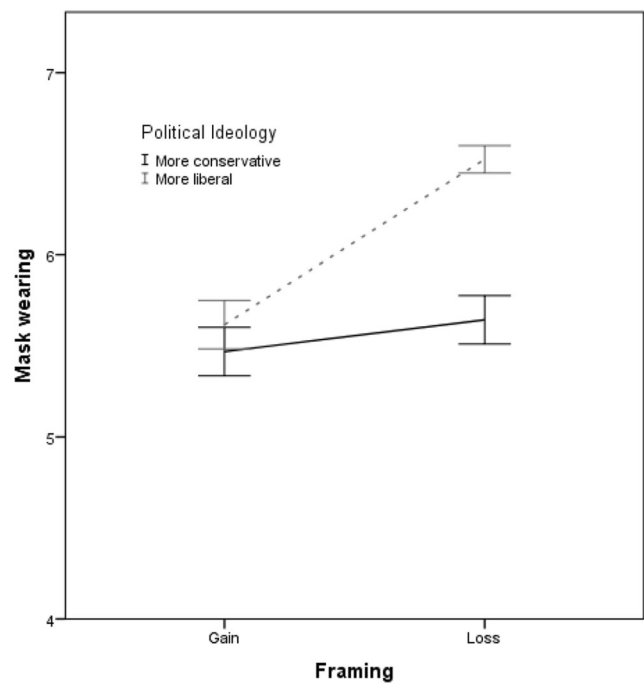
	Mask-wearing	Social distancing
Blocks and Variables	B(SE)	B(SE)
Block 1		
$R^2$ Change	.22***	.19***
Age	.01(.01)	-.02(.01)**
Gender	-.21(.13)	-.01(.16)
Income	.13(.05)*	-.21(.06)**
Education	-.15(.08)	.71(.10)***
PI	.28(.06)***	-.21(.08)**
HSRA	.26(.06)***	-.01(.08)
SNS	.29(.09)**	-.15(.11)
Framing	.41(.12)**	-.36(.15)*
Block 2		
$R^2$ Change	.03**	.01
Age	.01(.01)	-.02(.01)*
Gender	-.23(.12)	.003(.16)
Income	.13(.05)*	-.22(.06)**
Education	-.13(.08)	.70(.10)***
PI	.18(.08)*	-.20(.10)*
HSRA	.30(.08)***	-.04(.11)
SNS	.46(.13)***	-.14(.17)
Framing	.43(.12)***	-.38(.15)*
Framing $\times$ PI	.24(.12)*	-.04(.15)
Framing $\times$ SNS	-.28(.17)	-.06(.22)
Framing $\times$ HSRA	-.11(.12)	.08(.16)
HSRA $\times$ Age	.01(.005)*	-.01(.007)*

Framing: 1 = gain, 2 = loss; HSRA: health/safety risk attitude; SNS: subjective numeracy; PI: political ideology. \*:  $p < .05$ ; \*\*:  $p < .01$ ; \*\*\*:  $p < .001$ .

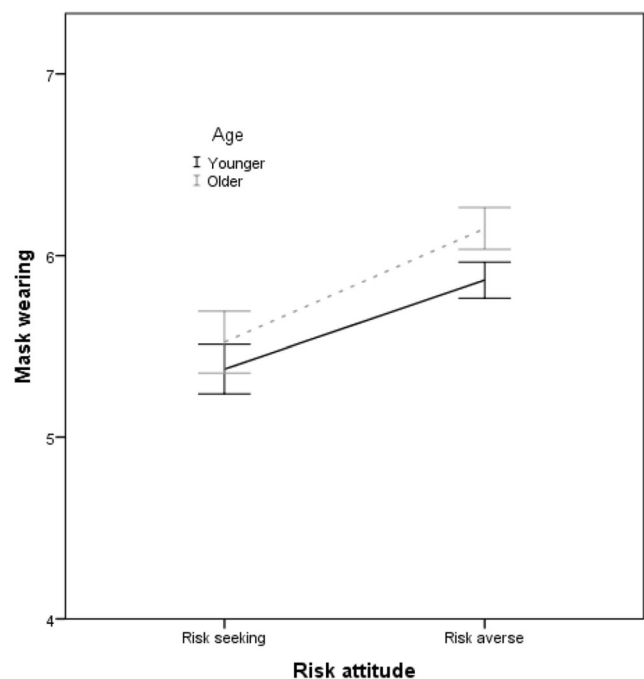
pattern of the interactions. As shown in Fig. 1, the framing effect (gain-loss asymmetry) appears to be more pronounced in the more liberal participants than in the more conservative participants. Figures 2 and 3 exhibit the interactions between risk attitude and age for mask-wearing and social distancing, respectively. For mask wearing, while risk averse was associated with greater mask-wearing in both age groups, such a pattern was more pronounced in the older participants than in the younger participants. For social distancing compliance, whereas the effect of risk averse was relatively stable in younger participants, risk averse was more related to greater social distancing compliance in older participants.

## Discussion

The COVID-19 pandemic has been deadly, but health experts suggest there are certain behaviors that one can practice to

**Fig. 1** Interaction between framing and political ideology on mask wearing

reduce the spread of the virus i.e., social distancing and mask wearing (Leung et al., 2020). The manner in which these preventative-behavior messages are presented to the public may have an effect on how individuals respond to the message. There are also other psychological and demographic factors that may influence how or why individuals have responded to the pandemic with the use of protective

**Fig. 2** Interaction between risk attitude and age on mask wearing

behaviors in different ways. It is important to understand these factors in order to best communicate health-related messages to certain groups of people in order to gain the highest level of compliance.

The present study manipulated the number of projected deaths with gain-loss framing. A major finding was that in general, participants in the loss-framed condition (130,000 deaths without preventative measures) than in the gain-framed condition (130,000 lives could be saved with preventative measures) were more likely to wear a mask and follow social distancing. Such a pattern was consistent with the concept of loss aversion, which states that the negative feeling toward losses is stronger than the positive feeling toward equal amount gains (Tversky & Kahneman, 1979). It is worth noting that with a similar manipulation, Sanders et al. (2021) did not find a significant framing effect on views on lockdown and intention to adhere to public health guidelines, whereas Gantiva et al. (2021) found the gain-framed message was more effective in promoting self-care behaviors. A possible reason could be timing and severity of the situation. When Gantiva et al. (2021) and Sanders et al. (2021) collected their data in April and May, 2020, respectively, there were approximately 5000 COVID-19 cases and 250 deaths in Columbia, and 248,000 COVID-19 cases and 35,000 deaths in the U.K. ([www.worldometers.info/coronavirus](http://www.worldometers.info/coronavirus)). The present study collected data on November 11th, 2020. By this time, there had been over 9.2 million COVID-19 cases and 230,000 deaths in the U.S. Thus, the situation was far worse when the present study was performed even when taking the size of the population into account. Additionally, the number of

estimated deaths used in the framing messages in present study was far larger than those used in Gantiva et al. (2021) and Sanders et al. (2021). As a result, U.S. residents might be more alarmed and horrified by the severity of the situation. Hence, they were more sensitive to the loss-framed message. Additionally, some past studies found that gain-framed messages were more effective in promoting health behaviors. For instance, Yang (2018) found gain-framed messages had a larger impact on smoking cessation. As noted in Rothman and Salovey (1997), the effectiveness of gain-loss framing was related to outcome uncertainty. Compared to gain-framed messages, loss-framed messages were more effective when the outcome was more uncertain. Consistent with this notion, because the effect of COVID-19 on illness and deaths was much more uncertain and less understood than the effect of smoking, loss-framed messages appeared to be more influential in the present study. Together, despite the differences, the present study still added to the body of knowledge about framing and health behaviors.

The present study also tested the role of individual characteristics in protecting behaviors in the COVID-19 pandemic. Consistent with past research and a Gallup poll (Miguel et al., 2021; Ritter, 2020; Xu & Cheng, 2021), the present study replicated the role of political ideology, with more liberal ideology being associated with more preventative behaviors. Interestingly, we found education was negatively correlated with social distancing compliance. A possible reason might be those with a higher level of education better understood social interaction as a basic human need (Sikali, 2020) and were used to having social experiences (e.g., college activities). Hence, it might be more difficult for these people to maintain social distancing. Additionally, the study found risk-averse attitude was positively related to mask-wearing but not social distancing. Moreover, the study also discovered that such an attitude interacted with age, with the effect of risk attitude being stronger in older adults. The difference in protecting behaviors between the two age groups might be due to the greater effects of the coronavirus on the older population. For instance, the rate of mortality was much higher in the elderly compared to individuals less than 50 years old (Kang & Jung, 2020). Thus, older adults might take the risk more seriously and weigh risk more in their decisions. Additionally, the study found a positive relationship between subjective numeracy and mask-wearing, and thus supported the numeracy hypothesis regarding positive association between numeracy and advantageous decisions (Sinayev & Peters, 2015).

More importantly, our study examined the potential moderating effect of these individual characteristics on framing. Previous research found political ideology moderated the effect of need for cognition and self-control on protective behaviors (Xu & Cheng, 2021). The current work further extended the moderating role of political ideology to the framing effect. Our finding was consistent with Thibodeau and

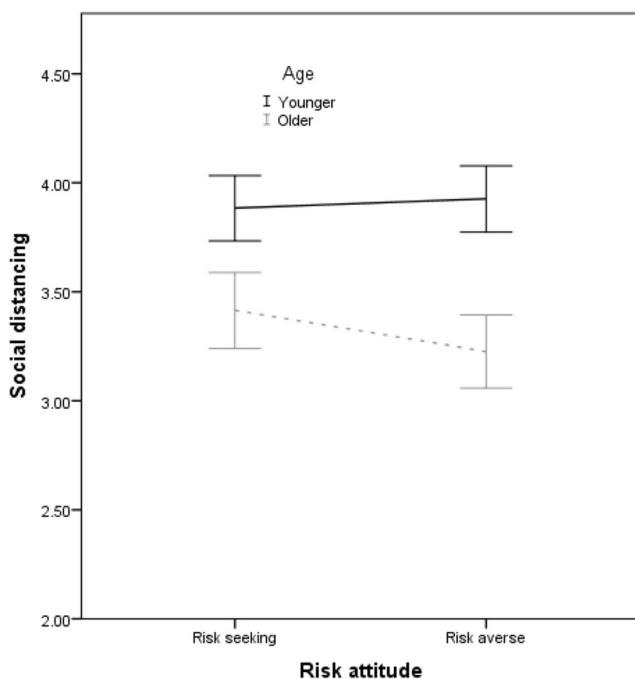


Fig. 3 Interaction between risk attitude and age on social distancing



Boroditsky (2011). That is, we found conservatives, as opposed to liberals, were relatively insensitive to framing manipulation. Xu and Cheng (2021) also found that more conservative ideology weakened the effect of need for cognition and self-control on mask-wearing. A possible reason might be that conservatives held not only a more negative but also a firmer view on protecting behaviors in the pandemic, given that former President Trump and other conservative political figures repeatedly refuse to wear a mask and downplayed the usefulness of mask (Givhan, 2020; Kempthorne & Terrizzi Jr, 2021). Thus, people with a more conservative ideology might be less influenced by other factors, including message framing.

In addition to the findings discussed above, the present study also analyzed the relationship between the behaviors of mask-wearing and social distancing. Not surprisingly, the zero-order correlation indicated that the two preventative behaviors were significantly correlated. The exploratory factor analysis further implied that mask-wearing and social distancing had a common underlying construct. For instance, those who have serious concerns (maybe due to underlying medical conditions) about the virus are more likely to wear a mask and follow social distancing. Alternatively, individuals who have a higher trust in their government, or individuals who have a higher belief/understanding in science would be more likely to adopt both behaviors. Future studies can empirically test and compare these potential constructs to further understand the common underlying mechanisms of preventative behaviors.

On the other hand, results from the regressions suggested some differences between these two preventative behaviors. That is, compared to social distancing, mask-wearing was subject to more intrinsic and extrinsic factors (risk attitude, subjective numeracy, and the interaction between framing and political ideology). A possible reason might be that social distancing was introduced before mask-wearing in the U.S. and residents were more used to social distancing. Alternatively, culture might be a reason because mask-wearing is relatively new to Western countries (Joung, 2020). Regardless of the reason, the findings imply that the government may need to spend more effort on introducing the benefits and necessity of wearing a mask.

## Implications

The present study generated some implications. First, message framing is a technique that can be used in a variety of domains of life. Framing has a large impact on how the audience perceives and responds to a message, and hence it is essentially a fast way to change behaviors. Consistent with this notion, the present study found a significant main effect of framing. Therefore, the government can use framing towards how they go about placing restrictions and mask-mandates.

Second, together with other studies (Kempthorne & Terrizzi Jr, 2021; Ramos et al., 2020; Xu & Cheng, 2021), the present study demonstrated a profound influence of politics in the pandemic. It is noted that the 2020 United States presidential election took place during the midst of the COVID-19 pandemic, and it was one of the most intense and contrasting elections to date. While this was not a political study, the COVID-19 pandemic itself has been overly politicized by the media and political figures in the U.S. (Kahane, 2021), and our findings were consistent with the argument that politicization might have an effect on the public's health (Gostin, 2018). At this point, while specific means is not immediately clear given the partisan political climate in the U.S., the study still advocates for depoliticizing the pandemic and preventative measures.

## Limitations

Limitations should be addressed as well. First, the present study failed to find an interaction between subjective numeracy and framing. A possible reason for this might be that the numerical information in the framing messages (i.e., 130,000 lives saved/lost) was too easy to trigger the numeracy effect. Also, the present study did not adopt objective numeracy as a comparison. Thus, it was not clear whether the non-significant result was due to the difference between objective and subjective numeracy. Future research should adopt both to fully illustrate the function of numeracy in the pandemic.

Second, the study's sample was not particularly racially/ethnically diverse. Although our study was not looking at the relationship between race and protective behavior compliance, it is important to gain a diverse sample in order to generalize the results to the public. Therefore, a further look into the relationship between race/ethnicity on the use of protective-related behaviors or on framing sensitivity would be beneficial and add to the literature.

Third, we should acknowledge that our examination of the relationship between mask-wearing and social distancing was preliminary and exploratory. As we briefly mentioned in the Results section, the EFA missed more than 40% of variance of the behaviors. Moreover, the loading of mask-wearing ( $-.42$ ) was far lower than the loadings of social distancing items (at least  $.69$ ). Similarly, the extracted factor could only explain 17% of variance of mask-wearing. In comparison, for social distancing items, the factor could explain at least 47% of variance. The results indicated that mask-wearing could not be well explained by the extracted factor. A possible reason could be that the present study tested social distancing in multiple scenarios but only tested mask-wearing generically (one item). Hence, our measure failed to comprehensively describe mask-wearing behavior. Additionally, in everyday life, it is possible that people do not perform the two preventative behaviors simultaneously. For example, in public transit in

urban areas, while people may choose to wear a mask, it would be difficult to maintain social distancing given limited physical space. In addition, people often partake in outdoor physical activities while maintaining social distance but not wearing a mask. Moreover, it may seem as if some individuals think that face masks are a replacement for social distancing, but both protective behaviors must be utilized to produce the best outcome (Pajer, 2020). While the current study focused on how message framing might affect different health behaviors, future studies can further examine the relationship and underlying mechanism of these behaviors.

In conclusion, the present study suggests that individuals who are more risk averse, liberal, and who have a higher subjective numeracy score will demonstrate higher levels of mask wearing or social distancing compliance. In addition, loss framing may be more influential in the promotion of health-related behaviors. Moreover, such a framing effect is more prominent in liberals than in conservatives. Overall, the present study depicts the function of framing in health communication, and highlights the key psychological and demographic factors on the decision to use protective behaviors during the COVID-19 pandemic.

**Data Availability** The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

## Declarations

**Ethical Statement** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional review board (IRB 21–0058) at the University of Northern Iowa with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

**Conflict of Interest** On behalf of all authors, the corresponding author states that there is no conflict of interest.

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