Current Psychology
https://doi.org/10.1007/s12144-025-08184-1

To mask, or not to mask: An exploratory examination of factors that predict changes in mask wearing over the pandemic in College Students

Zach J. Gray[1] · **Hannah M. Henderson**[1] · **Grant S. Shields**[1]

Accepted: 29 June 2025

Abstract
The COVID-19 pandemic disrupted society for years. Much evidence shows face masks reduced the spread of the virus; nonetheless, many individuals stopped wearing masks before recommendations (or even mandates) for their use ended. Although predictors of mask wearing have been explored, this preregistered, exploratory study was the first to examine psychological predictors of changes in mask wearing over the course of the pandemic. In particular, we examined a number of potential predictors (e.g., Big Five personality traits, risk taking, etc.) of changes in self-reported mask wearing from March 2020 to August 2021-March 2022 in a sample (N=357) of young adults in the South-Central United States. We found that political orientation, various personality traits, empathy, affect, and decision-making predicted changes in reported mask wearing. Moreover, political orientation moderated many of these associations. These results carry implications for public health, such as describing factors to which appeals might better produce adherence to health guidelines by political orientation.

Keywords Pandemic · Masks · Decision-making · Personality · COVID-19

Introduction

Beginning in early 2020, the global pandemic brought on by SARS-CoV-2 (i.e., the virus that causes COVID-19) impacted all walks of life (Ciotti et al., 2020). The pandemic was marked by multiple waves and variants of the virus, which maintained steady rates of infection, hospitalization, and mortality (del Rio et al., 2022). By May 2023, the World Health Organization (WHO) declared an end to the state of emergency brought on by the pandemic (see https://www.pfizer.com/news/announcements/global-and-us-agencies-declare-end-covid-19-emergency). Despite the heavy costs of the COVID-19 pandemic (e.g., an estimated seven million deaths; Worldometer, 2024), many of the tools to combat it were met with hesitancy and debate (Neilson, 2022; Powdthavee et al., 2021). One of the more debated topics related to the pandemic was the use of face masks to prevent the spread of the virus. In the United States, mask mandates (i.e., a government-enforced policy of mask wearing in public spaces) were met with backlash, mostly by elected officials of the Republican party and conservative-leaning media companies (DeMora et al., 2021; Motta et al., 2020; Stroebe et al., 2021).

Despite evidence for face masks decreasing infection rates, many people either stopped wearing face masks, or completely refused (Adjodah et al., 2021; Neilson, 2022; Wang et al., 2020). Although some of the decrease in mask-wearing can presumably be attributed to the development of vaccines for SARS-CoV-2 and evolving safety guidelines from the CDC and WHO, the specific individual differences that drove these behavioral changes remain unclear. Given the complexity of the psychological and sociopolitical factors at play, this study adopted an exploratory approach to better understand the variability in mask-wearing behaviors. Specifically, this research offers an exploratory examination of various psychological and demographic factors that we speculated based on some prior work might be associated with changes in mask-wearing. As this is an exploratory

✉ Zach J. Gray
zjgray@uark.edu

[1] Department of Psychological Science, University of Arkansas, Fayetteville, AR, USA

Published online: 06 August 2025

study, the aim is not to confirm definitive causal relationships but rather to identify potential patterns and associations that could inform research and preparedness regarding any potential future pandemics.

COVID-19 and face masks

SARS-CoV-2 is spread through respiratory particles that are released by coughing, sneezing, or breathing, and can be spread by individuals who are either symptomatic or asymptomatic (Buitrago-Garcia et al., 2022). There is myriad of evidence that high-compliance mask wearing greatly reduces the spread of the virus, as masks work to slow the transmission of the virus by serving as filters which block the respiratory particles from spreading outwards from the nose and mouth (Howard et al., 2021; Van Dyke et al., 2020). Correct use of face masks (i.e., covering both nose and mouth) was found to effectively reduce rates of transmission (Greenhalgh et al., 2024). Moreover, higher adherence to mask mandates was found to directly correlate with reduced hospitalizations and mortality rates (Adjodah et al., 2021). Moreover, the general consensus regarding appropriate response to potential future pandemics includes proper use of any protective measures (Higgs and Sorenson, 2024). Despite the evidence that compliance with these mandates would lead to preferable health outcomes (e.g., less hospitalizations), and that the mandates both in the US and internationally increased overall mask wearing (e.g., see Smith et al., 2024), there was considerable resistance to said compliance.

Politicization of mask wearing

Much of the discord surrounding mask wearing stemmed from the politicization of it. Indeed, longitudinal research during the pandemic showed that US conservatives were less likely than US liberals to engage in pandemic-related safety behaviors such as mask wearing and social distancing (Stroebe et al., 2021). As mask wearing became increasingly politicized, it fell into the same pitfall as many politicized issues: it was treated as an issue of morality (Turner-Zwinkels et al., 2017). Pro-mask arguments took the narrative that mask wearing was both backed by scientific evidence to reduce spread of the virus and that was is the 'morally correct' action to take – as it is meant to reduce your own transmission of the virus to others (Chan, 2021). In contrast, anti-mask arguments mainly focused on personal liberties and group loyalty, with the idea that enforcing any mandatory requirement is a violation of freedom, considered a fundamental human right (Xu & Cheng, 2021).

These morally based ideological divides between left and right have heightened tensions in an already highly charged political atmosphere. It has been argued that conservatives and progressives rely on different moral values in making decisions (Haidt & Graham, 2007). When examining the five facets of moral foundations theory (harm/care, fairness/reciprocity, ingroup/loyalty, authority/respect, and purity/sanctity), progressives reliably favor the first two, whereas conservatives trend towards a combination of the five (Graham et al., 2009). Moreover, both sides have displayed ingroup favoritism and engaged in both real-world and online antagonism of one another (Lang et al., 2021; Powdthavee et al., 2021).

The morality behind the decision to wear or not wear a mask can have implications across a plethora of psychological variables. For example, with the emphasis on harm/care seen through progressive ideologies, it could be presumed that to a liberal, a conservative not wearing a mask could be representative of behavior meant to intentionally harm another. Conversely, for a conservative who prioritizes liberty and personal responsibility, enforcement of a mask mandate by a liberal could be viewed as a behavior meant to intentionally infringe upon individual freedom. Intentionally harming another person can be exemplar of Dark Triad personality traits, which have been found to be associated with reduced mask mandate compliance (Howard et al., 2021).

Additional factors in mask wearing

Cognitive factors

Deficits in executive functions (e.g., working memory) were implicated with low compliance to pandemic-related safety measures such as social distancing (Xie et al., 2020). Moreover, symptoms of executive dysfunction have also been associated with reduced mask wearing, as have facets of risky decision-making (e.g., delay discounting) (Hudson et al., 2023).

Personality factors

Several studies have linked personality traits based off the Five-Factor Model of personality and perceptions of mask wearing, although the evidence has been mixed (Howard et al., 2021). Some studies have found that higher levels of traits like openness and conscientiousness are more predictive of both mask wearing behaviors and positive perceptions of mask wearing (Howard et al., 2021). Additionally, higher levels of traits like need for cognition have been associated with greater self-reported mask wearing (Xu & Cheng, 2021).

Additional factors

Apart from cognition, personality, and political orientation, mask attitudes and behaviors have been associated with several other factors. For example, higher levels of empathy have predicted more mask wearing, whereas higher levels of risk taking have associated with less mask wearing (Pfattheicher et al., 2020; Thoma et al., 2021). Additionally, the politicized nature of masking raises the possibility that participants' responses might be influenced by social desirability bias – liberal participants might be more inclined to endorse mask wearing, whereas conservative participants might be more inclined towards reporting non-wearing (Jensen, 2020). Although many of these factors have been used to explain mask wearing behaviors at single time points, how they might impact mask wearing over the course of the pandemic is unknown.

Current research

Despite the evidence that mask wearing reduced the spread of SARS-CoV-2, the number of masks seen in public steadily decreased over the course of the pandemic (Feng et al., 2020; Howard et al., 2021). Polls taken by the Associated Press found that while 82% of Americans reported wearing a mask in public in February 2021, only 44% reported wearing a mask in March 2022 (AP, 2022). Consistent with these trends, we hypothesized that self-reported differences in mask wearing between early pandemic (Spring 2020) and later on (Fall 2021/Spring 2022) will show a decline in mask use. The purpose of this research was to take an exploratory approach at understanding the psychological factors that were associated with changes in mask wearing over the course of the pandemic. Drawing on the work described above regarding mask preferences, we hypothesized that individual differences in risk-taking, executive function, empathy, personality traits, political affiliation, stress, and affect could serve as potential predictors of changes in self-reported differences in mask wearing (pre-registration can be found at https://aspredicted.org/blind.php?x=59R_PMJ).

Method

All relevant data and syntax files can be found at https://osf.io/qsdbj/?view_only=f0f7e68b72fb4872869f94a334b42be7.

Participants

Participants (N=303; 66% female) were healthy young adults (M=18.85, SD=1.36; range: 18–35) who passed attention checks (N=357 prior to excluding the 54 participants who failed attention checks and/or other exclusion criteria) attending a large public university in the West South Central United States. Participants completed an online survey about their "cognition, emotion, and daily experiences;" data collection started in August of 2021 (7-day moving average of daily new cases in the state at the time was 2,248) and ended in March 2022 (7-day moving average was 596) (Worldometer, 2022). Participants were also screened for major physical or mental health disorders, recent illness, disruptions to sleep or circadian rhythms, and use of medications or substances that could affect cognition, mood, or alertness. These criteria included recent use of beta-agonists, corticosteroids, sedatives, or recreational drugs, as well as current pregnancy or breastfeeding status. Full sample characteristics are listed in Table 1. Participants were compensated with course credit.

Materials

Mask wearing attitudes assessment

As the feasibility of collecting data regarding actual masking behavior was difficult due to limitations of self-report, especially regarding everyday behaviors like mask wearing (Podsakoff et al., 2003), we asked participants to imagine how they would behave in various scenarios in which a mask could have been worn. Moreover, as masking became such a politicized (and subsequently moral) issue, we believed that assessing people's perceptions of their own mask wearing would serve as an appropriate approximation to actual behavior. As self-reported, imagined behavior has been shown to resemble real behavior (Epley & Dunning, 2006; Vazire & Mehl, 2008), mask wearing attitudes were assessed by providing participants several imaginary situations.

Seven vignettes describing situations in public settings with varying degrees of COVID-19 related uncertainty were presented to the participants to gauge how they felt in those situations. Each situation described a location within the town of the university and asked participants to imagine themselves in that location during a moderate COVID-19 outbreak. The vignettes described other people in the locations, and specifically, whether they were wearing a face mask correctly (i.e., over nose and mouth), incorrectly (i.e., only over mouth), or not at all. For each vignette, participants were asked (a) if they would have worn a mask in that situation (1=no, 2=yes), (b) how comfortable they would have felt in that situation, (c) how they felt about individuals in the story who were wearing a mask, (d) how they felt about individuals in the story who were wearing a mask improperly (i.e., not covering their nose), and (e) how

Table 1 Characteristics of participants

Baseline characteristic	Liberal[1]		Moderate		Conservative		Full sample	
	N=66	%	*N=135*	%	*N=102*	%	*N=303*	%
Gender								
Female	48	72.72	88	65.19	68	66.67	204	67.33
Male	18	27.28	47	34.81	34	33.33	99	32.67
Mean age (*SD*)	18.74 (1.18)	-	18.85 (1.55)	-	18.93 (1.17)	-	18.84 (1.36)	-
COVID-19 vaccination status[2]								
Fully vaccinated	62	93.93	110	81.48	38	37.26	210	69.31
Partially vaccinated	3	4.54	2	1.48	10	9.80	15	4.95
Not yet vaccinated, but intend to	1	1.53	9	6.67	7	6.68	17	5.61
Not vaccinated, do not intend to	0	0	14	10.37	47	46.08	61	20.13
Primary Race/Ethnicity								
Alaska Native or Native American	0	0	2	1.48	2	1.96	4	1.33
Asian/Asian American	6	9.09	8	5.94	1	.98	15	4.95
Native Hawaiian or Pacific Islander	0	0	1	.70	0	0	1	.33
Black or African-American	4	6.06	6	4.44	1	.98	11	3.63
Non-Hispanic White	49	74.25	109	80.77	96	94.12	254	83.82
Hispanic/Latino/a	7	10.60	9	6.67	2	1.96	18	5.94

[1] Liberals, moderates, and conservatives were categorized via cluster analysis

[2]Answers were recorded between August 2021 – March 2022, at which point the COVID-19 vaccine had been readily available for months in the United States

they felt about individuals in the story who were not wearing a mask, rating them from 1 (very negative) to 7 (very positive). Each question had satisfactory internal consistency, αs = 0.85, 0.91, 0.95, 0.94, and 0.96, respectively. All vignettes are provided in the Supplemental Material, with an example vignette is shown below.

> *Imagine that [the city in which they attend the university] is having a moderate outbreak of COVID-19, and you are going to a coffee shop to study. Once inside, you realize that you did not see a sign regarding the store's mask policy. The employees have masks, but eight of the fifteen patrons do not. Out of the seven masked customers, three are wearing them below their noses. The tables are relatively spaced out, but it is difficult to maintain social distancing.*

After each of the vignettes had been completed for the present day, participants then completed the same seven vignettes, modified to assess mask wearing propensity and attitudes at the beginning of the pandemic. In each of these vignettes about the past, to begin, the participant was asked to "think back to spring 2020." Spring 2020 was chosen to attempt to capture the uncertainty surrounding the first few months of the COVID-19 pandemic, the initial declaration of the state of a global pandemic by the WHO, and, in particular, prior to availability of any COVID-19 vaccines in the United States. Participants answered the same series of questions for each past vignette. As with the present-day vignettes, the Spring 2020 vignettes had satisfactory to excellent internal consistency, αs = 0.87, 0.94, 0.97, 0.96, 0.96, respectively. To score each question, responses for each question were averaged across all seven vignettes for both 2020 and 2021–22. This allowed us to calculate the difference in self-reported behavior across the two time points, providing an approximation of perceived changes in mask-wearing behavior over time.

Potential predictors

As this project was conducted in an exploratory manner, there were many nonsignificant predictors included in the initial model (i.e., with all variables) that did not reach the final model (i.e., they did not achieve statistical significance in reverse stepwise regressions). The Supplemental Materials for this article contain a full description of all additional predictors, as well as the citation for each predictor.

Personality traits or self-reported self-perceptions

Big five

The five-factor model of personality was measured in this study via the Ten-Item Personality Index (TIPI) (Gosling et al., 2003). Participants were presented with 10 sets of adjectives (e.g., dependable and self-disciplined) and indicate how well those adjectives describe them by using a scale that ranged from 1 (Disagree strongly) to 7 (Agree strongly). The TIPI has excellent test–retest reliability, with the correlations being 0.76, 0.71, 0.70, 0.62, and 0.77 for the conscientiousness, agreeableness, neuroticism/emotional stability, openness to experience, and extraversion scales,

respectively (Gosling et al., 2003). As the TIPI only consists of two items per trait, any findings should be considered to be tentative and interpreted with caution. The brevity of the TIPI means it may not fully capture the nuances of each personality trait, potentially limiting the reliability and validity of the findings.

Empathy

To measure multiple facets of empathy, participants completed the Interpersonal Reactivity Index (IRI) (Davis, 1983). The IRI consists of four subscales: Empathic concern (i.e., feelings of sympathy towards others), perspective taking (i.e., the ability to adopt another's point of view), personal distress (i.e., feelings of anxiety in difficult social situations), and fantasy (i.e., the ability to understand the behaviors, feelings, and actions of fictional characters). An example item from the perspective taking subscale is, "I sometimes try to understand my friends better by imagining how things look from their perspective." Participants were asked how much they believe each statement applies to them on a scale of 0 (Does not describe me well) to 4 (Describes me very well). Internal consistency was satisfactory or better for the fantasy ($\alpha = 0.80$), empathic concern ($\alpha = 0.77$), and perspective taking ($\alpha = 0.75$) subscales, and poor for the personal distress ($\alpha = 0.69$) subscale.

Impulsiveness and venturesomeness

Participants completed the I-7 Impulsiveness scale (I-7) (Eysenck et al., 1985). The I-7 consists of three subscales: Impulsiveness, venturesomeness, and empathy. Impulsiveness measures behavior done without regard for consequences, regardless of the risk involved. An example item from the impulsiveness subscale is, "Do you get so 'carried away' by new and exciting ideas that you never think of possible snags?" Venturesomeness refers to behaving in a risky way, despite being aware of the risk. An example item from the venturesomeness subscale is, "Would you enjoy parachute jumping?" An example item from the empathy subscale is, "Do you get very upset when you see someone cry?" Participants provided their responses using a Yes (2) or No (1) scale. Internal consistency was acceptable for the impulsiveness subscale ($\alpha = 0.78$), venturesomeness subscale ($\alpha = 0.70$), and empathy subscale ($\alpha = 0.74$).

Passive risk taking

Passive risk-taking, meaning risk taken through inaction (as opposed to active risk taken through action), was measured with the Passive Risk Taking scale (PRT) (Keinan and Bereby-Meyer, 2012). The scale consists of three subscales measuring three domains of which risky behavior affects: medical issues, issues regarding resources, and ethical issues. A sample item is, "Please indicate how much the following statement applies to you: Not say anything when receiving too much change at the store;" responses were given on a scale that ranged from 1 (Very unlikely) to 7 (Very likely). The overall PRT score had good internal consistency, Cronbach's $\alpha = 0.80$. For PRT subscales, the resources ($\alpha = 0.79$) and medical issues ($\alpha = 0.72$) subscales had satisfactory internal consistency, while the ethics ($\alpha = 0.42$) subscale did not. Due to the ethics subscale's low internal consistency, we decided to analyze PRT scores as a total score, as opposed to individual subscales.

Political ideology and affiliation

To assess participants' political opinions, they indicated how they rated their opinions from 1 (Very liberal) to 7 (Very conservative) on a) social issues, b) fiscal policy issues, and c) foreign policy issues, as well as their d) overall political opinions (see Supplemental Materials for full list of questions). Scores were combined to create an overall political composite score for each participant, and this composite's internal consistency was excellent, $\alpha = 0.98$.

Social desirability

Social desirability, or the tendency to bias self-report answers in a way that is more socially advantageous (i.e., self-flattering), was measured with the Social Desirability Scale (SDS-17) (Stöber, 2001). Participants are asked in a True/False format whether they have had situations described in the scale's items that are meant to capture situations that are both common and unflattering. An example item is "Sometimes I only help because I expect something in return." One item regarding the use of illegal drugs was removed from analysis as was suggested by the scale's author. The scale had good internal consistency, $\alpha = 0.72$.

Perceived stress

Participants' perceived stress was measured with the Perceived Stress Scale (PSS) (Cohen et al., 1983). An example item from the PSS is, "In the last month, how often have you felt nervous and 'stressed'?" Participants provided their responses using a scale that ranged from 0 (Never) to 4 (Very often). The PSS had good internal consistency, $\alpha = 0.81$.

Risky and temporal decision-making

To measure risky decision-making and delay discounting, participants completed the Dynamic Experiments for

Estimating Preferences (DEEP) (Toubia et al., 2013). The DEEP risky decision-making task presents participants with a series of choices between two gambles in order to ascertain their preferences for risk seeking/aversion, loss aversion, and probability distortion. As an example, participants would choose from either (a) 90% chance to win $1; 10% chance to lose $5 or (b) 30% chance to win $100; 70% chance to lose $30. The DEEP delay discounting task presents participants with a series of choices about timing preferences with monetary reward to determine their temporal discounting rate and degree of present bias. As an example, participants would choose from either (a) Receive $300 in 100 days or (b) Receive $100 today. Parameters were estimated via Bayesian hierarchical modeling (Toubia et al., 2013).

Positive and negative affect

To measure participants' current affect, they completed the Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988). The PANAS consists of 10 of each positively- (e.g., Active) and negatively-valenced (e.g., Irritable) adjectives, with participants rating how much they believed the adjective to describe them from 1 (Very slightly or not at all) to 5 (Extremely). Internal consistency was very good for both positive ($\alpha = 0.90$) and negative ($\alpha = 0.90$) affect.

Data analysis

All data were analyzed in R, version 4.1.1. In order to elucidate changes in mask wearing behaviors and attitudes, residualized scores were calculated for each of the vignettes, with answers relating to Spring 2020 being regressed onto answers relating to how the participants felt at the time of the study. This produced residualized mask change scores, with lower scores indicating greater decreases in mask wearing in 2021–22 relative to what was expected given their mask wearing in Spring 2020. Paired samples *t* tests were conducted to assess whether there were differences in mask wearing, how comfortable a participant would have felt in a COVID-19 risky situation, and how they felt about others' mask wearing behaviors between 2021–22 and Spring 2020. Pairwise correlations between all study variables of interest and mask wearing behaviors in Spring 2020, 2021–22, and the residualized scores between the two were computed. Reverse stepwise regression analyses were used to examine relations among changes in mask wearing attitudes and the examined predictors to determine which predictors were most strongly associated with changes in mask wearing behaviors/attitudes. All predictors listed in the Potential Predictors section were included in the initial models for reverse stepwise regression analyses. Age, sex, and race/ethnicity were used as covariates in all regression analyses, due to their differential associations with pandemic safety guideline adherence (Papageorge et al., 2021). Outliers for the flanker task (see Supplement) included any participants who had more than 10 instances of reaction times under 150 ms and more than 10 errors on congruent flanker trials; meeting these criteria were a priori considered to be a failed attention check, in addition to the other attention checks present in the study. Any participant who failed an attention check was excluded from analyses. Finally, six outliers (>2 *SD*s above the mean, indicating a large increase in mask wearing) were excluded from analyses examining changes in mask wearing.

Cluster analysis

Because political orientation has been observed as such a marked differentiator of mask wearing attitudes, we expected that predictors of changes in mask wearing might differ by political orientation. Given potential nonlinearities in political orientation (e.g., potential categorical differences between liberal, moderate, and conservative individuals), we conducted a cluster analysis using the Mclust package (version 5.4.10) in R. It should be noted that although college campuses are often thought of as liberal-leaning, there are a variety of political ideologies present on most campuses (Lottes & Kuriloff, 1994), and the distribution of responses showed that our sampled West South Central US college population indeed represented a diverse sample of the political spectrum (see Supplemental Material).

Results

Bivariate correlations between all study variables of interest are reported in the Supplemental Materials (Supplemental Table 1).

Mask wearing attitudes over time

As expected, individuals reported being less likely to wear a mask in 2021–22 than in 2020, $t(293) = -12.37$, $p < 0.001$, and this decrease in mask wearing occurred across the political spectrum (see Table 2). This was a fairly substantial decline in mask wearing in our participants from 2020 to 2021–22: Participants reported that they would have worn a mask in 73.67% of situations in 2020, but only 61.22% of situations in 2021/2022. Similarly, 75.63% of participants reported that they would have worn a mask in every single situation described in the vignettes in 2020, whereas only 59.66% of participants reported that they would have worn a mask in every vignette situation in 2021–22. In

Table 2 Differences in mask wearing based on political affiliation

Group	Mask wearing 2020		Mask wearing 2021-22		*t*	df	*p*	d_z
	M	*SD*	*M*	*SD*				
Liberal	1.93[1]	.17	1.83	.17	−4.91	63	<.001	−0.61
Conservative	1.54	.34	1.37	.30	−7.43	96	<.001	−0.74
Moderate	1.65	.29	1.81	.29	−8.76	132	<.001	−0.57
Total sample	1.75	.30	1.60	.32	−12.37	293	<.001	−0.72

[1]Scores closer to 2 indicate higher mask wearing (i.e., 1 = no mask, 2 = mask)

addition, during data collection (2021–2022) and relative to Spring 2020, individuals reported feeling more comfortable in a situation with COVID-19-related ambiguity (i.e., a situation where transmission of the virus is more likely), $t(293) = -6.32$, $p < 0.001$, more positive about mask-wearers, $t(299) = 4.44$, $p < 0.001$, and more positive about others who either wore a mask incorrectly or did not wear a mask at all, $ps < 0.001$.

Predictors of changes in mask wearing over time

At a bivariate level, as expected, more conservative individuals showed greater reductions in mask wearing over time, $r(292) = -0.33$, $p < 0.001$. Similarly, greater passive risk taking and extraversion were also associated with greater reductions in mask wearing, $r(298) = -0.15$, $p = 0.006$, and $r(298) = -0.30$, $p < 0.001$, respectively. Additionally, greater impulsivity and venturesomeness were each associated with greater reductions in mask wearing in 2021–2022 than would have been expected given mask wearing in 2020, $r(292) = 0.12$, $p = 0.04$ and $r(292) = 0.12$, $p = 0.04$, respectively.

Because many of the considered predictors are related, we conducted reverse stepwise regressions using all potential predictors (i.e., those listed both in the Supplement and above) in order to determine which traits were most predictive of mask wearing behaviors in 2020, 2021–22, and how those behaviors changed. At each step, the variable furthest from significance was excluded until only marginally significant or significant predictors remained in the model, which resulted in the following model with five predictors. First, political orientation was associated with changes in mask wearing, such that more conservative views were associated with greater decreases in mask wearing from 2020 to 2021–22, $B = -0.036$, $\beta = -0.173$, $p = 0.001$ (see Fig. 1a). Similarly, individuals higher in extraversion also showed greater reductions in mask wearing over time, $B = 0.013$, $\beta = -0.214$, $p = 0.001$ (see Fig. 2c). Contrary to our expectation, increased empathy (specifically, empathic concern) was also associated with a greater reduction in mask wearing, $B = -0.007$, $\beta = -0.166$, $p = 0.002$ (see Fig. 1b). Additionally, higher levels of passive risk taking were marginally associated with a greater reduction in mask wearing in 2021–2022 relative to what was expected from 2020 mask wearing, $B = -0.001$, $\beta = -0.104$, $p = 0.059$ (see Fig. 2a). The only positive predictor in this model was conscientiousness: Greater conscientiousness was associated with a smaller decrease in mask wearing in 2021–2022 given 2020 mask wearing, $B = 0.010$, $\beta = 0.121$ $p = 0.027$ (see Fig. 2b).

Moderation by political orientation

As described above, we conducted cluster analysis to determine whether political orientation clustered at a latent level. In this analysis, we found that a three-cluster solution (liberal, $n = 65$; moderate, $n = 135$; and conservative $n = 100$) was the best fit to the data, BIC = 1100.2 (all ΔBICs > 11.4).

To determine whether liberal, moderate, and conservative participants differed in predictors of changes in mask wearing, we conducted a reverse stepwise regression with each latent class interacted with the predictors of interest. We retained marginal predictions because we found that including predictors with only marginal significance explained significantly more of the variance in changes in mask wearing than retaining only significant predictors, $F(11, 270) = 2.186$, $p = 0.015$. The final model consisted of three significant or marginal main effects that were not qualified by interactions by political cluster, and six significant or marginal interactions with political cluster. Full results of the final model are outlined in Tables 3 and 4. Table 4 contains the regression estimates for each predictor across the political clusters.

Contrary to initial expectations, higher levels of empathic concern were significantly associated with greater decreases in mask wearing only for liberal individuals (see Fig. 3a). Lower levels of perceived stress were associated with smaller decreases in mask wearing only for individuals in the moderate group (see Fig. 3b). Conservative individuals who were higher in trait-level openness to experience had lower reported decreases in mask wearing (see Fig. 3c). Positive affect was positively associated with a smaller increase in mask wearing for conservatives, but not for liberals or moderates (see Fig. 4a). Conservatives showed a positive association between a greater degree of present bias and a smaller decrease in mask wearing (see Fig. 4b). Finally, conservatives with higher social desirability had an association with greater decrease in self-reported mask wearing (see Fig. 4c).

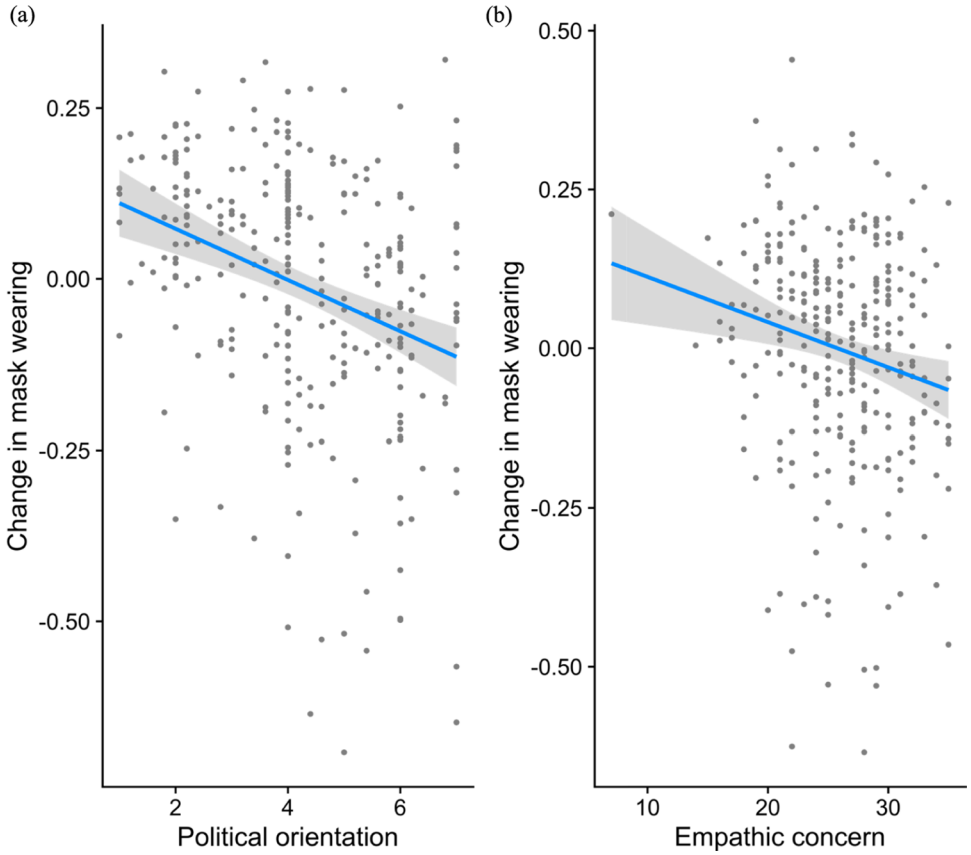

Fig. 1 Partial residual plots of change in mask wearing with (a) political orientation and (b) empathic concern. Greater degrees of conservativism (higher scores on the x-axis are more conservative) and higher levels of empathic concern were both associated with greater decreases in mask wearing. Main effects of predictors while controlling for all other predictors in the model

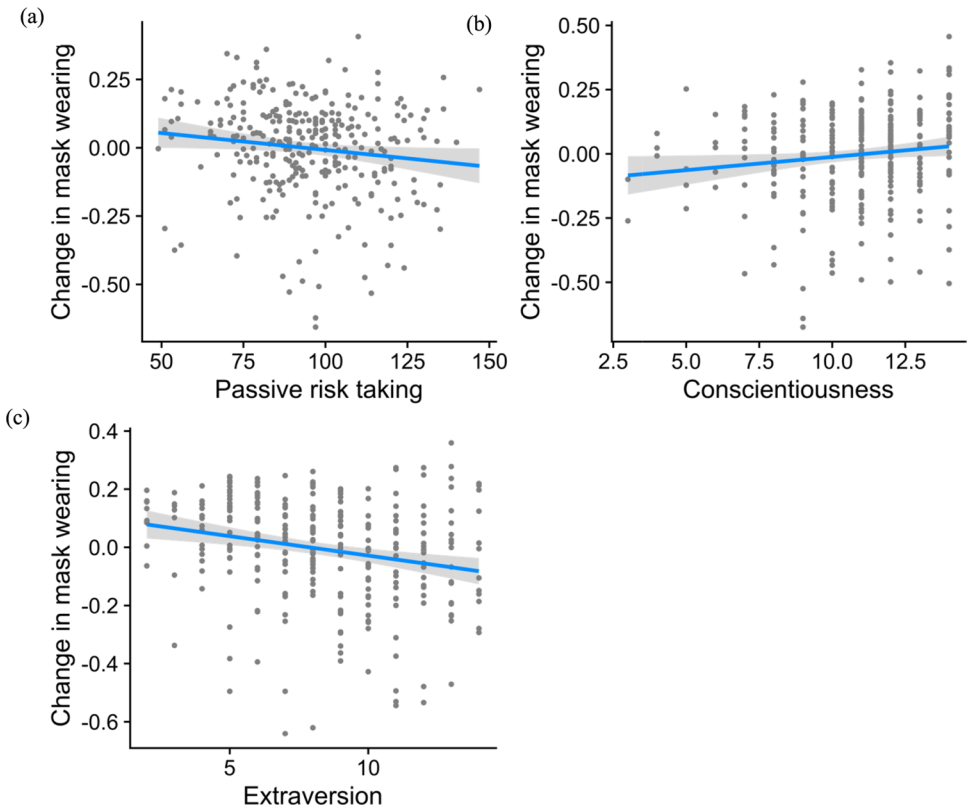

Fig. 2 Partial residual plots of changes in mask wearing with (a) passive risk taking, (b) conscientiousness, and (c) extraversion. Greater risk taking and greater extraversion were each associated with greater decrease in mask wearing, whereas greater conscientiousness buffered against the typically observed decline in mask wearing. Main effects of predictors while controlling for all other predictors in the model

Table 3 ANOVA results following a reverse-stepwise regression

Measure	*SS*	*df*	*F*	*p*	η_p^2
Probability distortion	0.08	1	0.48	.095	.010
Political orientation	0.11	2	1.96	.143	.014
Present bias	0.01	1	0.17	.679	.001
Empathic concern	0.42	1	14.42	<.001	.051
Perceived stress	0.01	1	0.47	.492	.002
Openness to experience	0.04	1	1.35	.246	.005
Conscientiousness	0.19	1	6.61	.011	.024
Extraversion	0.92	1	31.81	<.001	.105
Positive affect	0.05	1	1.54	.216	.006
Social desirability	0.14	1	4.73	.030	.017
Political orientation × Probability distortion	0.15	2	2.53	.081	.018
Political orientation × Empathic concern	0.15	2	2.55	.080	.019
Political orientation × Perceived stress	0.32	2	5.51	.005	.039
Political orientation × Openness	0.18	2	3.12	.046	.023
Political orientation × Positive affect	0.25	2	4.27	.015	.031
Political orientation × Social desirability	0.17	2	2.97	.053	.022
Residuals	7.84	270	-	-	-

Table 4 Regression coefficients for each predictor of changes in mask wearing in the final model that were moderated by political orientation

	Liberal	Moderate	Conservative
Predictor	β	β	β
Present bias	-.075	-.135†	.140
Empathic concern	-.431**	-.075	-.187*
Openness to experience	.068	-.080	.225*
Perceived stress	-.003	.262***	-.142
Positive affect	-.170	.112	.278**
Social desirability	.218†	.226**	-.062

$^{\dagger}p$ <.10, *p <.05, **p <.01, ***p <.001

Negative β values indicate that greater values in the predictor were associated with an accelerated decrease in mask wearing from 2020 to 2021/2022, whereas positive β values indicate that greater values in the predictor were associated with an attenuated decrease in mask wearing.

Despite conservatives reporting significantly higher trait extraversion (see Supplemental Material), there was no differential effect of extraversion across the three latent groups on changes in mask, with greater extraversion being associated with a greater decrease in mask wearing. As for main effects not qualified by interactions within this model, first, greater probability distortion for low-probability events (i.e., the tendency to overestimate the probability of a low-probability event occurring) within the risky decision-making task was marginally associated with greater increase mask wearing (see Table 3).

Next, we conducted reverse stepwise regressions with the same predictors to see what factors were related to mask wearing in 2021–22. Mask wearing was numerically most strongly associated with political orientation, such that individuals with more conservative views reported that they would be less likely to wear a mask in any of the situations in 2021–22, $B=-0.096$, $\beta=-0.473$, $p<0.001$. Self-reported extraversion was also associated with lower 2021–22 mask wearing, $B=-0.024$, $\beta=-0.237$, $p<0.001$. Other factors associated with less mask wearing in 2021–22 included higher levels of passive risk taking and Dark Triad traits, $B=-0.003$, $\beta=-0.112$, $p<0.001$ and $B=-0.002$, $\beta=-0.180$, $p=0.042$, respectively. Finally, older individuals were more likely to report that they would wear a mask in the situations described by the vignettes, $B=0.024$, $\beta=0.106$, $p=0.013$.

Finally, we looked to see what factors were associated with mask wearing behaviors in 2020. Vaccination status was numerically the strongest predictor, such that individuals who were not vaccinated against COVID-19 and did not intend to get vaccinated against the virus were less likely to wear a mask in 2020, $B=-0.216$, $\beta=-0.282$ $p<0.001$. In addition, more conservative individuals also reported less mask wearing in 2020, as did individuals who had higher levels of passive risk taking, $B=-0.046$, $\beta=-0.239$, $p<0.001$, and $B=-0.002$, $\beta=-0.142$, $p=0.001$, respectively. Individuals higher in trait extraversion also reported less mask wearing, $B=-0.019$, $\beta=-0.187$, $p<0.001$. Greater empathy (on the I7) was associated with greater reported mask wearing in 2020, $B=0.012$, $\beta=0.125$, $p=0.007$. Other predictors of increased mask wearing in 2020 included experiencing a greater number of recent life stressors, greater agreeableness, greater openness to experience, and older participant age, $ps<0.03$.

Although vaccination status did not emerge as a predictor in our reverse stepwise regression, we explored its association with mask wearing independent of other predictors. In these exploratory analyses, present-day vaccination status was associated with mask wearing behaviors in 2020, $F(3, 296)=28.30$, $p<0.001$, in 2021–22, $F(3, 296)=28.30$, $p<0.001$), and in the change between the two $F(3, 290)=3.30$, $p=0.021$. For the situations in 2020 and 2021–22, individuals who opted against the vaccine were

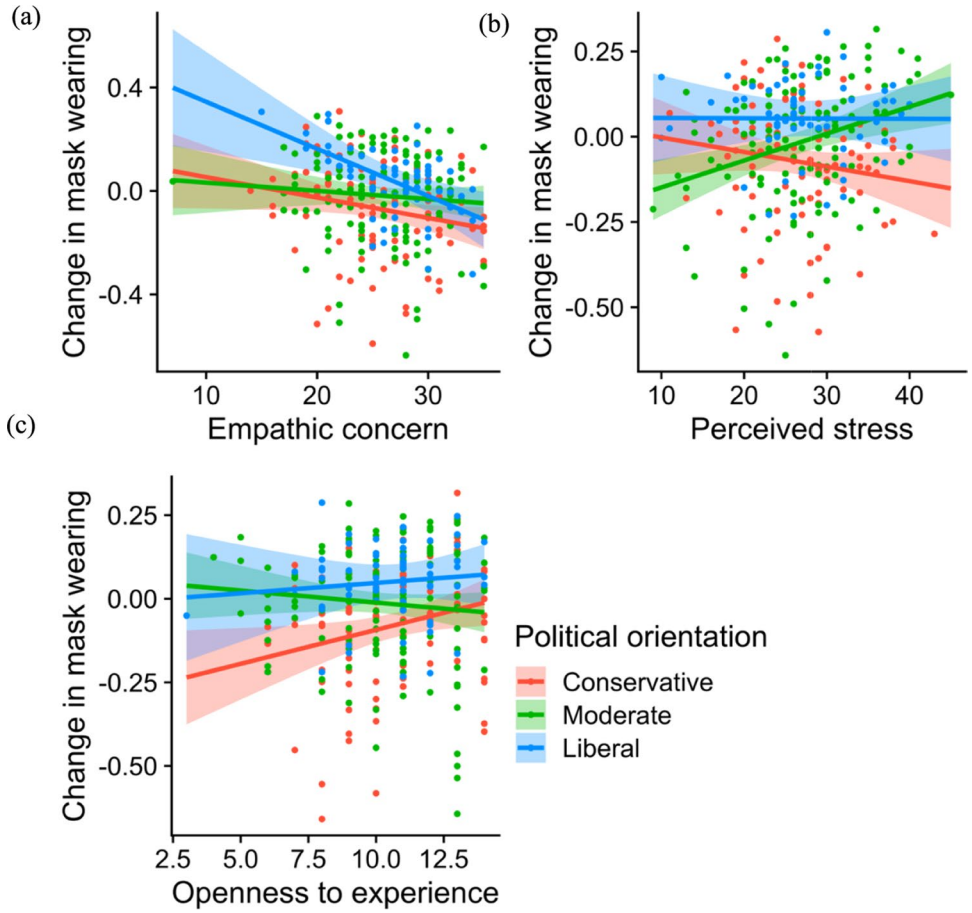

Fig. 3 Partial residual plots of changes in mask wearing across political orientation with (a) empathic concern, (b) perceived stress, and (c) openness to experience. Liberals had an association greater empathic concern and greater reduction in mask wearing. Moderates had an association between greater levels of perceived stress and less reductions in mask wearing. Finally, for conservatives, there was an association between higher levels of openness to experience and less reduction in mask wearing

less likely to wear a mask ($ps < 0.039$). Given that vaccination did not come out in any of the reverse stepwise regressions as a significant predictor, this indicates that the link between 2021–22 vaccination status and changes in mask wearing was better explained by other predictors (e.g., political orientation, personality traits).

Discussion

While the use of face masks during the global pandemic was a source of debate and politically charged vitriol, the scientific consensus remains that face masks are the one of the most effective tools at slowing the spread of infectious diseases such as COVID-19 (Wang et al., 2020). Despite this, mask wearing in public generally decreased over the course of the pandemic. To understand this decrease in mask wearing, we explored whether multiple distinct predictors explained changes in self-reported mask wearing behaviors over the course of the pandemic in a large, politically diverse sample. We found that political orientation, traits measured by the TIPI (specifically, extraversion and conscientiousness as measured by the TIPI), and empathic concern all predicted changes in self-reported mask wearing from the early pandemic (i.e., Spring 2020) to later in the pandemic (i.e., post-Delta and Omicron waves). Additionally, we found that the factors that predicted changes in mask wearing over the course of the pandemic differed for liberals, conservatives, and moderates.

As expected, people's attitudes towards masks were largely guided by political orientation. However, for each latent political cluster, there were different predictors of changes in mask wearing. Interestingly, higher levels of empathic concern predicted less mask wearing over time in liberals, but more mask wearing over time for moderates. In our sample, liberal individuals were more likely to wear a mask at both time points (i.e., both early and later pandemic). Because there was a positive correlation between political liberalness and empathic concern in this sample (data not shown), and because mask wearing generally decreased over time for all participants regardless of political orientation, individuals who were both empathetic and liberal may have had the most room to decrease their mask wearing. Liberal arguments for mask wearing are often focused on the morality of mask wearing in order to protect others (e.g., immunocompromised individuals, older adults, etc.) (Chan, 2021; Pfattheicher et al., 2020). During the early stages of the pandemic, when there was more general

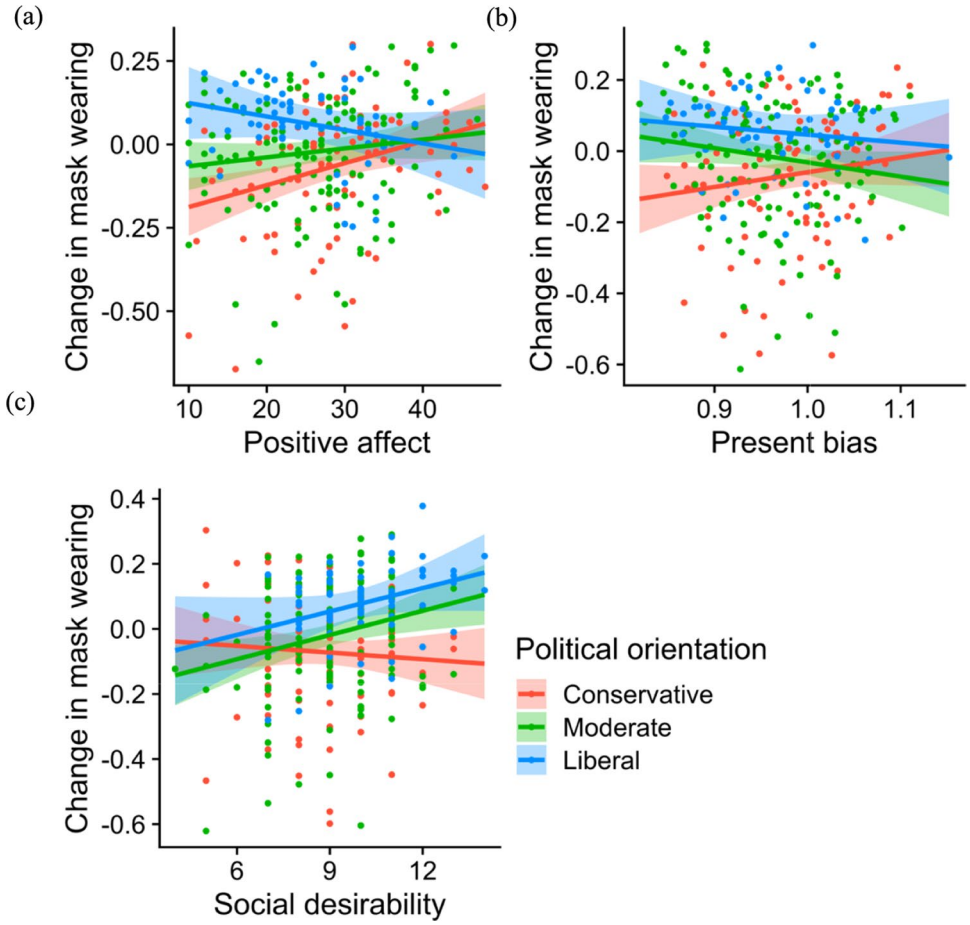

Fig. 4 Partial residual plots of changes in mask wearing across political orientation with (a) positive affect, (b) present bias, and (c) social desirability. Conservatives had associations between both greater positive affect and greater present bias with less reduction in mask wearing. Additionally, conservatives had an association between more social desirability and greater reductions in mask wearing

uncertainty about the effects of COVID-19 on vulnerable individuals, people with a greater degree of empathic concern for others were more likely to wear a mask to mitigate possibly spreading to those at-risk individuals.

It is also possible that individuals with greater levels of empathic concern have also experienced a greater degree of 'pandemic fatigue,' or the cultural phenomenon in which most individuals have decreased their pandemic-related precautions (Haktanir et al., 2021). Although pandemic fatigue has been attributed to motivational exhaustion from extended adherence to safety guidelines, it is more likely that a confluence of factors converge to explain the behavior. For example, depletion of financial and emotional resources, evolving information (e.g., changing guidelines), and increased mistrust in authority all could explain part of the behavioral changes seen in 'pandemic fatigue' (Petherick et al., 2021). It is also possible that pandemic fatigue may, for some people, be partially driven by empathy fatigue, or the tendency of individuals to become mentally, emotionally, and physically exhausted from extended periods of empathic feeling (Stebnicki, 2007). Although empathy fatigue has been predominately studied in the context of caregivers, future research should examine whether extended periods of empathic concern towards others, especially unknown others (e.g., immunocompromised individuals, even if one does not know any immunocompromised individuals) are related to differences in the rate at which individuals decrease their pandemic-safety-related precautions.

For political conservatives, a greater degree of openness to experience was associated with smaller decreases in mask wearing. Openness as a trait is generally associated with the political left, with low openness associated with political conservatism under the context of navigating ambiguous and uncertain situations (Hirsh et al., 2010; Jost et al., 2007). The observed positive association between extraversion (at least, as measured by the TIPI) and smaller decreases in mask wearing could be explained as conservatives who were higher in openness were more willing to listen to arguments for mask wearing (be it science or morality). This interpretation aligns with cross-national findings indicating that conservatism is not inherently associated with reduced health-protective behaviors; in non-U.S. samples, conservatives were often just as likely, or more likely, than liberals to adopt such behaviors (Stroebe et al., 2021). The uniquely American politicization of mask wearing, shaped by right-wing media and partisan messaging, may

therefore moderate the typical relationship between ideology and health behaviors.

Moreover, conservatives who had higher state-level positive affect reported a smaller decrease in mask wearing. As we measured positive affect at the state level, it is possible that individuals in a positive affect state were more engaged in more global (i.e., broadened) attention (Isgett & Fredrickson, 2015). Additionally, it is important to consider that state-level positive affect is highly correlated with trait-level positive affect (Wilt et al., 2012). Individuals with a positive disposition are generally more engaged in attention at a global level (Hicks & King, 2007). This could explain why some individuals are more likely to seek out information that is contrary to the rhetoric of their own political party. As conservatives were overall less likely to wear masks, it is possible that experiencing greater positive affect led them to report being more open to a behavior that is contrary to the typical response based on their political orientation.

This interpretation potentially aligns with longitudinal work that has been done on pandemic health behaviors in the US. Although US conservatives were less likely to engage in overall pandemic-related health behaviors relative to US liberals, this relationship was mediated by their perceptions of perceived health risk (Stroebe et al., 2021). Crucially, this mediation between political orientation and perceived health risks was not as pronounced in non-US participants (and even reversed for some, as some non-US conservatives were *more* likely to engage in pandemic safety behaviors). The authors opined that a reason for the discrepancy between U.S. and non-U.S. conservatives was due to the uniquely politicized context in the United States, where conservative political leaders (e.g., the Trump administration) and right-leaning media sources (e.g., Fox News) downplayed the severity of COVID-19 and undermined public trust in health guidelines. As a result, health-protective behaviors became entangled with partisan identity in ways not observed in other countries. Future studies on how public health events unfold should consider how major sociocultural factors can influence individual psychological factors.

Higher levels of trait extraversion, as measured by the TIPI, were associated with greater decreases in mask wearing over the pandemic across the political spectrum. Pandemic-related lockdowns led to increases in loneliness for many individuals, with many young adults experiencing prolonged levels of social anxiety and isolation (Loades et al., 2020). More extraverted individuals generally experienced better social outcomes during the pandemic, as engagement with a larger social circle provided a buffer against pandemic-induced loneliness (Yu & Hu, 2022). Our sample showed that regardless of political orientation, more extraverted individuals (at least, as measured by the TIPI) showed greater reductions in mask wearing over time. This could be due to a greater willingness to forgo behaviors (i.e., mask wearing) meant to mitigate risk in order to engage in more social activities, evidenced by the correlation between extraversion and passive risk.

Higher social desirability was associated with greater decreases in mask wearing only in conservatives; social desirability was associated with less decreases in mask wearing in liberals and moderates. Whether scales of social desirability are measuring a form of response bias or an actual behavioral tendency is an open question (see Lanz et al., 2022). Regardless, higher levels of social desirability would likely serve to protect one's social status within a group. Because conservatives as a group value demasking, whereas moderates and liberals value masking, the differential correlations we observed between social desirability and changes in mask wearing are consistent with this interpretation of social desirability.

Interestingly, a higher degree of perceived stress over the past month was associated with greater increases in mask wearing over time only for political moderates. As face masks became increasingly politicized over the course of the pandemic, it is possible that moderates were able to ignore the politically charged arguments for wearing/not wearing a mask and instead wear it more based on their current state. Alternatively, greater perceived stress over the prior month may have been related to more current mask wearing in moderates because moderates are more likely to change mask wearing behavior in response to (stressful) fluctuations in the pandemic (e.g., not wearing a mask when cases are low and wearing a mask if cases are high, whereas liberals and moderates may not modify their behavior by case count).

Strengths and limitations

This study, although exploratory in nature, has several strengths, including a large sample size, a wide variety of behavioral and self-reported measures, and it being the first to explore reasons for changes in mask wearing. However, this study also has limitations that should be noted. First, we only assessed mask wearing behaviors through self-report of imagined behavior. It is difficult to accurately assess where differences between people's imagined behaviors and actual behaviors lie. While there is evidence that self-reported intentions in hypothetical situations is predictive of real-world behavior (Godin & Kok, 1996), discrepancies do arise when real-time pressures and social influences are considered (Epley & Dunning, 2006). Exploring the gap between attitudes about mask wearing and actual mask wearing is a question that future research should attempt to answer, as preparation for any future pandemic-like events.

Additionally, as mask wearing became a sociopolitical point of contention, it is possible that participants responded in a manner more in line with their party's political beliefs, regardless of personal beliefs. However, our finding that conservative, moderate, and liberal individuals all reported decreases in mask wearing suggests that participants reported changes in mask wearing in ways that deviated from political norms (e.g., conservative individuals were not equally low at both timepoints, and liberal individuals were not equally high at both timepoints). Future studies should address how individual motivation for political beliefs prospectively relate to socio-politically relevant decision-making over time, should another pandemic-related situation occur. In addition, future studies should look to further explain what elements of political orientation are important for understanding health behaviors (e.g., mask wearing during a global pandemic). Second, our sample was WEIRD (western, educated, industrialized, rich, and democratic), meaning we are limited in our ability to generalize our findings to the population at large (Henrich et al., 2010). For example, socioeconomic factors (e.g., financial stability, education, and access to resources) are known to be associated with differences in decision-making, risk taking, cognitive abilities, and health behaviors (Sheehy-Skeffington, 2020), entailing that our findings may not generalize to populations such as those with lower socioeconomic status. Moreover, other work has shown that even within the U.S., cultural orientations such as collectivism, honor culture, and norm tightness vary regionally and shape mask-related behaviors and attitudes, such as whether masks are viewed as civic duty or personal affront (Kemmelmeier & Jami, 2021). Third, we did not find any associations between the flanker effect and changes in mask wearing, though we hesitate to interpret this lack of association due to our use of a JavaScript-based task rather than a laboratory assessment. Fourth, our findings were entirely correlational, and no causal effects can be determined. Fifth, as the TIPI only consists of ten items, it should be noted that it sacrifices diagnostic clarity for brevity. Any personality-based results should be interpreted with caution, as the limited scope of the measure may not fully capture the Big Five personality traits (Gosling et al., 2003; Rammstedt & Beierlein, 2014).

In sum, this exploratory study found that people's mask wearing decreased over the course of the pandemic, and–across individuals–greater conservativism, extraversion, and passive risk-taking were associated with greater a decline in mask wearing from 2020 to 2021–2022, whereas greater conscientiousness (at least, as measured by the TIPI) was associated with a smaller decline in mask wearing from 2020 to 2021–2022. However, reasons for decreases in mask wearing over time differed between liberal, moderate, and conservative individuals. For politically liberal individuals alone, higher levels of empathic concern predicted a greater reduction in mask wearing from 2020 to 2021–22. For politically moderate individuals alone, lower levels of perceived stress predicted a greater decline in mask wearing from 2020 to 2021–22. Finally, for politically conservative individuals alone, lower levels of openness to experience and positive affect predicted a greater decline in mask wearing from 2020 to 2021–22. Although correlational, our findings could be taken to suggest that individual reasons for wearing a mask are a result of a confluence of political, personality, affective, and cognitive factors.

Conclusion

Although the COVID-19 pandemic has ended, these findings have implications for future public health campaigns, as they help to elucidate factors that could be leveraged to enhance the uptake of public health messages both across and within different demographic and ideological groups. With political polarization on the rise, understanding how individuals with diverse political and moral beliefs respond during times of crisis is critical for ensuring the effectiveness of public health interventions. As COVID-19 will certainly not be the last global health threat that humanity must face, developing strategies that account for these sociopolitical dynamics will be key to improving preparedness and fostering greater resilience in public health responses to future pandemics or similar crises. Public health messaging must recognize that people are not purely rational actors—they are social beings influenced by identity, reputation, and community expectations. Rather than appealing to a single standard of "correct" behavior, effective messaging should meet people where they are, offering frames that align with a variety of values while minimizing the sense that compliance signals group loyalty. In doing so, interventions can reduce resistance and encourage genuine engagement across ideological lines.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s12144-025-08184-1.

Authors' contributions Conceptualization: Z.J.G, H.M.H
Data curation: Z.J.G.
Formal analysis: Z.J.G
Investigation: Z.J.G.
Supervision: G.S.S.
Software: G.S.S
Methodology: Z.J.G, H.M.H, G.S.S
Writing – original draft: Z. J.G
Writing – review & editing: Z.J.G, H.M.H, G.S.S

Funding This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declarations

Ethical approval This investigation was approved by the authors' University Ethics Committee.

Informed consent Before data collection, written informed consent was obtained from all participants.

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

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