REGULAR ARTICLE

Spring 2020 COVID-19 Surge: Prospective Relations between Demographic Factors, Personality Traits, Social Cognitions and Guideline Adherence, Mask Wearing, and Symptoms in a U.S. Sample

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Abstract

Background To date, much of the research on individual difference correlates of coronavirus guideline adherence is cross-sectional, leaving prospective associations between these factors unaddressed. Additionally, investigations of prospective predictors of mask-wearing, COVID-19 symptoms, and viral testing remain wanting.
Purpose The present study examined prospective relations between demographic factors, personality traits, social cognitions and guideline adherence, mask-wearing, symptoms, and viral testing in a U.S. sample ($N = 500$) during the initial surge of COVID-19 deaths in the United State between late March and early May 2020.
Methods Guided by a disposition-belief-motivation framework, correlational analyses, and path models tested associations among baseline personality traits, guideline adherence social cognitions, health beliefs, guideline adherence and follow-up guideline adherence, mask-wearing, symptom counts, and 30-day viral testing.
Results Modeling results showed greater baseline agreeableness, conscientiousness, and extraversion were associated with more frequent baseline guideline adherence. More liberal political beliefs, greater guideline adherence intentions, and more frequent guideline adherence at baseline predicted more frequent mask-wearing at follow-up. Sex (female), lower perceived health, and greater neuroticism at baseline predicted greater symptom counts at follow-up. Reports of viral testing were quite low (1.80%), yet were consistent with concurrent national reporting and limited availability of testing.
Conclusions Results show how inconsistencies and politicization of health policy communication were concomitant with the effects of individual-level political beliefs on mask-wearing during the initial surge. The results further clarify how personality traits related to social responsibility (i.e., agreeableness, conscientiousness) are associated with following new norms for prescribed behaviors and how symptom reporting can be as much a marker of perceived health as emotional stability.

Keywords: COVID-19 · Guideline adherence · Mask-wearing · Symptoms · Personality · Health beliefs

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Introduction

To date, research investigating individual differences in demographic factors, personality traits, social cognitions, and adherence to coronavirus governmental advisements (including mask-wearing) has shown greater conscientiousness, extraversion, agreeableness, and openness to be associated with greater guideline adherence [1–3]. In addition, research on intentions to practice social distancing has shown greater endorsement of subjective and moral norms for distancing, perceived control of distancing, self-efficacy for distancing, and positive attitudes toward distancing to be associated with stronger plans to socially distance [4, 5]. However, much of the extant research on correlates of coronavirus guideline adherence is cross-sectional, leaving prospective associations between adherence and these factors unaddressed. Moreover, investigations

of prospective associations between personality traits and social cognitions and COVID-19 symptom counts and SARS-CoV-2 viral testing remain wanting [6], especially during the initial increase of cases and deaths in the United States during Spring 2020. Using an integrative disposition-belief-motivation framework, the goal of the present study was to test prospective associations between personality traits, guideline-related beliefs and intentions, health beliefs, guideline adherence and subsequent guideline adherence, mask-wearing (as was later advised), COVID-19 symptom counts, and SARS-CoV-2 viral testing during the first surge of cases and deaths in the United States during spring 2020. The disposition-belief approach allows for the integration of components of the Theory of Planned Behavior, Social Cognitive Theory, and the Health Belief Models with personality traits to produce a more comprehensive rendering of pandemic-related behaviors and outcomes [7].

In the United States, the White House Coronavirus Task Force introduced guidelines pertaining to social distancing (e.g., avoiding being closer than 6 ft to other people, worked or engaged in schooling or otherwise remained at home whenever possible) and hygienic practices (e.g., washed hands for 20 s, avoided touching face) on March 16, 2020 (see supplemental material). These initial guidelines did not include mask-wearing, which the Centers for Disease Control and Prevention (CDC) subsequently included as a recommendation on April 3, 2020 (see Fig. 1 for public health and epidemiological timelines). Multivariate modeling of demographic characteristics, personality traits, and social cognitions in a U.S. sample during the initial 15-day period showed greater overall guideline adherence was directly associated with greater conscientiousness, social endorsement of guidelines, positive attitudes toward guidelines,

guideline self-efficacy, and the presence of a shelter-in-place order [1]. More frequent guideline adherence also was indirectly associated with greater openness to experience via positive attitudes toward guidelines. Related research has shown intentions to be associated with social distancing behavior and other preventive behaviors, including hand washing, respiratory hygiene, and staying at home [4, 5, 8]. Evidence suggests more frequent mask-wearing is positively associated with beliefs about related behavioral outcomes, need for cognition, self-control, risk aversion, and more liberal political orientation and negatively associated with beliefs in misinformation [9, 10].

Other research had adopted a health belief approach to test how coronavirus-related social cognitions influence preventive behaviors. The evidence for perceived risk of exposure and perceived severity is somewhat mixed; specifically, the perceived likelihood of being infected (perceived risk) was positively correlated with social distancing and hand washing, more so than the likelihood of transmission (perceived severity) of becoming infected [11]. Other studies showed perceived risk and severity were both positively associated with preventive behaviors [12–14], while other research showed these relations were attenuated when other social cognitions and personality traits were modeled simultaneously [1].

Additional COVID-related outcomes, including symptoms and viral testing, remain largely unstudied but should, in principle, be related to guideline adherence and mask-wearing, as well as some of the correlates of guideline adherence and mask-wearing described above. Some research has addressed SARS-CoV-2 testing and COVID-19 symptom reporting [13, 15], however, no evidence speaks directly to guideline adherence or other predictors of self-reported symptoms or viral testing.
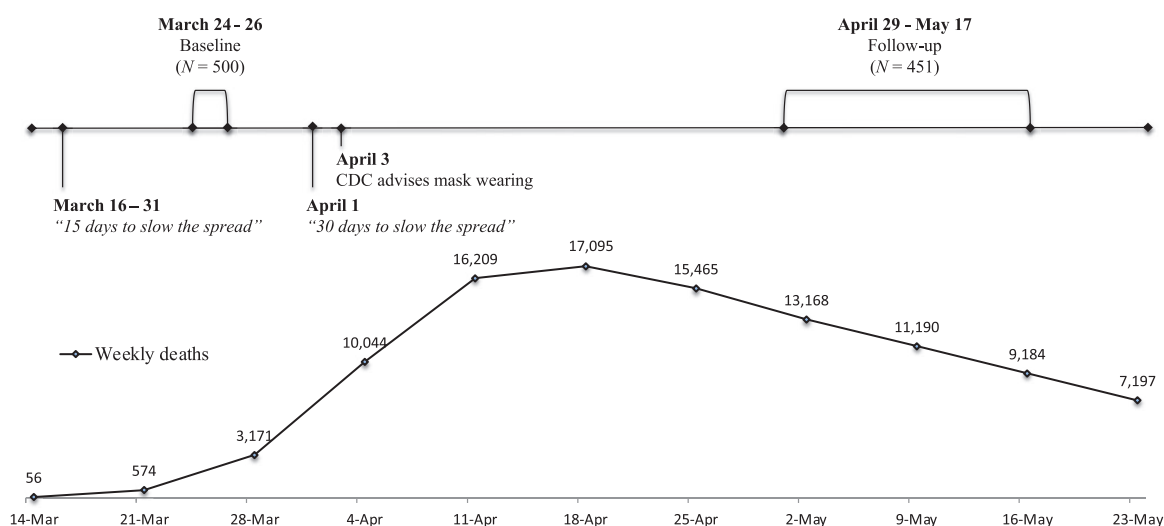

Fig. 1. Timelines for data collection, public health advisements, and weekly deaths. Mortality data source: https://www.cdc.gov/nchs/nvss/vsrr/covid_weekly/index.htm.

Present Study

The goal of the present study was to examine prospective relations between traits, social cognitions, health beliefs, and intentions during the initial period of formal public health guidance and emergency measures (March 2020) and subsequent guideline adherence (distancing and hygienic practices), mask-wearing, COVID-19 symptoms, and viral testing during the initial surge in cases and deaths (late April to early May 2020; see Fig. 1 for assessment timeline). Specifically, the present study tested prospective associations between demographic factors, Big Five personality traits, guideline-related social cognitions (perceived social norms, perceived control, attitudes, and self-efficacy), intentions to follow guidelines, perceived risk of infection, perceived severity of illness if infected, political orientation, overall guideline adherence and subsequent guideline adherence, mask-wearing, symptom counts, and viral testing. The hypotheses for the present work were guided by a temperamental (direct influence) process perspective as specified in the disposition-belief-motivation model of health-related behaviors [7, 16], as well as prior research using the baseline study [1].

In disposition-belief-motivation models, dispositions, beliefs, and motivations can serve as direct influences on behaviors and behavioral outcomes. The use of such an integrative model can help elaborate the roles of personality traits, social cognitions, and behavioral intentions in the expression of health-related behaviors and outcomes. In the present work, this approach includes constructs from the Theory of Planned Behavior (attitudes, subjective norms, perceived behavioral control, intention), Social Cognitive Theory (self-efficacy), and the Health Belief Model (perceived risk and perceived severity). Within this approach, the present work utilized a temperamental process perspective, which posits traits, social cognitions, and intentions may directly influence the expression of guideline adherence and symptom counts. Temperamental processes are generally expected when behaviors or outcomes are closely aligned with levels of trait or belief expression, such as a neurotic (e.g., more anxious) individual being more likely to report a greater number of psychosomatic complaints, or an individual believing close others reject advisements from public health officials (e.g., weaker perceived norm) and then not strongly adhering to guidelines.

Consistent with findings from the baseline study [1], it was hypothesized that greater conscientiousness, social endorsement of guidelines, positive attitudes toward guidelines, guideline self-efficacy, intentions, perceived risk and perceived severity at baseline would predict more frequent guideline adherence and mask-wearing at follow up. Due to the tendency for neurotic individuals

to report greater somatic symptoms and poorer health [17, 18], it also was hypothesized that greater neuroticism would be associated with greater symptom counts at follow-up. For demographic variables, it was hypothesized that a more liberal political orientation would predict more frequent guideline adherence and mask-wearing [10]. Beyond these expectations, exploratory analyses further tested the relationships between other demographic characteristics, personality traits, guideline-related social cognitions, and symptom counts and viral testing.

Method

Sample and Procedure

The baseline assessment collected a sample of 500 U.S. adults via Prolific (www.prolific.co), an online sampling platform. The baseline sample was recruited from a national sample invitation distributed to more than 20,000 pool members who initially qualified to fill one of 50 subgroups defined by five strata for age (18 –27, 28–37, 38–47, 48–57, and 58+), five strata for the race (simplified by Prolific; White, Mixed, Asian, Black, and Other), and two strata for sex (female, male). As with all Prolific studies, participation is based on a first-come first-serve procedure, where, for the stratified sample, a respondent could participate as long as space remained in a relevant subgroup. Income, education, geography, and other characteristics of the population are not used for stratification by Prolific. The initial data collection was assessed using a Qualtrics survey via Prolific between March 24, 2020 and March 26, 2020. Assessment occurred during the second week of the initial 15-day period of the "slow the spread" initiative advocated by the White House Coronavirus Task Force (see Fig. 1 for timelines). A baseline sample size of 500 was targeted to ensure power requirements for small-to-moderate effect sizes were met, as well as requirements for the multivariate path modeling (described below). The follow-up data collection began on April 29 and ended May 17, 2020.

Descriptive statistics for sample characteristics and for study variables are reported in Tables 1 and 2. A total of 451 participants completed the follow-up data collection (retention from baseline to follow-up being 90.2%). Participants received $17.10/ h via PayPal as compensation. Mean duration for the follow-up survey was 12.72 min (SD = 7.62 min). To maintain data quality, engagement and attention were encouraged by limiting each page to five questions. Items also varied in framing stems and the content of response options and the longest block of items with the same response options

Table 1. Demographic descriptive statistics

Variable	Baseline (N = 500) M (SD) or %
Age	45.40 (15.78)
Sex (% female)	51.40%
Race	
White	74.20%
Black or African-American	13.00%
Native American Indian or Alaska Native	0.40%
Asian	6.80%
Native Hawaiian or Pacific Islander	1.80%
Other	3.00%
Multi-ethnic	0.60%
Spanish, Hispanic, or Latino (% Yes)	7.00%
Education	
Less than high school degree	0.60%
High school graduate (diploma or GED)	11.60%
Some college but no degree	22.00%
Associate degree in college (2-year)	9.80%
Bachelor's degree in college (4-year)	36.00%
Master's degree	14.60%
Doctoral degree	2.40%
Professional degree (JD, MD)	3.00%
Income	
Less than $10K	6.20%
$10K–19K	7.20%
$20K–29K	11.20%
$30K–$39K	10.20%
$40K–$49K	10.80%
$50K–$59K	9.80%
$60K–$69K	6.40%
$70K–$79K	8.40%
$80K–$89K	3.40%
$90K–$99K	6.40%
$100K–$149K	14.60%
$150K+	5.40%
Self-rated health (5-point item response scale)	3.34 (0.94)
Follow-up shelter-in-place order	
Yes (%)	85.80%
No (%)	10.60%
Not sure (%)	3.60%

Table 2. Descriptive statistics for personality traits, social cognitions, guideline adherence, mask-wearing, symptom counts, and viral testing

Baseline (N = 500)	M (SD) or %
Personality traits (5-point response scale)	
Agreeableness	3.96 (.67)
Conscientiousness	3.95 (.71)
Extraversion	2.94 (.94)
Neuroticism	2.67 (1.01)
Openness	3.82 (.65)
Political beliefs (conservative, 8-point response scale)	2.96 (1.95)
Social cognitions, guideline adherence (5-point response scale)	
Perceived norms	4.56 (.77)
Perceived control	4.49 (.74)
Attitudes	4.20 (.67)
Self-efficacy	4.09 (.87)
Intentions	4.70 (.68)
Exposure risk	3.44 (1.25)
Health risk	3.05 (1.28)
Guideline adherence	4.39 (.53)
Follow-up (N = 451)	
Guideline adherence (5-point response scale)	4.44 (.49)
Mask-wearing (5-point response scale)	4.02 (1.51)
30-day symptom count (1–9)	0.74 (1.23)
Viral testing (yes/no)	1.80%

Measures

Demographic characteristics.

Items assessed age (in years), sex (female, male), race, Spanish/Hispanic/Latino status (yes, no), education, income, political beliefs, and self-rated health. Race was assessed with seven categories (Asian, Black or African-American, Native American Indian or Alaska Native, Native Hawaiian, or Pacific Islander, Other, White, or Multiethnic (a combination of the other categories selected by the participant). Highest level of education attained was assessed using scores from 1 to 8 (1 = less than a high school degree, 8 = professional or doctorate degree). Income was assessed using scores from 1 to 12 (1 = less than $10,000; 12 = $150,000 or more). Political belief at follow-up was assessed with a single item asking participants to place themselves on an eight-point scale (0–7) arranged from extremely liberal (left) to extremely conservative (right). Baseline self-rated health was assessed with a single item using a five-point scale ("In general, would you say your health is?"; 1 = poor, 5 = excellent).

(i.e., the BFI-44) used intermittent reverse item coding as a check on attention (e.g., a participant should not strongly agree that they worry a lot and that they are emotionally stable and not easily upset). The study was approved by Wayne State University's Institutional Review Board with exempt status.

Big Five traits

Personality traits at baseline were assessed using the well-validated 44-item Big Five Inventory (BFI), which assesses the traits of agreeableness, conscientiousness, extraversion, neuroticism, and openness to experience [19]. All items were rated using a five-point scale (1 = disagree strongly, 5 = agree strongly). A nine-item scale was used to assess agreeableness (e.g., "is helpful and unselfish with others"; ω = .83). A nine-item scale was used to assess conscientiousness (e.g., "does a thorough job"; ω = .86). An eight-item scale was used to assess extraversion (e.g., "is outgoing, sociable"; ω = .89) An eight-item scale was used to assess neuroticism (e.g., "gets nervous easily"; ω = .91). A 10-item scale was used to assess openness to experience (e.g., "is curious about many different things"; ω = .85).

Guideline-related social cognitions

Four multi-item scales were used at baseline to assess guideline-related social cognitions of perceived norms, perceived control, attitudes, and self-efficacy [1]. *Perceived norms* was assessed using the mean of two adapted items measuring social support for following the guidelines using a five-point scale (ω = .88; 1 = disagree strongly, 5 = agree strongly; "People who are important to me think I should follow the U.S. governmental guidelines to help slow the spread of the Coronavirus" and "People who are important to me encourage me to follow the U.S. governmental guidelines to help slow the spread of the Coronavirus"). *Perceived control* was assessed using the mean of two adapted items measuring perceptions of personal agency for following the guidelines using a five-point scale (ω = .48; 1 = disagree strongly, 5 = agree strongly; "If I wanted to, I could easily follow the U.S. governmental guidelines to help slow the spread of the Coronavirus" and "How much I follow the U.S. governmental guidelines to help slow the spread of the Coronavirus is completely up to me"). *Attitudes* were assessed using the mean of four adapted items measuring evaluations of guidelines using bipolar semantic differential adjectives on a five-point scale (ω = .83; unpleasant (1)–pleasant (5), harmful (1)–beneficial (5), foolish (1)–wise (5), useless (1)–useful (5)). *Self-efficacy* was assessed using the mean of four items to measure confidence in overcoming obstacles to following the guidelines using a five-point scale (ω = .88; 1 = disagree strongly, 5 = agree strongly; "How confident do you feel you can follow the U.S. governmental guidelines to help slow the spread of the Coronavirus when you feel like you do not have any symptoms?" " How confident do you feel you can follow the U.S. governmental guidelines to help slow the spread of the Coronavirus

when you feel lonely?" "How confident do you feel you can follow the U.S. governmental guidelines when you feel the need to get out?" "How confident do you feel you can follow the U.S. governmental guidelines to help slow the spread of the Coronavirus when family or friends ask you to visit them or ask if they can visit you?"). *Intention* was assessed with one item on a five-point scale ("I intend to follow the U.S. governmental guidelines to help slow the spread of the Coronavirus as closely as possible"; 1 = disagree strongly, 5 = agree strongly).

Perceived exposure risk to coronavirus and *perceived health risk (severity)* if exposed at baseline were assessed with two items using a 5-point scale (1 = disagree strongly, 5 = agree strongly; "I feel I am at risk of being exposed to the Coronavirus" and " If I were exposed to the Coronavirus, then the health consequences to me would be severe.").

Guideline adherence

During the baseline assessment, participants responded using a 5-point scale (1 = never, 5 = always) to ten items written to measure guideline adherence for the past seven days, as specified in the March 16, 2020, Presidential briefing and accompanying White House Coronavirus Task Force pamphlet (see electronic supplemental material for original "15 days to slow the spread" document). The mean of the 10 items was used to create a scale reflecting the overall frequency of following the guidelines during the past seven days (ω = .81). Participants completed the same measure at follow-up (ω = .87). A complete description of the wording and response options for these items is available (open-access) in the baseline study [1].

Mask-wearing

The use of a face covering was an additional guideline that was publicly announced by the CDC on April 3, 2020. Because this guideline appeared after the first wave of data collection, but before the follow-up, it was assessed separately from the original 10 items using the same 5-point scale ("I wore a mask or face covering in public settings where other social distancing practices could be difficult to maintain").

Shelter-in-place order

The presence of a shelter-in-place (stay-at-home) order at follow-up was assessed with a trichotomous item (yes, no, I'm not sure) after asking participants "at present, do you live in an area (city, county, or state) where there is a shelter-in-place order (staying at home and not leaving except for essential activities)?". This item was then dichotomized (1= "yes", 0 = "no" or "I'm not sure").

Total symptom count

At follow-up, participants were asked to indicate how many of the following nine symptoms they had experienced in the past 30 days: fever, cough, shortness of breath or difficulty breathing, chills, repeated shaking with chills, muscle pain, headache, sore throat, or new loss of taste or smell. A total symptom count score was calculated by summing the total number of symptoms, if any, that were reported. These symptoms were obtained from the CDC's list of symptoms as retrieved on April 22, 2020 (see supplemental materials).

Viral diagnostic testing

At follow-up, one item pertaining to viral testing was used to assess whether participants had been tested ("Have you been tested for the coronavirus (COVID-19) during the past 30 days?"; 1 = no, 2 = yes, and the results were negative, 3 = yes, and the results were positive for the coronavirus, 4 = yes, but I do not know the result of the test.). Responses were dichotomized to indicate whether a participant had received diagnostic testing, regardless of the testing outcome.

Analyses

Correlational analyses were used to examine the strength and direction of associations among the study variables. Following the procedure used in the baseline study, variables indicating evidence of skewed distribution were corrected using a Blom transformation of the raw scores. This involved rank ordering the raw scores (settling ties by using the mean of the contested ranks) and then transforming the ranks to *z*-scores using the normal distribution. Perceived norms, perceived control, attitudes, self-efficacy, guideline adherence (both at baseline and follow up) and symptom count (at follow-up) were transformed using this procedure. Simulation research analyzing multiple transformation types indicate that this transformation (i.e., of skewed data similar to that observed in the present study) resulted in a more accurate selection of a true model from a set of alternative models [20].

As can be seen in Table 2, the base rate for viral testing approached zero. As a result, very little variance remained to be explained using any analytic approach, including logistic regression [21]. As a result, viral testing was excluded from subsequent analyses. Notably, and as is further described in the discussion, the very low base rate observed for testing in the present study was not anomalous and reflects testing capacity and guidance at the time.

A path model was specified based on the hypothesized effects and those indicated from the baseline study.

Correlations were freed between baseline manifest variable terms and between the follow-up error terms when indicated by the bivariate analyses. The path model was assessed using Amos v.26. Missing continuous and binary data were modeled using full information maximum likelihood (FIML). FIML estimation procedures use all available data in a likelihood function that has been shown to outperform other strategies for handling missing data (e.g., imputation, multiple imputation, case/variable deletion) [22, 23]. Model fit was assessed using the comparative fit index (CFI) and the root mean square error of approximation (RMSEA). Greater CFI scores (range: 0 to 1) indicate a better fit. For example, a model with a CFI score of .90 or greater (meaning at least 90% of the covariation in the data is reproduced by the tested model) suggests adequate fit [24]. RMSEA is an index of the closeness of fit of a tested model in relation to its degrees of freedom. Values approaching zero indicate a good fit [25]. By convention, if RMSEA is less than or equal to .05, then this suggests an adequate fit.

Results

Sample Characteristics

Tables 1 and 2 display the descriptive statistics for all variables at baseline and follow-up. According to Prolific, the representativeness of age by sex by race group proportions for the United States can be calculated from U.S. Census Bureau population group estimates from 2015. It should be noted that, in the present work, Prolific used a backend prescreen for race based on the five simplified subgroups described above. However, upon initiating the survey, participants were allowed to choose among the complete list of racial categories used by the U.S. Census Bureau, including selecting multiple options. Census data from the 2015 American Community Survey (ACD) estimated demographic characteristics as follows; median age of 37.6 years, 50.8% female, 73.6% White, 12.6% Black or African-American, 0.8% Native American Indian or Alaska Native, 5.6% Asian, 0.2% Native Hawaiian or Pacific Islander, 4.7% other, and 3% for two or more races. Aside from age, which was older than the acquired sample, these figures correspond to those reported in Table 1. It also should be noted that, as a function of the simplified racial categories used by Prolific, the percent identifying as Latino, Hispanic, or Spanish in the present study was less than half of that estimated by the 2015 ACS study (17.1%). The 2015 ACS demographic data are available at: https://data.census.gov/cedsci/table?tid=ACSDP5Y2015.DP05

As can be seen in Table 2, at follow-up, the mean frequency of overall guideline adherence on a 5-point

scale was 4.44 (*SD* = .49), whereas the mean frequency of mask-wearing, was 4.02 (*SD* = 1.51). For symptom count, 39.1% of the sample reported having experienced at least one symptom in the past 30 days. As noted above, the sample's base rate for viral testing was very low (1.80%).

Descriptive and Correlational Results

Bivariate relations between baseline demographic variables, social cognitions, and personality traits and overall guideline adherence, mask-wearing, symptom count, and diagnostic viral testing. Table 3 displays the correlations among baseline age, sex, education, income, perceived health, personality traits, guideline-related social cognitions, and guideline adherence, and follow-up guideline adherence, mask-wearing, and total symptom counts. Independent samples *t* tests showed small differences based on sex for guideline adherence (female; *p* < .05, Cohen's *d* = .214) and symptom count (female; *p* < .01, Cohen's *d* = .342). Independent samples *t* tests for shelter-in-place differences showed medium differences for both guideline adherence (*p* < .01, Cohen's *d* = .525) and mask-wearing (*p* < .01, Cohen's *d* = .415), but not for total symptom counts (*p* > .05, Cohen's *d* = .002).

In line with the hypothesized associations, more liberal political beliefs, more frequent guideline adherence, and greater agreeableness, conscientiousness, extraversion, social endorsement of the guidelines (perceived norms and control), positive attitudes toward guidelines, guideline self-efficacy, guideline adherence intentions, perceived risk, and perceived severity at baseline were all positively associated with more frequent guideline adherence at follow up (all *p*s < .01, except for political beliefs, *p* < .05). These variables were similarly correlated with mask-wearing at follow up (*p*s < .01), except for conscientiousness and perceived control, which both showed no association with mask-wearing. As expected, neuroticism showed a positive association with symptom count (*p* < .01).

While not hypothesized, the correlational results also showed openness was associated with more frequent guideline adherence and more frequent mask-wearing. Exploratory analyses between demographic variables, personality traits, guideline related social cognitions, and symptom count showed sex (female, *p* < .01), perceived health (*p* < .01), agreeableness (*p* < .05), conscientiousness (*p* < .05), and perceived exposure risk (*p* < .01), perceived health risk (*p* < .01) were significantly correlated with the number of symptoms reported.

Table 3. Correlations among baseline demographic factors, personality traits, social cognitions, guideline adherence and follow-up guideline adherence, mask-wearing, and symptom counts

	Follow-up variables		
Baseline variables	Guideline adherence	Mask-wearing	30-day symptom count
Age	.09	.07	−.07
Sex (female)	.11*	.07	.17**
Self-rated health	.01	−.07	−.23**
Education	.05	−.04	.02
Income	.01	−.02	−.05
Agreeableness	.21**	.09	−.09*
Conscientiousness	.18**	−.03	−.11*
Extraversion	.15**	.05	−.06
Neuroticism	−.09	−.01	.26**
Openness	.12*	.12*	.04
Political views (conservative)	−.12*	−.20**	−.09
Perceived norms	.30**	.22**	.03
Perceived control	.20**	.07	.02
Attitudes	.33**	.23**	.00
Self-efficacy	.37**	.18**	.00
Intentions	.38**	.28**	.08
Exposure risk	.13**	.15**	.16**
Health risk	.22**	.20**	.13**
Guideline adherence	.66**	.28**	.01
Shelter-in-place (follow-up)	.18**	.14**	.00

**p < .01. *p < .05.

Prospective associations between personality traits, demographic characteristics, guideline-related social cognitions, baseline 7-day guideline adherence and follow-up mask-wearing, 7-day guideline adherence, and symptom count. Informed by the hypotheses and bivariate associations, the path model depicted in Fig. 2 included baseline age, sex, perceived health, political views, the five personality traits, perceived norms, perceived control, attitudes, self-efficacy, guideline adherence intention, guideline adherence, perceived exposure risk, and perceived health risk as predictors of follow-up guideline adherence, mask-wearing, and symptom count. While education and income did not show significant associations with any of the follow-up variables, they showed significant correlations with other variables at baseline and were therefore allowed to covary with those baseline variables in the model. In line with Bogg and Milad [1], the follow-up presence versus absence/uncertainty of a shelter in place order was included in the final model.

The tested path model showed good internal fit ($\chi^2 = 153.3$, $df = 122$, $p = .03$: CFI = .987, RMSEA = .023; $r^2_{\text{symptom count}} = .11$, $r^2_{\text{mask-wearing}} = .14$, $r^2_{\text{guideline adherence}} = .45$). All direct associations are reported as standardized weights in Fig. 2. Nonsignificant pathways were removed from the figure for clarity of presentation, but all tested pathways are included in the figure note. In the final model, statistically significant predictors of greater symptom count at follow-up included sex (female; $p < .05$), lower baseline perceived health ($p < .01$), and greater baseline neuroticism ($p < .01$). Predictors of greater mask-wearing at follow-up included greater guideline adherence intention ($p < .05$), baseline political beliefs (liberal; $p < .01$), more frequent guideline adherence at baseline ($p < .01$). Showing evidence of stability, baseline guideline adherence predicted follow-up guideline adherence ($p < .01$).

Covariates of baseline predictors

Within the model, several baseline variables were significant correlates of the baseline predictors (see Fig. 2 caption for a complete description of additional model effects). Being female was associated with greater self-efficacy ($p < .01$). Greater baseline perceived health was associated with greater education, income, agreeableness, conscientiousness, extraversion, and lower age, perceived exposure risk and perceived health risk ($ps < .01–.05$). Greater baseline neuroticism was associated with greater perceived exposure risk and perceived health risk and lower agreeableness, conscientiousness, extraversion, perceived control, self-efficacy, openness, and age ($ps < .01–.05$). Greater guideline adherence intention at baseline was associated with greater agreeableness, perceived norms, perceived control, attitudes, self-efficacy, perceived exposure risk, and perceived health risk ($ps <$

.01–.05). More conservative political beliefs at baseline were associated with greater age, conscientiousness, and extraversion and lower openness, perceived norms, attitudes, and exposure risk ($ps < .01–.05$). More frequent baseline guideline adherence was associated with greater agreeableness, conscientiousness, extraversion, openness, perceived norms, perceived control, attitudes, self-efficacy, perceived exposure risk, and perceived health risk ($ps < .01–.05$).

Discussion

The goal of the present study was to test prospective associations between demographic characteristics, personality traits, guideline-related beliefs, guideline adherence and subsequent guideline adherence, mask-wearing, COVID-19 symptom counts, and viral testing during the initial surge in cases and mortality during Spring 2020. The correlational findings indicated several baseline demographic factors, personality traits, guideline-related social cognitions, and health beliefs were associated with follow-up guideline adherence, mask-wearing, and symptoms. Although the base rate of self-reported viral testing precluded meaningful relational tests (i.e., 1.80%), the rate itself was comparable to the percentage of tests reported as a function of the total population during April of 2020 (i.e., 1.65%; https://covidtracking.com/data/national). The low rate reflects the shortage of testing during this time period, as well as guidance to withhold testing from asymptomatic or mildly symptomatic individuals [26, 27].

The prospective design of the current work provides insight beyond the existing cross-sectional evidence for individual differences in behavioral responses to COVID-19. The results of the prospective path analyses showed guideline adherence was relatively stable from baseline to follow-up, and demonstrated a large effect size ($\beta = .562$), despite the nascent nature of the guidelines and their constituent behavioral components. Moreover, the results showed a small effect size ($\beta = .154$) of more frequent baseline guideline adherence predicting more frequent mask-wearing at follow-up. To our knowledge, no studies have yet to assess the prospective effects of prior guideline adherence on mask-wearing. In addition, consistent with a temperamental process framework, there was a small effect ($\beta = .127$) of greater baseline intention for guideline adherence on mask-wearing at follow up. The results also showed a small effect ($\beta = .137$) of liberal political beliefs predicting more frequent mask-wearing at follow up. While there is a dearth of research employing prospective designs, especially for mask-wearing, the small effect size for political beliefs and mask-wearing is comparable to cross-sectional
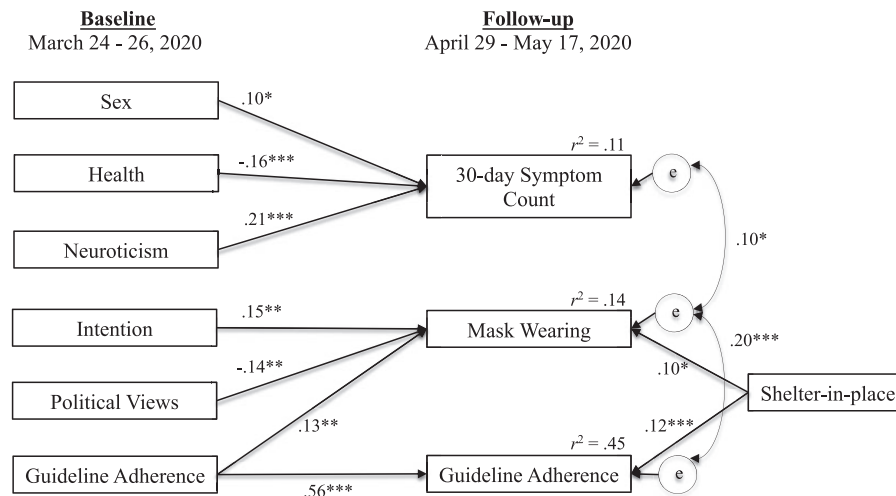
Fig. 2. Path model of direct associations among personality traits, demographic variables, and guideline-related social cognitions and symptom counts, mask-wearing, and guideline adherence. ***p < .001. **p < .01. *p < .05. All terms are standardized weights. Blom-transformed scores were used for perceived norms, perceived control, attitudes, self-efficacy, guideline adherence (at baseline and follow-up), and symptom count. Nonsignificant direct predictors of other variables were not included in the model for clarity of presentation. Nonsignificant standardized direct associations were as follows (all *p*s > .05): openness → mask-wearing = .02; perceived norms → mask-wearing = .04; agreeableness → symptom count = .01; conscientiousness → symptom count = .03; political views → guideline adherence (follow-up) −.07; exposure risk → guideline adherence (follow-up) = .02; health risk → guideline adherence (follow-up) = .03; age → guideline adherence (follow-up) = −.04; perceived norms → guideline adherence (follow-up) = −.01; perceived control → guideline adherence (follow-up) = −.01; attitudes → guideline adherence (follow-up) = .04; self-efficacy → guideline adherence (follow-up) = .04; openness → guideline adherence (follow-up) = −.04; sex → guideline adherence (follow-up) = .00; attitudes → mask-wearing = .07; exposure risk → symptom count = .08; health risk → symptom count = −.00; conscientiousness → guideline adherence (follow-up) = −.01; agreeableness → guideline adherence (follow-up) = .06; extraversion → guideline adherence (follow-up) = .06; self-efficacy → mask-wearing = −.04; exposure risk → mask-wearing = .04; health risk → mask-wearing = .07; intention → guideline adherence (follow-up) = .07. The associations among the correlated terms were as follows (*p* < .001, unless otherwise noted): extraversion ↔ agreeableness = .31; extraversion ↔ conscientiousness = .32; extraversion ↔ neuroticism = −.34; extraversion ↔ openness = .24; extraversion ↔ age = .21; extraversion ↔ perceived health = .15; extraversion ↔ guideline adherence (baseline) = .13; agreeableness ↔ conscientiousness = .42; agreeableness ↔ neuroticism = −.45; agreeableness ↔ openness = .20; agreeableness ↔ = .20; agreeableness ↔ perceived health = .14; agreeableness ↔ perceived norms = .12 (*p* <.01); agreeableness ↔ perceived control = .18; agreeableness ↔ attitudes = .13; agreeableness ↔ self-efficacy = .11 (*p* < .01); agreeableness ↔ guideline adherence (baseline) = .19; conscientiousness ↔ neuroticism = −.53; conscientiousness ↔ openness = .18; conscientiousness ↔ age = .28; conscientiousness ↔ perceived health = .12 (*p* <.01); conscientiousness ↔ perceived control = .12 (*p* < .01); conscientiousness ↔ attitudes = .01 (*ns*); conscientiousness ↔ self-efficacy = .11 (*p* < .01); conscientiousness ↔ guideline adherence (baseline) = .23; neuroticism ↔ age = −.33; neuroticism ↔ perceived health = −.18; neuroticism ↔ perceived control = −.07 (*p* <.05); neuroticism ↔ self-efficacy = −.10 (*p* <.01); neuroticism ↔ guideline adherence (baseline) = −.15; openness ↔ perceived norms = .07 (*ns*); openness ↔ perceived control = .09 (*p* < .05); openness ↔ attitudes = .11 (*p* <.01); openness ↔ self-efficacy = .06 (*ns*); openness ↔ guideline adherence (baseline) = .13; age ↔ perceived health = −.10 (*p* < .05); age ↔ attitudes = .01 (*ns*); age ↔ self-efficacy = .15; age ↔ guideline adherence (baseline) = .07 (*ns*); perceived norms ↔ perceived control = .27; perceived norms ↔ attitudes = .32; perceived norms ↔ self-efficacy = .29; guideline adherence (baseline) ↔ perceived norms = .35; perceived control ↔ attitudes = .28; perceived control ↔ self-efficacy = .30; guideline adherence (baseline) ↔ perceived control = .26; attitudes ↔ self-efficacy = .49; guideline adherence (baseline) ↔ attitudes = .33; neuroticism ↔ openness = −.18; openness ↔ age = .15; guideline adherence (baseline) ↔ self-efficacy = .40; age ↔ political views = .21; extraversion ↔ political views = .08 (*p* <.05); conscientiousness ↔ political views = .16; neuroticism ↔ political views = −.17; openness ↔ political views = −.20; perceived norms ↔ political views = −.09 (*p* <.05); attitudes ↔ political views = −.11 (*p* < .01); perceived health ↔ exposure risk = −.22; neuroticism ↔ exposure risk = .10 (*p* <.01); perceived norms ↔ exposure risk = .19; political views ↔ exposure risk = −.09 (*p* <.05); political views ↔ health risk = −.08 (*ns*); exposure risk ↔ health risk = .39; age ↔ health risk = .24; perceived health ↔ health risk = −.37; openness ↔ health risk = .10 (*p* <.01); perceived norms ↔ health risk = .17; perceived control ↔ health risk = .13; attitudes ↔ health risk = .15; self-efficacy ↔ health risk = .17; guideline adherence (baseline) ↔ health risk = .21; guideline adherence (baseline) ↔ exposure risk = .13; attitudes ↔ sex = .06 (*ns*); self-efficacy ↔ sex = .10 (*p* <.01); guideline adherence (baseline) ↔ sex = .08 (*p* <.05); neuroticism ↔ health risk = .10 (*p* <.01); neuroticism ↔ sex = .21; agreeableness ↔ health risk = .09 (*p* <.05); agreeableness ↔ intention = .14; perceived norms ↔ intention = .42; perceived control ↔ intention = .28; political views ↔ intention = −.06 (*ns*); guideline adherence (baseline) ↔ intention = .38; exposure risk ↔ intention = .13; health risk ↔ intention = .13; attitudes ↔ intention = .48; self-efficacy ↔ intention = .49; income ↔ sex −.08 (*p* <.05); income ↔ attitudes = −.04 (*ns*); income ↔ health risk = −.14; education ↔ age = .20; education ↔ perceived health = .18; income ↔ perceived health = .26; income ↔ education = .35; education ↔ perceived norms = .05 (*ns*).

studies showing conservative beliefs to be related to less frequent participation in other preventive behaviors, such as social distancing behavior [28].

The effect for political beliefs—assessed before mask-wearing was formally advised by the CDC—shows how the politization/polarization of aspects

of the pandemic likely influenced receptivity and responsivity to subsequent public health guidance [29]. Notably, in the path model, political views were not significantly associated with baseline or follow-up guideline adherence, suggesting the initial formal guidelines were less politicized than mask-wearing, which was not part of the initial suite of guidelines. The path analyses also showed a small effect of the presence of a shelter-in-place order being associated with more frequent guideline adherence and mask-wearing (βs = .122, .100, respectively), despite possible politization/polarization.

Finally, and in accord with a temperamental process perspective and prior research, there was a medium effect size (β = .205) for greater baseline neuroticism predicting greater follow-up symptom counts, further implicating anxious and unstable tendencies in the perception and reporting of psychosomatic complaints. This finding is consistent with other evidence showing greater neuroticism to be associated with more health concerns [30]. Additional results showed a small effect size for women being somewhat more likely to report symptoms at follow-up (β = .104), as were individuals who reported lower baseline self-rated health (β = −.164). Notably, baseline guideline adherence and the presence versus absence/uncertainty of a shelter-in-place order were not associated with follow-up symptom counts.

Several baseline variables were associated with the prospective baseline predictors described above. The patterns of relations for the most common of these can be summarized as follows. Greater baseline agreeableness was associated with greater baseline health, lower neuroticism, greater guideline adherence intention, and more frequent guideline adherence. Greater baseline conscientiousness was associated with greater baseline health, lower neuroticism, more conservative beliefs, and more frequent guideline adherence. Greater baseline extraversion was associated with greater baseline health, lower neuroticism, more conservative beliefs, and more frequent guideline adherence. In other work, extraversion and conscientiousness have been shown to be associated with perceptions of good health [31]. Additionally, the results support previous evidence depicting associations between greater agreeableness, conscientiousness, and extraversion and taking health precautions [2, 30, 32]. These patterns of associations further suggest the roles for agreeableness, conscientiousness, and extraversion in the expression of guideline adherence [1–3]. Further prospective and longitudinal research is required to address the dynamics of the temporal interrelations between these traits, related social cognitions, and guideline adherence.

Limitations and Implications

The present work was bound to Prolific.co's sampling strategy, which did not allow for stratification by income, education, region, etc., thereby limiting the representativeness the sample to age, sex, and race. Additionally, the guideline adherence and symptom items – while reducing assessment burden and reactivity – were limited in their retrospective framing and self-report format. Contemporaneous (e.g., diary) reporting of guideline adherence and symptoms would likely provide a more accurate account of these behaviors and experiences [33]. In addition, because the baseline data collection focused on the initial 15-day period in March, 2020, obtaining institutional review board approval in an expedient manner was prioritized. As such, questions that could potentially be personally identifiable (e.g., ZIP codes), violate HIPAA or other relevant privacy regulations, or otherwise pose a risk greater than everyday life (e.g., reporting maladaptive coping behaviors) were excluded from the assessment. This approach resulted in timely exempt status approval, but also limited the assessment of other factors of interest. Lastly, due to concerns for assessment burden, information regarding the household composition of the participants was not assessed. It is possible that individuals who were living with or taking care of vulnerable individuals (elderly, immune compromised, etc.) would hold different perceptions of severity and associated preventive behaviors than those who were not personally associated with high-risk individuals. While the current study did not assess this context, it likely warrants attention in ongoing research.

Despite the limitations, the use of a prospective design, embedded in ongoing public health and epidemiological timelines, represents a strength of the present study, as do the assessment and modeling of a comprehensive suite of dispositions and beliefs in the prediction of coronavirus guideline adherence and COVID-19 symptoms. Despite the approval of multiple vaccines, modeling indicates SARS-CoV-2 is likely to persist in various forms for the foreseeable future, resulting in the need for ongoing or recurrent hygienic and social distancing practices, as well as the possibility of further emergency orders [34]. The present work highlights the gaps in health policy implementation at the individual level and shows how inconsistencies and contradictions in health policy communication promulgated by some public officials were concomitant with individual-level political beliefs being predictive of some guidelines and not others. In addition, the results further clarify how personality traits related to social responsibility (i.e., agreeableness, conscientiousness) [35] are associated with following new norms for prescribed behaviors and how symptom

reporting can be as much an index of perceived health as emotional stability.

One of the principles that arose from the person-situation debate in personality and social psychology is that associations between traits and beliefs and behaviors should be reduced or absent in "clearly normatively scripted situations" [36]. The results of the present study suggest the social context for guideline adherence and mask wearing during Spring 2020, in particular, was not overly strong, as evidenced by the observed associations with traits, beliefs, and intention. While these findings provide criterion evidence for the constructs of interest (e.g., a politicized behavior being associated with political beliefs), they also show how individual differences affect public health goals.

During a pandemic, the primary public health principle guiding preventive strategies in the United States is the use of research-based measures that do not unduly infringe upon individual liberties or diminish well-being [37]. When measures and advisements must be implemented, then any disruptions to the basic needs of the population (e.g., medical care, schooling, housing, income, social integration) must be offset or minimized by the government. Under this public health premise, the creation of a social contract is prioritized [38].

In principle, the specific terms of a social contract would serve as the primary influences of adhering to advisements and guidelines. Concordantly, an early and essential task of the political-public-health leadership would be promoting coherent and robust perceptions of a social contract. In such a context, a strong perception of contingencies associated with guideline adherence would likely attenuate the influence of the individual characteristics associated with adherence (i.e., agreeableness, conscientiousness, intentions, political views). In other words, the terms of the social contract (mitigation responses and offsets for social/behavioral constraints and other possible harms to well-being) should be the primary drivers of guideline adherence, rather than individual differences in dispositions, beliefs, and motivations. Establishing such a contract and clearly and consistently communicating its structure and terms, while not fully eliminating effects of individual difference factors, could help serve public health goals by reducing gaps in guideline adherence and mask wearing.

Compliance with Ethical Standards

References

1. Bogg T, Milad E. Demographic, personality, and social cognition correlates of coronavirus guideline adherence in a U.S. sample. *Health Psychol.* 2020;39:1026–1036.

2. Clark C, Davila A, Regis M, Kraus S. Predictors of COVID-19 voluntary compliance behaviors: An international investigation. *Glob Transit.* 2020;2:76–82.

3. Willroth EC, Smith AM, Shallcross AJ, Graham EK, Mroczek DK, Ford BQ. The health behavior model of personality in the context of a public health crisis. *Psychosom Med.* 2021. doi:10.1097/PSY.0000000000000937. Epub ahead of print. PMID: 33790198.

4. Hagger MS, Smith SR, Keech JJ, Moyers SA, Hamilton K. Predicting social distancing intention and behavior during the COVID-19 pandemic: An integrated social cognition model. *Ann Behav Med.* 2020;54:713–727.

5. Lin CY, Imani V, Majd NR, et al. Using an integrated social cognition model to predict COVID-19 preventive behaviours. *Br J Health Psychol.* 2020;25:981–1005.

6. Zhou Y, MacGeorge EL, Myrick JG. Mental health and its predictors during the early months of the COVID-19 pandemic experience in the United States. *Int J Environ Res Public Health.* 2020;17(17): 6315.

7. Vo PT, Bogg T. Testing theory of planned behavior and neo-socioanalytic theory models of trait activity, industriousness, exercise social cognitions, exercise intentions, and physical activity in a representative U.S. sample. *Front Psychol.* 2015;6:1114.

8. Hamilton K, Smith SR, Keech JJ, Moyers SA, Hagger MS. Application of the health action process approach to social distancing behavior during COVID-19. *Appl Psychol Health Well Being.* 2020;12:1244–1269.

9. Hornik R, Kikut A, Jesch E, Woko C, Siegel L, Kim K. Association of COVID-19 misinformation with face mask wearing and social distancing in a nationally representative US sample. *Health Commun.* 2021;36:6–14.

10. Xu P, Cheng J. Individual differences in social distancing and mask-wearing in the pandemic of COVID-19: The role of need for cognition, self-control and risk attitude. *Pers Individ Dif.* 2021;175:110706. doi:10.1016/j.paid.2021.110706.

11. Wise T, Zbozinek TD, Michelini G, Hagan CC, Mobbs D. Changes in risk perception and self-reported protective behaviour during the first week of the COVID-19 pandemic in the United States. *R Soc Open Sci.* 2020;7:200742.

12. Lee M, You M. Psychological and behavioral responses in South Korea during the early stages of coronavirus disease 2019 (COVID-19). *Int J Environ Res Public Health.* 2020; 17(9): 2977.

13. Berg MB, Lin L. Prevalence and predictors of early COVID-19 behavioral intentions in the United States. *Transl Behav Med.* 2020;10:843–849.

14. Bruine de Bruin W, Bennett D. Relationships between initial COVID-19 risk perceptions and protective health behaviors: A national survey. *Am J Prev Med*. 2020;59(2):157–167. doi:10.1016/j.amepre.2020.05.001.

15. Raude J, Lecrique JM, Lasbeur L, et al. Determinants of preventive behaviors in response to the COVID-19 pandemic in France: Comparing the sociocultural, psychosocial, and social cognitive explanations. *Front Psychol*. 2020;11:584500.

16. Hampson SE. Personality processes: Mechanisms by which personality traits "get outside the skin". *Annu Rev Psychol*. 2012;63:315–339.

17. Costa PT Jr, McCrae RR. Neuroticism, somatic complaints, and disease: Is the bark worse than the bite? *J Pers*. 1987;55:299–316.

18. Lahey BB. Public health significance of neuroticism. *Am Psychol*. 2009;64:241–256.

19. John OP, Naumann LP, Soto CJ. Paradigm shift to the integrative Big-Five trait taxonomy: History, measurement, and conceptual issues. In: John OP, Robins RW, Pervin LA, eds. *Handbook of Personality: Theory and Research*. New York, NY: Guilford Press; 2008:114–158.

20. van den Oord EJ, Simonoff E, Eaves LJ, Pickles A, Silberg J, Maes H. An evaluation of different approaches for behavior genetic analyses with psychiatric symptom scores. *Behav Genet*. 2000;30:1–18.

21. Sharma D, McGee D, Kibria, BG. Measures of explained variation and the base-rate problem for logistic regression. *Am J Biostat*. 2011; 2(1): 11.

22. Enders CK. The impact of nonnormality on full information maximum-likelihood estimation for structural equation models with missing data. *Psychol Methods*. 2001;6:352–370.

23. Enders CK, Bandalos DL. The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Struct Equ Modeling*. 2001; 8(3): 430–457.

24. Bentler PM. Comparative fit indexes in structural models. *Psychol Bull*. 1990;107:238–246.

25. Browne MW, Cudeck R. Alternative ways of assessing model fit. *Sociol Methods Res*. 1992; 21: 230–258.

26. Schuchat A; CDC COVID-19 Response Team. Public health response to the initiation and spread of pandemic COVID-19 in the United States, February 24−April 21, 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69:551–556.

27. Wu SL, Mertens AN, Crider YS, et al. Substantial underestimation of SARS-CoV-2 infection in the United States. *Nat Commun*. 2020;11:4507.

28. Rothgerber H, Wilson T, Whaley D, et al. Politicizing the COVID-19 pandemic: Ideological differences in adherence to social distancing. *PsyArxiv Prepr*. 2020. doi:10.31234/osf.io/k23cv.

29. Hart PS, Chinn S, Soroka S. Politicization and polarization in COVID-19 news coverage. *Sci Commun*. 2020; 42(5): 679–697.

30. Aschwanden D, Strickhouser JE, Sesker AA, et al. Psychological and behavioural responses to coronavirus disease 2019: The role of personality. *Eur J Pers*. 2020:10.1002/per.2281. doi:10.1002/per.2281. Epub ahead of print. PMID: 32836766; PMCID: PMC7361622..

31. Goodwin R, Engstrom G. Personality and the perception of health in the general population. *Psychol Med*. 2002;32:325–332.

32. Nofal AM, Cacciotti G, Lee N. Who complies with COVID-19 transmission mitigation behavioral guidelines? *PLoS One*. 2020;15:e0240396.

33. Schwarz N. Cognitive aspects of survey methodology. *Appl Cogn Psychol*. 2007; 21(2): 277–287.

34. Kissler SM, Tedijanto C, Goldstein E, Grad YH, Lipsitch M. Projecting the transmission dynamics of SARS-CoV-2 through the postpandemic period. *Science*. 2020;368:860–868.

35. Roberts BW, Bogg T. A longitudinal study of the relationships between conscientiousness and the social-environmental factors and substance-use behaviors that influence health. *J Pers*. 2004;72:325–354.

36. Kenrick DT, Funder DC. Profiting from controversy. Lessons from the person-situation debate. *Am Psychol*. 1988;43:23–34.

37. Gostin LO, Hodge JG Jr, Wiley LF. Presidential powers and response to COVID-19. *JAMA*. 2020;323:1547–1548.

38. Gostin LO, Friedman EA, Wetter SA. Responding to COVID-19: How to navigate a public health emergency legally and ethically. *Hastings Cent Rep*. 2020;50:8–12.