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REGULAR ARTICLE

Descriptive Norms and Prototypes Predict COVID-19 Prevention Cognitions and Behaviors in the United States: Applying the Prototype Willingness Model to Pandemic Mitigation

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Abstract

Background Early in the COVID-19 pandemic, prevention behavior adoption occurred in a rapidly changing context. In contrast to expectancy-value theories, the Prototype Willingness Model (PWM) is well-suited for investigating novel and socially informed behaviors.

Purpose We explored whether PWM social cognitions predicted coronavirus prevention behaviors.

Method A representative sample of United States adults (N = 738; M_{age} = 46.8; 51.8% women; 78% white; April 2020) who had not had COVID-19 reported PWM predictor variables (perceived vulnerability, prevention descriptive norms, prototypes engaging in prevention behavior, and prevention behavioral intentions). Two weeks later, participants reported their prevention behaviors (handwashing, mask-wearing, social distancing, etc.) and future public health behavioral willingness (contact tracing, temperature checks, etc.).

Results Controlling for putative demographic, past behavior, and coronavirus-contextual (e.g., local infection rates) covariates, mediation models indicated that higher norms and favorable prototypes were associated with greater prevention behavioral intentions, which in turn predicted increased prevention behavior, $F(18, 705) = 92.20, p < .001, R^2 = .70$. Higher norms and favorable prototypes associated both directly and indirectly (through greater prevention behavioral intention) with greater willingness to engage in emerging public health behaviors, $F(15, 715) = 21.49, p < .001, R^2 = .31$.

Conclusions Greater descriptive norms and favorable prototypes for prevention behavior predicted: (a) future prevention behaviors through increases in behavioral intentions and (b) willingness to participate in emerging public health behaviors. These results held across demographic groups, political affiliation, and severity of regional outbreaks. Public health efforts to curb pandemics should highlight normative prevention participation and enhance positive prototypes.

Keywords: Prototype Willingness Model · Descriptive norms · COVID-19 · Social distancing · Mask wearing

COVID-19 (coronavirus) is a highly contagious, novel coronavirus disease that originated as a local outbreak in Wuhan (Hubei, China) and was classified as a pandemic by World Health Organization on March 11, 2020 [1]. By April 2020, over 218,000 people in the United States had been diagnosed with coronavirus and over 6,500 had died [2]. With no cure or vaccine, mitigation relied entirely on Americans' participation in prevention behavior, but adherence across prevention behavior was highly varied in early April [3]. Several prevention behaviors were recommended (e.g., social distancing, handwashing [4]) and public health interventions used in previous pandemics (e.g., contact tracing and follow-up testing, symptom checking) were gaining public attention as promising avenues to mitigate virus spread. Enhancing public participation in prevention behaviors is essential to control pandemics and psychological theory can provide guidance for understanding and predicting human behavior [5]. Yet, a meta-analysis of behavioral research from past pandemics (e.g., SARS, H1N1) found that much of the rapidly produced behavioral research during pandemics

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was atheoretical and cross-sectional [6]. More theoretically grounded, longitudinal research is necessary to enhance public health planning and provide urgently needed information to encourage public participation in coronavirus prevention; specifically, early in the COVID-19 pandemic public health leaders sought behavioral recommendations grounded in social cognitions and positive behavior representations [5].

To answer the call to improve pandemic behavioral research, we used the Prototype Willingness Model [7] as a theoretical framework appropriate for understanding coronavirus prevention behaviors. The Prototype Willingness Model is an extensively validated health behavior model; meta-analyses reveal its utility for predicting multiple health behaviors across a variety of populations [7–9]). Alongside traditional expectancy-value cognitive predictors (e.g., perceived vulnerability for a negative health outcome), the Prototype Willingness Model highlights social cognitions, including descriptive norms and prototypes, as drivers of behavioral decision cognitions (e.g., behavioral intentions and behavioral willingness) and subsequent behavior. First, descriptive norms capture prevalence perceptions of behavioral participation in social referent groups (e.g., *Most of my friends are staying home, washing their hands, and wearing masks*). Descriptive norms serve as an important behavioral guide especially during uncertain circumstances [10]. Second, prototypes are valanced images of a typical person who engages in the behavior (e.g., *The type of person who participates in contact tracing, coronavirus testing, and symptom tracking is a good, responsible person*) [7]. Behavioral intentions are a traditional behavioral decision cognition predictive for behaviors that require planning and that individuals have more experience with (e.g., *I intend to wash my hands much more than normal to protect against coronavirus*). The Prototype Willingness Model also introduces behavioral willingness as an additional behavioral decision cognition, which reflects an openness to participating in behavior under conducive circumstances. Behavioral willingness forms for *new* behaviors prior to behavioral intentions is more predictive for behaviors that are socially reactive, less planful and that individuals have less experience with, and applies to emerging health behaviors individuals are aware of, but cannot yet access or perform (e.g., *If a contact tracer called me, I would be willing to answer all of their questions*) [7, 11, 12].

The Prototype Willingness Model is well suited for examining coronavirus prevention for four reasons. First, social cognitions (i.e., cognitions that are about *people* doing behaviors in addition to expectancy-value cognitions such as perceived vulnerability) are particularly influential for novel behaviors during uncertain circumstances. Many coronavirus prevention and public health behaviors were novel in the United States (e.g., mask-wearing) and were not behaviors that could be planned, but behaviors that were responsive to the social environment (e.g., cooperating with an unexpected call from a contact tracer). Second, coronavirus prevention was not solely reflective of reasoned choices, but imbued with unique social dynamics and consequences (e.g., staying home from scheduled social gatherings, mask-wearing) where descriptive norms may have served as an important heuristic. Third, coronavirus prevention behaviors are health-promotive, and both theory [7] and empirical research [9] demonstrate the Prototype Willingness Model's predictive validity for health-promotive behaviors. Fourth, recent research reveals that Prototype Willingness Model cognitions play a role in behavior cross-over; descriptive norms for one behavior (i.e., alcohol use) related to participation in adjacent-behaviors (i.e., mixing marijuana and prescription stimulants with alcohol) [13]. For new public health behaviors without enough history to inform social cognitions (e.g., descriptive norms of people who use a contact tracing app before the technology is developed), cognitions of adjacent prevention behaviors may inform cross-behavior uptake via behavioral willingness. While we are aware of no research that has explored the Prototype Willingness Model in the context of the COVID-19 pandemic, existing research on perceived vulnerability, descriptive norms, and prototypes as individual constructs provide some insight to possible behavioral prediction pathways.

Perceived Vulnerability

Perceived vulnerability is a well-established predictor of precautionary behavior uptake and central to several expectancy-value behavioral prediction models. A meta-analysis of experimental studies showed that heightened perceived vulnerability predicted both health-related intentions and behaviors [14]. In the context of infectious disease, a meta-analysis focused on flu vaccination uptake showed that perceived vulnerability prospectively predicted vaccination [15]. Finally, several studies on coronavirus preventive behaviors found that perceived vulnerability for COVID-19 cross-sectionally [16] and prospectively [17] associated with prevention behaviors in the United States and cross-sectionally associated with prevention behaviors worldwide [18].

Descriptive Norms

The Prototype Willingness Model has not been applied to respiratory or coronavirus prevention, but descriptive norms specifically have been studied for various infection prevention behaviors. In the United Kingdom, greater descriptive norms were associated with behavioral intentions for handwashing and mask-wearing among university students and adults in the context of respiratory infection prevention (e.g., H1N1 [19, 20]). Early in the COVID-19 pandemic, descriptive norms of family and friends' prevention behavior was cross-sectionally associated with handwashing, social distancing, and mask-wearing in both the United Kingdom and the Netherlands [21]. In addition, one representative longitudinal study in the United Kingdom found that respondents' perceptions of the number of coronavirus prevention behaviors they thought other people were doing predicted their handwashing, social distancing and mask-wearing 1 week later [22]. Collectively, these studies show that descriptive norms relate cross-sectionally to behavioral decision cognitions or behavior, or longitudinally with behavior. However, longitudinal research is needed to elucidate the directional influence of descriptive norms and explore the mediational pathway of behavioral decision cognitions.

Prototypes

Favorable health-promotive prototypes (e.g., exercisers, healthy eaters, safe sun/tanning engagers) predict both behavioral intentions and subsequent behavior [9]. One study investigating general health habits had British adolescents report prototype ratings across 14 behaviors that included handwashing. Results demonstrated that perceived similarity to the health-promotive prototype predicted greater behavior engagement [23], but the mediating pathway through behavioral intention was not explored. The COVID-19 pandemic presents an important context to expand assessment of how health-promotive prototype favorability influences behavior [9, 24].

Contextual Factors Related to Coronavirus Prevention Behavior

In addition to examining the Prototype Willingness Model for coronavirus prevention, it is important to control for contextual factors that may drive both social cognitions and prevention behavior to isolate the role of perceived vulnerability, descriptive norms, and prototypes. Alongside gender, race, ethnicity, age, and socioeconomic status, which were associated with prevention behavior in past pandemics [6, 25] and early during the COVID-19 pandemic [16, 26, 27], additional factors were highly contextually relevant for early coronavirus prevention behavior in the United States. For example, liberal political orientation [16] and past seasonal flu vaccination [28] predicted early prevention behavior. Severity of the infection was highly divergent across geographic locations, yet no longitudinal research that we are aware of has addressed local pandemic severity using available epidemiological data as a potential covariate. Finally, timing of prevention behavior mandates, such as requiring social distancing or mask-wearing, were adopted unevenly across the United States by various authorities (e.g., states, counties, cities, employers [29, 30]), and thus, are important to assess at the individual level as potential drivers for both social cognitions and behavior.

The Present Study

The present study explored coronavirus prevention behavior early in the pandemic. A national United States adult sample was surveyed at 2 weeks apart in April 2020. By early April, regulations limiting gathering and closing restaurants had gone into effect in 49 states and school closures were in effect for all 50 states [29, 31]; stay-at-home orders were mandatory in most states at the time of the study [32]. At baseline (Time 1, beginning April 14), participants reported their participation in coronavirus prevention behaviors. Between Time 1 and Time 2, there was increased national awareness of public health interventions, including contact tracing and coronavirus testing via public health workers and smartphone applications and symptom checking via temperature checks [33]. We capitalized on this development, assessing behavioral willingness for *new* public health behaviors at Time 2. Given the novel and social nature of the pandemic, we hypothesized that cognitions from Prototype Willingness Model would predict coronavirus prevention decision cognitions and behaviors (preregistered: Hypothesis 6 https://osf.io/ufb2v). Specifically,

1. For prevention behaviors (e.g., handwashing, social distancing), we expected that greater perceived vulnerability, higher descriptive norms, and more favorable prototypes would associate with greater behavioral intentions which, in turn, would predict future prevention behavior.
2. For new public health behaviors (e.g., cooperating with contact tracing), we expected that greater perceived vulnerability, higher descriptive norms, and favorable prototypes of prevention behaviors would associate with greater behavioral intentions for prevention behaviors and, in turn, predict willingness to engage in emerging public health behavior (public health behavioral willingness).

Additionally, we expected that these Prototype Willingness Model predictive pathways would be robust when controlling for baseline behavior and putative demographic, past behavior, and coronavirus-contextual factors.

Method

Participants

Participants were adults living in the United States who reported neither testing positive for coronavirus nor suspecting having had/currently having coronavirus. The sample was recruited from Prolific, an online recruitment platform, and participants were demographically matched to the United States census by age, sex, and race/ethnicity [34]. Prolific uses potential participants' responses on prescreen questions to open demographically balanced recruitment slots on age, sex, and race/ethnicity strata, targeting representation across demographic characteristics [35]. The final analytic sample included 738 participants with responses at Time 1 and Time 2 (M_{age} = 46.78, SD_{age} = 15.93; 51.8% women; 78.0% white; see Table 1 for participant characteristics).

Procedure

Potential participants who had not had (or suspected having had) coronavirus were administered a survey using Qualtrics [36]. Participants were sent the first survey on April 14, 2020 (Time 1), took the survey between April 14 and 17, were contacted 2 weeks later on April 28, 2020 (Time 2) to complete the second survey, and completed the second survey between April 28 and May 2 (day range between Time 1 and Time 2: *M* = 13.25, *SD* = 0.92, range: 11–17). The surveys opened with an informed consent and concluded with a debrief that provided links to coronavirus and mental health resources.

Table 1. Participant, Past Behavior, and Coronavirus-Contextual Frequencies and Descriptives in Analytic Sample (*N* = 738; All Variables Derived from Time 1 Unless Otherwise Noted)

Category of covariates	Variables	Categories or directionality	*M* (*SD*) or % (*n*)	Observed range	*n*
Demographic and identity	Age		46.78 (15.93)	18–82	738
	Gender	Women	51.8% (382)		737
		Men	48.1% (355)		
	Race	African American	12.3% (91)		738
		White	78.0% (576)		
		Asian	7.0% (52)		
		Other	2.6% (19)		
	Hispanic ethnicity		5.7% (42)		738
	Sexual orientation	Straight	89.0% (657)		738
		Lesbian or gay	3.9% (29)		
		Bisexual	4.7% (35)		
		Other	2.3% (17)		
	Social class	Higher = higher class	2.68 (.82)	1–5	737
	Education	Higher = more educated	2.51 (1.10)	1–4	738
	Political ideology	Higher = more conservative	3.23 (1.64)	1–7	738
	Geographic region	Large city	19.6% (145)		738
		Suburb near large city	41.5% (306)		
		Small city or town	27.0% (199)		
		Rural area	11.9% (88)		
Past behavior	Past prevention behavior	Higher = greater behaviors	4.03 (.75)	1.57–5	738
	Seasonal flu vaccination		46.3% (342)		738
Coronavirus-contextual	Vulnerable group		39.2% (289)		738
	Indirect coronavirus experience	Higher = greater indirect experience	.293 (.547)	0–2	738
	Job essential/ works outside home		27.4% (202)		738
	Prevention regulations (stay-at-home/mask)[a]	Higher = more regulations	2.56 (.69)	0–3	738
	Actual infection rate in county[b]	Higher = more cases in county	162.89 (292.16)	0-2086.91	730
	Perceived severity of outbreak	Higher = more severe	2.68 (1.05)	1–5	738

[a] Regulations participants reported currently experiencing at Time 1 and Time 2 or retrospective reports since Time 1 (e.g., social distancing/stay-at-home order, mask-wearing).

[b] Variable log transformed in all analyses, but raw value reported here to aid in interpretation.

Participants were compensated $9.68/hr at Time 1 and $10.23/hr at Time 2. All procedures were approved by the Institutional Review Board of Dickinson College.

Preregistered eligibility criteria included not having tested positive for coronavirus or suspecting having had the virus and passing the attention check (https://osf.io/ufb2v). Both surveys included an embedded attention check question stating "If you are reading this, select Strongly Disagree" placed midway through the questionnaire within a block of questions with a 5-point scale from *Strongly disagree* (1) to *Strongly agree* (5). Participants who did not select *Strongly disagree* were coded as failing the attention check. 1,049 people responded to the Time 1 survey. Respondents were excluded if they reported that they had (or suspected they might have had) coronavirus ($n = 67$) or failed the attention check ($n = 45$), resulting in a sample of 937 Time 1 participants. Respondents who did not meet eligibility requirements at Time 1 or participants who did not provide valid Prolific IDs ($n = 21$) were not re-invited to participate in Time 2. As such, 916 people were sent the survey link for Time 2 and 798 took the survey (87% response rate). Of those who took the survey at Time 2, respondents were excluded if they reported that they had (or suspected they might have had) coronavirus ($n = 37$), failed the attention check ($n = 21$), or did not provide accurate Prolific IDs to match to Time 1 data ($n = 2$). This resulted in a sample size of 738 participants with complete responses on both surveys. Participants retained to Time 2 did not differ on gender, race, Hispanic ethnicity, social class, or political ideology ($ps \geq .22$), but were more likely to be older and highly educated ($ps < .01$).

Measures

Unless otherwise noted, questions on demographic information, past behavior, and Prototype Willingness Model predictor variables were assessed at Time 1. Outcome prevention behavior and public health behavioral willingness variables were assessed at Time 2.

Demographics

Participants reported their age and the gender binary with which they most identify (coded: 0 = woman; 1 = man). Participants reported their race (coded categorically: African American, Asian, White, and Other), whether they identify their ethnicity as Hispanic (coded: 0 = No, 1 = Yes), and their sexual orientation (coded categorically: Gay or Lesbian, Bisexual, Heterosexual, and Other).

There were two measures of socioeconomic status [37]. For social class, participants responded to the social class they feel they belong to on a 5-point scale: *the poor* (1), *the working class* (2), *the middle class* (3), *the upper-middle class* (4), *the upper class* (5) [38]. Participants reported on their highest level of education (coded: 1 = high school GED or less, 2 = associates degree, 3 = college degree, or 4 = more than college). Political ideology was measured with the question: "In terms of overall political orientation, how liberal or conservative are you?" with a 7-point response scale ranging from *extremely liberal* to *extremely conservative* [39]. For geographic area, participants responded to the following question: "What type of community do you live in?" by selecting one of the four response options (coded categorically: Large city, Suburb near a large city, Small city or town, Rural area [40]).

Past Behavior

Seasonal flu vaccination

Participants reported whether they received the seasonal flu vaccination, "Did you get the flu shot this season (between Sept 2019 and now)?" (coded: 0 = No/Not sure, 1 = Yes).

Past prevention behavior

Adapting from prior literature examining prevention behavior for infectious diseases [19, 41] along with one of the earliest available preprints examining coronavirus prevention behaviors [17], we asked participants to report their behaviors related to coronavirus prevention with the following questions: "In the past two weeks, I have…. 1) taken all precautionary measures against the coronavirus, 2) avoided close contact with all people outside my home, 3) avoided meeting up with any people in person (friends, family, etc.), 4) stayed at home nearly all the time, 5) washed my hands a great deal more than normal, 6) worn a face mask or cover every time I've gone outside, 7) sanitized or wiped down all my groceries" on a 5-point scale from *Strongly disagree* to *Strongly agree*. The seven items were averaged to create a scale with higher numbers signifying greater engagement in prevention behaviors ($\alpha = .77$).

Coronavirus-Contextual

Vulnerable group membership

Participants reported whether they belonged to a self-defined vulnerable/at-risk group for coronavirus (coded: 0 = No/Not sure, 1 = Yes).

Indirect coronavirus experience

Participants were asked if they personally knew someone who had contracted or died from coronavirus (coded: 0 = no experience, 1 = know someone with coronavirus, 2 = know someone who died from coronavirus/coronavirus complications).

Job essential/works outside home

At Time 2, participants retrospectively reported whether their job was considered essential or they worked outside the home during the prior 2 weeks. Due to substantial response overlap, these questions were consolidated with a *yes* response indicating a *yes* to either or both items (coded: 0 = No/Not applicable, not employed, 1 = Yes, job essential/worked outside home).

Prevention behavior regulations

Participants were asked three questions regarding prevention behavior regulations and rules. At Time 1, participants reported whether they were currently staying at home because of a stay-at-home or shelter-in-place order by their employer, county, city, or state (question 1). At Time 2, this question was repeated (question 2). Between Time 1 and Time 2, mask regulations were introduced in some places in the United States, therefore participants were asked at Time 2 whether they were required to wear a mask or face covering by order of their employer, county, city, or state (question 3). Participants responded to each of the three questions separately (coded: 0 = No/Not sure, 1 = Yes) and responses were summed to create a score representing the number of prevention behavior regulations participants experienced across Time 1 and Time 2 (range: 0–3).

Actual infection rate in county

Objective epidemiological infection rates were derived for the county each participant was residing in at the time of the survey. Participants reported the zip code they were residing in, which was used to link to geographically based objective county infection counts collated by the Johns Hopkins University Center for Systems Science Dashboard [2]. To create an infection *rate*, infection count was divided by census population estimates for the respective county and multiplied by 100,000, resulting in an infection count per 100,000 person rate. Due to an extreme positive skew, raw values were log-transformed, with higher numbers representing higher infection rates.

Perceived severity

Participants reported their perceived severity of the coronavirus outbreak in their state on a 5-point scale from *Not severe* to *Extremely severe*.

Prototype Willingness Model Predictors and Outcomes

All Prototype Willingness Model variables were assessed using traditional approaches for the model [42] adapted for coronavirus by drawing from one of the only available coronavirus prevention behavior preprints available at the time we constructed the survey [17]. For social cognitions related to prevention behavior (descriptive norms and prototypes), participants were prompted to consider *all* precautionary behaviors for the coronavirus: handwashing, social distancing, wearing a face mask, and sanitizing groceries.

Time 1 Predictor Variables

Perceived vulnerability

From the first coronavirus risk perception preprint we adapted the question and asked participants, "How likely do you think you are to become infected with the coronavirus?" with a sliding scale in which the endpoints were labeled 0 = *Very unlikely* to 100 = *Very likely* [17]. To reduce accuracy pressures, we prefaced the question by stating "Please indicate your OPINION on the likelihood of having the events happen in the next two weeks. This is not a test, we are just interested in your perceptions and we are not asking about percentages."

Descriptive norms for coronavirus prevention behavior

Participants were asked, "How many of your *family members* [close friends, people in your community] take all precautionary measures against coronavirus?" Participants responded on a 5-point scale from *None/very few* to *Almost all/all*. The three items were averaged to create a scale with higher numbers signifying higher descriptive norms (α = .81).

Prototype of prevention behavior

Participants were prompted to think about the type of person their age and gender who practices all the precautionary behaviors for coronavirus and rated this image on a 5-point scale from *Not at all* to *A great deal* on the following characteristics: Careless (reverse scored), Smart, Healthy, and Weak (reverse scored). The four prototype items were averaged to create a scale with higher numbers signifying more favorable prototypes (α = .68) [43].

Prevention behavioral intentions

Participants reported their behavioral intentions using analogous questions to prevention behaviors. Participants were asked, "In the next two weeks, I intend to…1) take all precautionary measures against the coronavirus, 2) avoid close contact with all people outside my home, 3) avoid meeting up with any people in person (friends, family, etc.), 4) stay at home nearly all the time, 5) wash my hands a great deal more than normal, 6) wear a face mask or cover every time I go outside, 7) sanitize or wipe down all my groceries" on a 5-point scale from *Strongly disagree* to *Strongly agree*. The seven items were averaged to create a scale with higher numbers signifying higher intentions (α = .83).

Time 2 Outcome Variables

Prevention behavior

Prevention behavior exactly replicated past prevention behavior questions assessed at Time 1 and items were averaged (α = .79).

Public health behavioral willingness

Participants were presented with three willingness scenarios: (i) "Suppose that you live in a community that uses contact-tracing to contain the coronavirus. This involves public health workers contacting you if a person with coronavirus had come into contact with you. If a public health worker contacted you as part of a contact-trace, how willing would you be to… a) answer any questions the public health worker has?, b) take a coronavirus test if the public health worker recommended it?, c) self-isolate if the public health worker recommended it?"; (ii) "Suppose that an app is developed to contact-trace the coronavirus. This app would work by using Bluetooth to alert people if they've come into contact with someone with coronavirus. For this to work, app-users would need to report if they've tested positive for the coronavirus. How willing would you be to… a) download the app?, b) report to the app if you test positive for coronavirus?, c) self-isolate for two weeks upon learning you'd come into contact with someone with coronavirus?"; (iii) "Suppose you go out to a restaurant for dinner. Temperature-taking is required to enter. How willing would you be to have your temperature taken so you can enter the restaurant?" Participants reported their willingness across these seven items on a 5-point scale from *Not at all willing* to *Completely willing* and items were averaged into a scale where higher numbers represented greater public health behavioral willingness (α = .87).

Results

Power Analysis and Analytic Plan

For a multiple regression with 18 predictors, a power analysis conducted in G*Power [44] yielded a sample size of 311 with the following settings: power at 95%, alpha level at 0.05, and a small to medium effect size (~f = .10); thus our study was adequately powered. We first determined putative covariates for hypothesis testing by examining bivariate relations between possible covariates (demographic, past behavior, and coronavirus-contextual variables) with either outcome variable (Time 2 prevention behavior or Time 2 public health behavioral willingness). Variables were included as covariates in respective hypothesis testing if the variable was significantly associated ($p < .05$) with the outcome variable.

Second, we used PROCESS v3.5 in SPSS 25 [45] to test the Prototype Willingness Model hypotheses, specifically whether predictors (perceived vulnerability, descriptive norms, and prototypes) affected Time 2 prevention behaviors or public health behavioral willingness either directly or indirectly via behavioral intentions. We assessed effects of all three predictor variables (perceived vulnerability, descriptive norms, and prototypes as X while controlling for covariates) directly on Time 2 outcome variables (Y), and indirectly via mediation through behavioral intention (M; Model 4); we set regression parameters at 5000 bootstrap bias-corrected samples and 95% confidence intervals [46]. Missing data were minimal and to capitalize on all available data, analyses were conducted with available-case analysis (pairwise deletion; see Tables 1 and 2 for individual construct *n*s).

Preliminary Analyses—Putative Covariates and Bivariate Associations

Several variables emerged as putative covariates in that they were associated with both Time 2 prevention behavior and public health behavioral willingness: being older, identifying as a woman, being more liberal, engaging in more past prevention behavior, having received the seasonal influenza vaccine, considering oneself in an at-risk group for coronavirus, having greater indirect experience with coronavirus, having an essential job or job outside the home, greater prevention behavior regulations, and perceiving the outbreak as severe in one's state all associated with higher Time 2 prevention behavior and public health behavioral willingness (ps ≤ .049). Hispanic ethnicity, sexual orientation, education level, and geographic area were not significantly associated with either Time 2 outcomes and were not included in further analyses (ps ≥ .084; see Supplemental Table for a full description of bivariate analyses).

For only Time 2 prevention behavior, county infection rate and race emerged as putative covariates and were included in the prevention behavior hypothesis test. County infection rate was positively associated with greater engagement in prevention behavior (r = .13, p = .001). Significant race differences emerged for prevention behavior (p = .012); post-hoc Scheffe's tests revealed that African Americans (M = 4.31, SD = .69) engaged in greater prevention behaviors compared to Whites (M = 4.06, SD = .78; p = .035). For only Time 2 public health behavioral willingness, social class emerged as a putative covariate and was included in the public health behavioral willingness hypothesis test; higher social class was associated with higher public health behavioral

Table 2. Bivariate Associations and Descriptive Statistics of Prototype Willingness Model Constructs (*N*s = 733–738)

Variables	1	2	3	4	5	6
(1) Perceived vulnerability of coronavirus (Time 1)	--					
(2) Prevention behavior descriptive norms (Time 1)	−.01	--				
(3) Prototypes of prevention behavior (Time 1)	−.03	.20**	--			
(4) Prevention behavior intention (Time 1)	.08*	.40**	.27**	--		
(5) Prevention behavior engagement (Time 2)	.08*	.37**	.20**	.80**	--	
(6) Public health behavior willingness (Time 2)	.14**	.30**	.23**	.43**	.41**	--
M	25.55	3.80	4.10	4.27	4.11	4.03
SD	22.82	.89	.63	.75	.77	.93
Observed range	0–100	1–5	1.75–5	1–5	1–5	1–5
Possible range	0–100	1–5	1–5	1–5	1–5	1–5
n	738	738	733	738	738	738

Note: All Prototype Willingness Model constructs are coded such that higher numbers indicate more/greater of the variable. *$p < .05$; ** $p < .0001$.

willingness ($r = .09$, $p = .021$; see Supplemental Table for a full description of bivariate analyses).

For Prototype Willingness Model constructs, bivariate correlations revealed that perceived vulnerability, descriptive norms, and prototypes all positively correlated with prevention behavioral intention, Time 2 prevention behaviors, and Time 2 public health behavioral willingness (see Table 2). Time 2 prevention behaviors and Time 2 public health behavioral willingness were also positively associated ($r = .41$, $p < .001$; see Table 2).

Hypothesis Testing—Prevention Behavior

We explored whether perceived vulnerability, descriptive norms, and prototypes were associated with Time 2 prevention behavior through increases in behavioral intention while controlling for putative covariates (see Fig. 1). Results for the overall model were significant, $F(18, 705) = 92.20$, $p < .001$, $R^2 = .70$, and demonstrated that behavioral intention was directly associated with prevention behavior 2 weeks later (b = .3604, se = .0429, $t = 8.41$, $p < .001$, CI: .2762–.4445). Perceived vulnerability was not directly associated with intention ($p = .187$) and was neither directly ($p = .234$), nor indirectly (ab = .0003, se = .0002, CI: −.0001–.0008) associated with prevention behavior.

For social cognitions, descriptive norms were associated with greater prevention behavior indirectly (ab = .0146, se = .0073, CI: .0009–.0300) through increased behavioral intention (b = .0406, se = .0173, $t = 2.34$, $p = .019$, CI: .0066–.0747), but descriptive norms were not directly associated with prevention behavior ($p = .606$). Similar to descriptive norms, favorable prototypes were associated with prevention behavior indirectly (ab = .0365, se = .0117, CI: .0155–.0612) through greater behavioral intention (b = .1012, se = .0231, $t = 4.38$, $p < .001$, CI: .0558–.1466), but were not directly associated with prevention behavior ($p = .811$). These results show that greater descriptive norms of prevention behavior and favorable prototypes were associated with greater intentions to engage in those behaviors and, in turn, greater engagement in coronavirus prevention behavior (see Fig. 1).

Hypothesis Testing—Public Health Behavioral Willingness

Next, we examined the effects of perceived vulnerability, descriptive norms, and prototypes on Time 2 public health behavioral willingness through increases in prevention behavioral intention while controlling for putative covariates. Results for the overall model were significant, $F(15, 715) = 21.49$, $p < .001$, $R^2 = .31$, and prevention behavioral intentions had a direct effect on public health behavioral willingness two weeks later (b = .4562, se = .0782, $t = 5.83$, $p < .001$, CI: .3026–.6098). Again, perceived vulnerability was not directly associated with behavioral intention ($p = .221$) and was neither directly ($p = .079$) nor indirectly associated with public health behavioral willingness (ab = .0004, se = .0003, CI: −.0002–.0010).

For social cognitions, descriptive norms had a direct (b = .1160, se = .0366, $t = 3.17$, $p = .002$, CI: .0442–.1879) and indirect (ab = .0206, se = .0100, CI: .0029–.0426) effect on public health behavioral willingness through greater behavioral intentions (b = .0453,

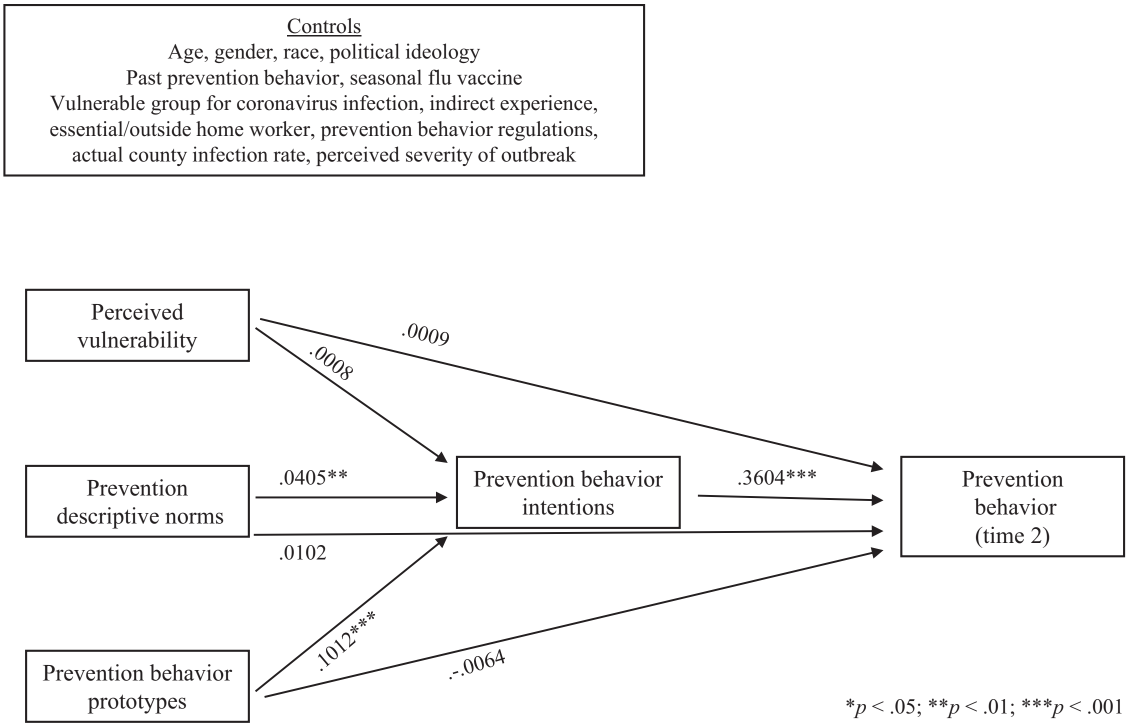

Fig 1. Prototype Willingness Model mediation predicting coronavirus prevention behavior, N = 724. *Note:* Prevention behavior includes handwashing, social distancing, mask-wearing, and sanitizing groceries. Figure displays unstandardized bs.

Descriptive norms (ab = .0146, se = .0073, CI: .0009–.0300) and favorable prototypes (ab = .0365, se = .0117, CI: .0155–.0612) associated with prevention behavior indirectly through greater behavioral intentions.

se = .0174, t = 2.60, p = .010, CI: .0111–.0794). Similar to descriptive norms, more favorable prototypes had a direct effect on public health behavioral willingness (b = .1189, se = .0486, t = 2.45, p = .015, CI: .0234–.2143) and an indirect effect (ab = .0481, se = .0156, CI: .0210–.0815) through increased prevention behavioral intentions (b = .1055, se = .0229, t = 4.61, p < .001, CI = .0606–.1505). These results show that descriptive norms and prototypes have both a direct effect on future public health behavioral willingness and an indirect effect through increased prevention behavioral intentions (see Fig. 2).

Discussion

The present results demonstrate the power of social cognitions in predicting coronavirus prevention behaviors at the beginning of the pandemic. Descriptive norms (of behavioral prevalence in close social referent groups) and favorable prototypes (of the typical person who engages in coronavirus prevention) predicted handwashing, social distancing, mask-wearing, and grocery sanitizing behavioral intentions, which in turn predicted engagement in these behaviors and behavioral willingness to engage in emerging public health behaviors (e.g., contact tracing cooperation) 2 weeks later. Additionally, descriptive norms and prototypes directly predicted increased public health behavioral willingness. Perceived vulnerability was not significantly related to either behavioral decision cognitions or behavior. These results held across demographics, past behavior, and coronavirus-contextual factors among a sample of adults reflective of the United States population. In sum, social cognitions derived from the Prototype Willingness Model are influential drivers of behavior early in a pandemic context and findings present implications for both psychological theory and pandemic public health applications.

The findings for descriptive norms predicting preventive behaviors parallel research demonstrating (a) cross-sectional relations between descriptive norms and behavioral intentions for pandemic prevention behaviors [19], (b) cross-sectional relations between descriptive norms and prevention behaviors (e.g., handwashing, mask-wearing, and social distancing [20, 21]), and (c) longitudinal relations between behavioral intentions and coronavirus prevention behaviors [22]. The present findings improve upon existing knowledge showing descriptive norms' prospective, indirect influence on future behavior *through* behavioral intentions. Before widespread mandates (e.g., masks), descriptive norms likely functioned as "social proof," providing guidance

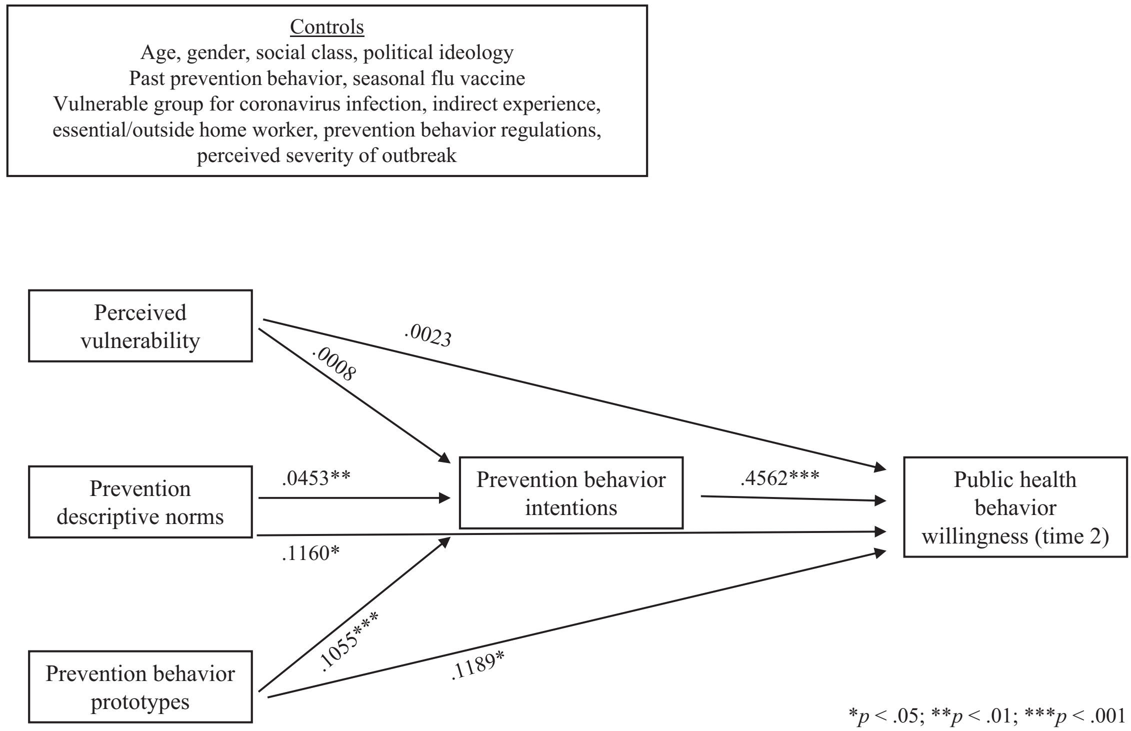

Fig. 2. Prototype Willingness Model prevention behavior mediation predicting willingness to engage in public health behavior, $N = 731$. *Note:* Prevention behavior cognitions (descriptive norms, protototypes, behavior intentions) include handwashing, social distancing, mask-wearing, and sanitizing groceries Public health behavioral willingness includes cooperation with public health worker contact tracing, smartphone application contact tracing, and temperature checks. Figure displays unstandardized bs.

Descriptive norms (ab = .0206, se = .0100, CI: .0029–.0426) and favorable prototypes (ab = .0481, se = .0156, CI: .0210–.0815) associated with public health behavioral willingness indirectly through greater prevention behavioral intentions.

during the early, uncertain weeks of coronavirus-risk [47]. Perceiving high handwashing, social distancing, mask-wearing, and grocery sanitizing among one's family, friends, and community likely signaled that these behaviors were "right" if one perceived that most other people were doing them. Our results suggest prevalence estimations of coronavirus prevention behaviors did not passively translate to more behavior but influenced greater future prevention indirectly through a contemplative process, increasing planful behavioral intentions, which dovetails with emerging research grounded in the Theory of Planned Behavior demonstrating that *subjective* norms influence coronavirus prevention behavior through behavioral intention [48–50].

Results also reveal the power of descriptive norms as cognitive antecedents of emerging public health behaviors; perceptions of normative prevention participation of friends, family, and community members increased future willingness to participate in emerging public health behaviors including contact tracing (Center for Disease Control provided funding for 64 health departments to roll out contact tracing in May 2020 [51]), smartphone application contact tracing (introduced in Virginia in August 2020 [52]), and customer temperature checks (first required at some retailers and shops during the first wave of reopens in late April 2020 [53]; later recommended at the federal and various state levels by early May 2020 [54, 55]). Results reflect the multiple behavior change perspective in theories of multiple behavior adoption [56], perceiving high prevalence of community participation in early pandemic prevention behavior can then increase openness to participate in other developing prevention behaviors. Higher normative perceptions of prevention behaviors early in a pandemic can enhance future prevention behavior through two routes: (a) enhancing intentions and downstream behavior for parallel behaviors in a contemplative process, (b) enhancing openness to engaging in emerging public health behaviors downstream via a heuristic process. In short, greater normative perception of prevention participation may have synergistic impact as public health leaders aim to promote emergency prevention actions (e.g., handwashing, social distancing) and ensure readiness for behaviors to come over the course of pandemic containment (e.g., contact tracing).

Alongside descriptive norms, favorable prototypes played an important role in coronavirus prevention behavior through increases in behavioral intention. These are the first known results demonstrating the role of prototypes in respiratory illness prevention, let alone pandemic-prevention behaviors, and demonstrate that prototypes are important for this behavioral domain. Results support earlier findings that favorable health-promotive prototypes predict health-promotive behavioral intentions [9]. The coronavirus pandemic presented a crucial opportunity to address calls for increased research applying prototypes to greater health promotive behaviors [9, 24], and revealed that coronavirus prevention prototypes related more directly with behavioral cognitions and behaviors than descriptive norms, their more widely researched, social-cognitive sibling. Theoretically, prototypes are reflexive, shaped by the social environment, and siphon distal social milieu (e.g., culture, advertisements, media representation/social media [57–59]) to heuristic openness to specific behaviors. Impressions of the typical person who engages in a behavior influence behavioral uptake through a social comparison process, behaviors can signal the kind of person we are to both our sense of self and social groups; for example, whether or not one felt positive about a specific mask may have had less of an influence on behavioral intentions than if one felt that the typical mask wearer was responsible and smart, informing a goal-state to integrate these characteristics into one's sense of self [9].

Contrary to expectations, our results revealed that perceived vulnerability did not predict coronavirus prevention behavioral cognitions and behaviors, although we did find bivariate relations between perceived vulnerability and prevention behavior participation (see Table 2). The present results mirror emerging research applying the Prototype Willingness Model to new health interventions, showing that social cognitions relate more strongly to decision cognitions [11]. Perceived vulnerability may also be important long term; perceived vulnerability predicted maintaining social distancing after reopenings (April to July 2020; [60]). Perceived vulnerability, as proscribed by the Prototype Willingness Model, captures one specified cognition within the domain of risk perceptions. Future research should investigate how affective and cognitive risk [61] predicts coronavirus prevention behaviors, including vaccination intentions [15].

Several strengths of the study render these conclusions particularly compelling regarding directional inference and external validity. The study was representative, high-powered, and addressed data quality through attention checks. The findings controlled for baseline behavior participation along with a thorough cache of relevant covariates based on both individual and contextual/societal levels, including real-time characteristics relevant for coronavirus prevention social cognitions, behavioral decision cognitions, and behaviors (e.g., prevention regulations experienced at the individual level). Most importantly, the study was longitudinal with high retention rates, and captured mediational pathways to future behavior during a timeframe broad enough for opportunities to perform prevention behaviors, but short enough to constrain historical influence of exogenous events on behavioral patterns.

Limitations

The study is not without limitations. First, while the sample matched the United States population on age, gender, and race, additional targeted recruitment and survey translation is essential in future research to ensure representation of marginalized groups and inclusion of Spanish speakers in the United States (see the COVID-19 Equity Research Initiative [62, 63]). Second, behavior was measured with self-report data, and while self-report is a robust method for assessing behavior, recall can be influenced by context and self-presentation motivations, especially for moralized behavior [64, 65]. While objective behavior assessment can incorporate wearable monitors (e.g., actigraphs), creative assessments for population-level social distancing via cell phone movement [28] or individual behavior using geographic ecological momentary assessment, a method that embeds global positioning software tagging participants' objective geography [66], could be employed to corroborate self-report social distancing behavior. Third, these findings captured a two-week period at the beginning of the pandemic and both behavioral recommendations and adherence changed throughout the pandemic. As transmission research emerged, the CDC revised their recommendations in ways more specified than some questions in the prevention behavior construct (e.g., distances of social distancing, sanitation guidance [4]). Since completing the study, growing consensus and psychometric validation around coronavirus prevention behavior measurement has emerged and continuing projects on coronavirus prevention should include validated self-report behavioral measurement [67] alongside objective behavior assessment.

Future directions

There are several promising future directions for this research. First, future research should assess nascent willingness and novel behavior uptake to determine whether behavior-adjacent Prototype Willingness Model cognitions influence behavior cross-over at historical inflection points. Second, ecological momentary assessment can capture daily influences of perceived vulnerability, descriptive norms, and prototypes on behavior [68], real-time impact of media campaigns on norms and prototypes [69], or social-contextual normative influence on behavioral choices across varied social settings [70]. Initial ecological momentary assessment coronavirus research has focused on the impact of social distancing and isolation on wellbeing behaviors (e.g., fruit and vegetable consumption, fast food consumption, exercise activity [71, 72]), and could be expanded to prevention behaviors (e.g., handwashing, mask-wearing, and social distancing). Third, future studies should also examine distal influences that shape social cognitions (descriptive norms and prototypes), such as media influence/consumption (e.g., pandemic-related internet use and prevention behavior [26]), social media [73], exposure to public health service announcements (e.g., governmental officials and celebrities [74]), and government laws [49]. Fourth, future research should integrate behavior-specific beliefs with Prototype Willingness Model constructs to determine their additional contribution to behavior uptake. For example, as the pandemic unfolded, pseudoscience beliefs predicted social distancing nonadherence after stay-at-home orders were lifted [60] and privacy concerns predicted underwhelming phone application contact tracing participation [75].

Applications

The present results provide a useful theoretical framework for informing community interventions. First, we found that descriptive norms predicted prevention behaviors which is consistent with past research showing that descriptive norms can be used successfully in public health messages to encourage prevention behavior [76] and drive behavioral participation when the behaviors are normative [5]. Personalized normative feedback, a brief intervention to correct inaccurate prevalence estimations, is an effective intervention for various health domains and influences behavior change via prototypes [77]. Normative messages can also be integrated into field-based interventions, like during the H1N1 pandemic when hand sanitizing stations randomly assigned to include a social norms message were used 44.3% more compared to stations without normative information [78].

Second, the present results showed that prototypes predicted behavioral outcomes; like descriptive norms, prototypes are malleable (see [9] for a list of studies with experimental manipulation of prototypes). One community intervention focused on enhancing positive images of mask-wearers was the Philadelphia Department of Health #maskupphilly messaging campaign launched summer 2020 [79]. The campaign displayed large images of people wearing masks in public venues (e.g., billboards, buses, leaflets at meal pick up location sites and in houses of worship, and by adapting several community murals so that mural subjects donned masks) and program evaluation data revealed increases in Philadelphia resident mask-wearing of approximately 16% in retail stores and 42% on city streets [80]. With both descriptive norm and prototype-based messaging interventions, it is important to portray messengers as similar in age and identity to targeted groups, as this enhances message efficacy [76]. Psychological scientists should continue to partner with public health initiatives to enhance application of psychological behavior change approaches [81].

Conclusions

At the time of submitting this manuscript, over 500,000 people living in America have died from coronavirus and prevention behaviors remain crucial in the collective effort to control the virus as vaccinations are distributed and mutations emerge [2]. From the past (H1N1, Ebola), to the present (COVID-19, HIV), to the next pandemic to come, it is essential to understand what drives prevention behavior and build a foundation of knowledge regarding forces that shape behavior as pandemics unfold [6]. Our results present a compelling case to integrate the Prototype Willingness Model into pandemic prevention; in particular descriptive norms and prototypes are malleable social cognitions that contribute to prevention behavior across demographic differences, geographic areas, and regionalized virus severity. While social closeness is the very avenue through which COVID-19 spreads, harnessing the power of social perceptions is key to enhancing behavioral prevention, virus suppression, and saving lives.

Supplementary Material

Supplementary material is available at *Annals of Behavioral Medicine* online.

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Compliance with Ethical Standards

Authors' Statement of Conflict of Interest and Adherence to Ethical Standards Laurel M. Peterson, Marie Helweg-Larsen, and Sarah DiMuccio declare that they have no conflict of interest. All procedures, including the informed consent process, were conducted in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000.

Authors' Contributions All authors were involved in the preparation of this manuscript and read and approved the final version.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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

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