Cultural influence on COVID-19 cognitions and growth speed: the role of collectivism

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Abstract

Major challenges faced by humans often require large-scale cooperation for communal benefits. We examined what motivates such cooperation in the context of social distancing and mask wearing to reduce the transmission intensity of the novel coronavirus. We hypothesized that collectivism, a cultural variable characterizing the extent that individuals see themselves in relation to others, contributes to people's willingness to engage in these behaviors. Consistent with preregistered predictions, across three studies (n=2864), including a U.S. nationally representative sample, collectivist orientation was positively associated with intentions, positive beliefs, norm perceptions, and policy support for the preventive behaviors. In separate analyses at the country level (n=69 countries), more collectivist countries demonstrated lower growth rate in both COVID-19 confirmed cases and deaths. Together, these studies demonstrate the positive role of collectivism at the individual- and country-level in reducing COVID-19 transmission, and highlight the need to consider culture in public health policies and communications.

Keywords: COVID-19; Collectivism; Social dilemma; Cooperation; Culture; Prevention paradox

Introduction

Since the outbreak of 2019 coronavirus pandemic (COVID-19), public health organizations have recommended several nonpharmaceutical practices (e.g., social distancing and mask wearing) intended to reduce infectious contacts between people (Wang et al., 2020). Even as a vaccine for COVID-19 becomes more widely available, these practices are important in preventing further spread of SARS-COV-2, and will also be vital in future analogous situations. Although there is scientific evidence supporting the effectiveness of these practices (Aiello et al., 2008; Betsch et al., 2020; Lewnard & Lo, 2020), they are not universally adopted. This is partly because these practices inherently involve individual sacrifice for the health and wellbeing of others and the community. For instance, social distancing may keep family and friends apart, and mask wearing can bring discomfort. These preventive practices can be seen as social dilemmas in which short-term self-interest is at odds with longer-term collective interests (Bogaert et al., 2008; van Dijk et al., 2013). They can also be understood as the "prevention paradox", in which a population-based preventative health measure that brings large benefits to the community (e.g., mass immunization) appears to benefit participating individuals relatively little (Rose, 2008).

What factors may influence people's beliefs, intentions, and policy support related to these preventive behaviors? The focus of the current investigation is on the role of individualism-collectivism (I-C), a cultural construct that reflects the extent to which people and societies value relationships and working together to achieve collective goals (Hofstede, 1980). Although I–C was originally conceptualized to refer to societal characteristics, it has also been used to distinguish between people with collectivistic and individualistic dispositions within the same society (Kim et al., 1994; Singelis, 1994). One of the most widely used participant-level

measures for I-C is the self-construal scale (Singelis, 1994), which reflects the way that individuals view themselves as being separate from (i.e., independent, or individualist self-construal) or connected to (i.e., interdependent, or collectivist self-construal) their social environment. Individualists tend to see themselves as unique and distinct from the group, and tend to value individual achievements. Collectivists tend to conceptualize themselves within the context of their social surroundings and appreciate connectedness.

We theorize that I-C could contribute to peoples' cognitions and behaviors related to preventive practices during COVID-19 in two ways: cooperation and social norm conformity. First, prior studies highlighted that collectivism is a strong predictor of cooperative behavior in social dilemmas (Marcus & Le, 2013), as collectivists take the interests of others more strongly into account, rather than focusing predominantly on their own individual interests (Arnocky et al., 2007; Utz, 2004; Wagner, 1995). In addition, participants primed with collectivist self-construals show higher levels of cooperation compared to participants who were primed with individualist self-construal (Utz, 2004). In real-world social dilemmas, such as environmental protection, stronger collectivist self-construal is associated with more positive attitudes toward resource cooperation (Arnocky et al., 2007). In the context of the COVID-19 pandemic, in addition to social distancing and mask wearing, cooperative behaviors could include: (1) prosocial behaviors aimed at helping others during the pandemic, and (2) supporting public policies aimed to help vulnerable populations. As such, collectivism may contribute to positive cognitions surrounding nonpharmaceutical preventive practices and prosocial behaviors through greater concerns for the collective benefit.

Second, differences in I-C can also influence behaviors by increasing the speed at which groups of people establish social norms about the "correct" ways to behave. Perceived social

norms encompass what people perceive others are doing (i.e., descriptive norms) as well as perceptions of whether a behavior is approved by others (i.e., injunctive norms). Establishing health behavior norms is important because perceived social norms are a key precursor of behavioral intentions (Ajzen, 1985). As people adopt new behaviors in response to the COVID-19 pandemic, a new set of norms are forming. Prior work demonstrated that people from collectivist societies may be faster at adopting new trends compared to people from individualistic societies (De et al., 2018; Muthukrishna & Schaller, 2020). This is in part driven by collectivists' sensitivity to the behavior of others around them and the tendency to be surrounded by others with collectivist self-construals (i.e., homophily; Jacobson, 2010; Liu et al., 2017). In the context of COVID-19, this may result in stronger perceived norms related to preventive behaviors in people with collectivistic self-construals.

To summarize, theory and empirical evidence suggest that people with stronger collectivist cultural construals may hold more favorable intentions, beliefs, perceived social norms, and policy support related to behavioral prevention practices due to higher tendencies for cooperation and norm observation. In turn, at the societal level, more collectivist countries may show more effective responses to the pandemic. As such, the current study aims to investigate the role of collectivism in shaping peoples' cognitions related to prevention behaviors at an individual level, as well as influencing the COVID-19 growth rate at a societal level.

Overview of the Studies

We conducted four studies between April and July 2020 to investigate the link between cultural collectivism and people's cognitions related to the prevention behaviors, as well as country-level growth rate in COVID-19 confirmed cases and deaths. Study 1 (n=846) examined the link between collectivism and cognitions surrounding social distancing. Study 2 (n=844;

preregistered at [link blinded for review]) investigated the association between collectivism and cognitions surrounding social distancing and prosocial behaviors. Study 3 (n=1063; preregistered at [link blinded for review]) included an U.S. nationally representative sample and demonstrated that collectivism was associated with more positive cognitions social distancing, mask wearing, and vaccination. Finally, Study 4 utilized publicly datasets to test the hypothesis that COVID-19 growth rate will be higher in individualist countries compared to collectivist countries.

Study 1

Study 1 aimed to examine the relationship between participants' individual-level collectivism and their cognitions related to social distancing.

Study 1 Methods

Participants

1103 U.S. participants were recruited from Amazon Mechanical Turk (Mturk) between April 4th and 6th, 2020 as part of a larger research project about COVID-19 message framing effects (see Supplemental Materials). Each participant provided informed consent, and this study was approved by the Institutional Review Board at the University of Pennsylvania. Two hundred and thirty-eight participants were excluded according to criteria we specified prior to data analysis (OSF link blinded for review). An additional 19 participants were excluded for having no variance in the I-C measure. A final sample of 846 participants were included in the current study. On average, participants were between 19 and 74 years old (Mean=37.7, Median=35, SD=11.4), mostly white (72.81%; African American: 15.60%; Asian: 7.80%; American Indian or Alaska Native: 1.06%), male (55.1%; female: 44.3%; other: 0.35%), and the majority had at least some college education (90.4%; high school graduate: 9.10%; less than high school: 0.47%).

Measures

Individualism/Collectivism self-construal scale. Due to online survey length limitations, we used an adapted version of the self-construal scale to measure participants' collectivism and individualism tendencies. This adapted version of the scale included four items to measure collectivism (Omega=0.73) and four items to measure individualism (MacDonald's Omega=0.71). We collected an independent sample of participants (n=48) to validate this adapted measure (supplemental materials).

Social distancing intentions. Individuals' intention to practice social distancing was measured on a seven-point scale (definitely won't - definitely will) and averaged across the following four items (MacDonald's Omega=0.84; Methodology Document).

Social distancing beliefs. Individuals' beliefs about social distancing being an effective tool at preventing the spread of COVID-19 were measured on a seven-point scale (strongly disagree - strongly agree) using eight items (MacDonald's Omega= 0.96; Methodology Document).

Social distancing norm perceptions. Participants' descriptive norm perceptions regarding the proportion of people that practice social distancing was measured using the following items: *What proportion of people in your city/town will do the following things in the next two weeks?* 1. stay home and avoid all social contact, even if they are not sick; 2. limit their grocery shopping to once a week or less; 3. stay at least 6 feet apart from others when they are in public; 4) avoid all public gatherings, even if they are not sick. These items were rated on a scale between 0% and 100%. This scale achieved high internal consistency (MacDonald's Omega=0.86).

Social distancing policy support. Participants' support for public policies that enforce social distancing was measured using the following items on a seven-point scale (do not support

at all - support very much): 1) require all nonessential employees to shelter in place (i.e., stay in homes and limit travel to only essential trips) to slow the spread of the coronavirus; 2) closure of all nonessential businesses until further notice to help slow the spread of the coronavirus; 3) maintain social distancing of at least 6 feet from other people and refrain from social gatherings of more than 10 people to help slow the spread of the coronavirus. This scale achieved good internal consistency (MacDonald's Omega=0.83).

Statistical Analysis

We estimated four ordinary least square (OLS) regression models to separately investigate the associations between participant-level collectivism and each of the following outcomes: (1) social distancing intentions, (2) beliefs, (3) norm perceptions and (4) policy support. Demographic variables (age, gender, race, education, and political orientation) were included as covariates.

Given that I-C is conceptualized as one dimension at the societal level, we also computed a composite collectivism-individualism measure to match the country-level analyses (Study 4). The composite measure was calculated by subtracting the individualist self-construal ratings from the collectivist ratings. Higher scores on this composite measure therefore reflect a higher level of collectivism relative to levels of individualism. This method has been used in prior work (Li et al., 2018; Y. Ma et al., 2012; Steel et al., 2018). We also estimated four OLS models to examine the association between this combined collectivism-individualism score and social distancing intentions, beliefs, norm perceptions and policy support, controlling for age, gender, race, education, and political orientation.

All continuous predictors are mean-centered and scaled by 1 standard deviation. Multiple comparisons were corrected using the Benjamini–Hochberg procedure. For each model, we

checked that the residuals are normally distributed. All continuous predictors are mean-centered and scaled by 1 standard deviation. For Study 1 and all following studies, data were analyzed using the R statistical toolbox (Version 3.6.3; R Core Team, 2013), and all figures were constructed using the R package *ggplot2* (Version 2.2.1; Wickham, 2016).

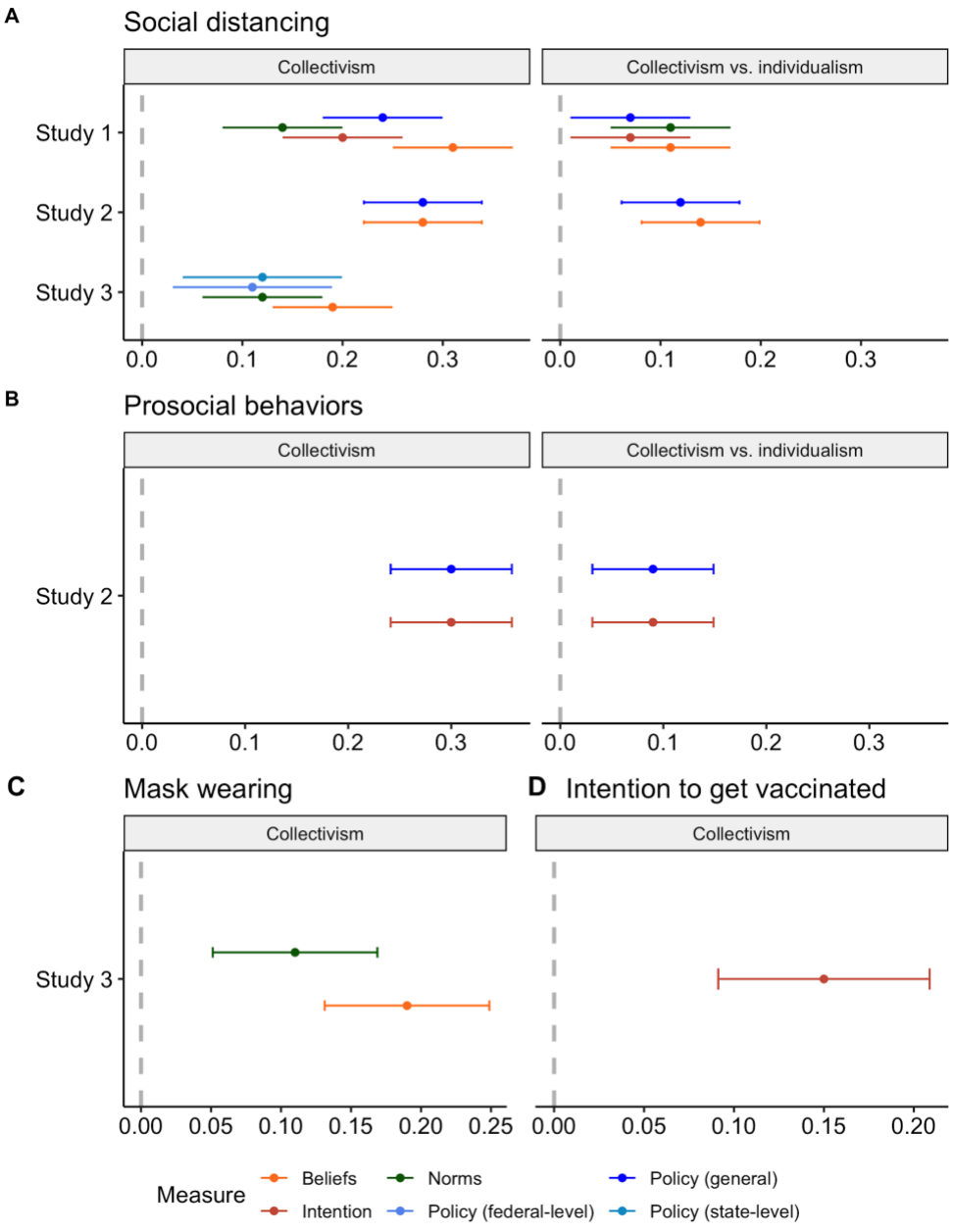
Study 1 Results

Study 1 aimed to examine the link between participants' cultural collectivism and four cognitions related to social distancing: (1) their intentions to practice social distancing ("intention"), (2) beliefs that social distancing is effective in preventing the spread of COVID-19 ("beliefs"), (3) normative perceptions about the extent to which other people are practicing social distancing ("norms"), and (4) their support for policies that enforce social distancing ("policy support"). Overall, participants showed high levels of social distancing behavioral intention (Median=6.75, Mean=6.36, SD=0.92, on a 7-point scale), norm perception (Median=73.75%, Mean=71.26%, SD=16%), beliefs (Median=6.63, Mean=6.24, SD=1.01, on a 7-point scale), and policy support (Median=6.67, Mean=6.20, SD=1.07, on a 7-point scale). Despite overall high levels of cognitions favorable to social distancing, we observed significant individual variance that was associated with individual-level collectivism. As shown in Figure 1A and Table 1, after controlling for age, gender, race, education, and political orientation, greater collectivism was positively associated with intentions (b=0.20, t(828)=5.93, 95% CI=[0.13, 0.26], $p_{adjusted} < .001$), beliefs (b=0.31, t(828)=9.32, 95% CI=[0.24, 0.37], $p_{adjusted} < .001$), descriptive norm perceptions (b=0.14, t(827)=4.19, 95% CI=[0.08, 0.21], $p_{adjusted} < .001$), and public policy support (b=0.24, t(828)=7.29, 95% CI=[0.17, 0.30], $p_{adjusted} < .001$). Multiple tests were corrected using the Benjamini and Hochberg method to reduce the false discovery rate (Benjamini & Hochberg, 1995). Robustness checks showed that these results remained statistically significant without the

covariates (Supplemental Table 2). Parallel exploratory analyses using individualism as a predictor can be found in the Supplemental Table 3-4.

Further, we estimated parallel models in which individualism and collectivism were combined into a single dimension (i.e., a composite measure in which individualist self-construal score was subtracted from collectivist self-construal score; (Li et al., 2018; Ma et al., 2012; Steel et al., 2018) to examine how the relative strength of collectivism is related to the outcome variables. After controlling for age, gender, race, education, and political orientation, the composite collectivism-individualism measure was positively associated with social distancing intentions (b=0.07, t(828)=2.11, 95% CI=[0.01, 0.14], p=.035), beliefs that social distancing is effective (b=0.11, t(828)=3.35, 95% CI=[0.05, 0.18], $p_{adjusted}$=.001), norm perceptions (b=0.11, t(827)=3.16, 95% CI=[0.04, 0.17], $p_{adjusted}$=.002), and support for policies that enforce social distancing (b=0.07, t(828)=2.23, 95% CI=[0.01, 0.14], $p_{adjusted}$=.030). See Figure 1A and Table 2 for details. Robustness checks showed that these results were similar without covariates (Supplementary Table 5). These results indicate that on average, individuals who are relatively more collectivist than individualist have more positive social distancing cognitions (intentions, beliefs, and norm perceptions) and policy support. Therefore, Study 1 results provided support that people's collectivist self-construal was positively associated with their cognitions (beliefs, behavioral intentions, and norm perceptions) and policy support for social distancing.

Figure 1. Regression coefficient plots showing the standardized coefficients of I-C measures (collectivism and the composite score) predicting cognitions surrounding (A) social distancing, (B) prosocial behaviors, (C) mask wearing, and (D) vaccination.



Study 2

Study 2 (preregistered at [link blinded for review]) aimed to replicate Study 1 findings on social distancing. We also examined how collectivism relate to people's intentions to cooperate by helping others (here termed "prosocial intentions") and supporting public policies aimed to help vulnerable groups (here termed "prosocial policy support").

Study 2 Methods

Participants

Study 2 was conducted between April 30th and May 2nd, 2020 with 1011 participants recruited from Mturk. Forty-nine participants were excluded according to pre-specified exclusion criteria in the survey (i.e., failure to pass screening survey and attention check, response invariance greater than 3SD from group mean; [link blinded for review]). Seven additional participants were excluded for having no variance in the I-C self-construal measure. A final sample of 955 participants were included in the current study. On average, participants were between 18 and 82 years old (Median=35, SD=12.74), mostly white (72.67%; African American: 12.46%; Asian: 9.63%; American Indian or Alaska Native: 0.73%) and male (50.99%; female: 48.38%; other: 0.10%).

Measures

The measures used in the current study included collectivism and individualism self-construals (measured using an adapted version of the self-construal scale; Singelis, 1994), social distancing beliefs, social distancing policy support, prosocial behavioral intentions, and prosocial policy support.

Individualism/Collectivism self-construal scale. To minimize participant burden, I-C was measured using an adapted self-construal scale, in which five items were selected from the

original twelve items to measure individualist self-construal, and five items were selected from the original twelve items to measure collectivist self-construal (Park & Kitayama, 2014; Singelis, 1994). This adaptation of the scale was different from Study 1 in order to test whether the associations observed in Study 1 were dependent on the items selected. The self-construal measures achieved satisfactory internal consistency (MacDonald's $omega_{collectivism}$=0.65, MacDonald's $omega_{individualism}$=0.67), and were included in Methodology Document.

Social distancing beliefs. Same as Study 1 (MacDonald's omega=0.97).

Social distancing policy support. Same as Study 1 (MacDonald's omega=0.89).

Prosocial behavioral intentions. Individuals' prosocial behavioral intentions (e.g., intention to help friends and family who are financially struggling) were measured on a seven-point scale (definitely won't – definitely will) using seven items (MacDonald's omega=0.89; Methodology Document) and were averaged across items.

Prosocial policy support. Participants' support for prosocial public policies (e.g., expand access to food assistance programs) were measured on a seven-point scale (do not support at all - support very much) using eleven items (MacDonald's omega=0.90; Methodology Document) and were averaged across items.

Statistical Analysis

Similar to Study 1, and consistent with our pre-registration, we estimated four ordinary least square (OLS) regression models to separately investigate the association between collectivism and social distancing beliefs, social distancing policy support, prosocial behavior intention, and prosocial policy support.

As in Study 1, we constructed a composite measure to examine to what extent the relative strength of collectivism (as opposed to individualism) is associated with the outcome variables

by subtracting the individualism score from the collectivism score. We estimated four ordinary least square regression models to examine the association between this composite score and social distancing beliefs, social distancing policy support, prosocial behavior intention, and prosocial policy support.

As stated in the preregistration, for each of the models above, we would first test if condition, age, gender, race, and job status change are significantly associated with the respective DV. If so, they would be included as covariates in the model. We also conducted robustness checks with models with no covariates (see Supplemental Tables 4-5). All continuous predictors are mean-centered and scaled by 1 standard deviation. For each model, we checked that the residuals are normally distributed. Multiple comparison was corrected using the Benjamini–Hochberg procedure.

Study 2 results

Overall, Study 2 participants reported high levels of social distancing beliefs, social distancing policy support, and prosocial policy support, and moderate prosocial intentions (Supplemental Table 1). First, with regard to social distancing cognitions, the results of Study 2 replicated Study 1 findings; collectivism was positively associated with beliefs that social distancing is effective at preventing the spread of COVID-19 and support for policies that enforce social distancing (Figure 1A; Table 3). Further, relatively higher collectivism compared to individualism was positively associated with beliefs that social distancing is effective ($b=0.14$, $t(899)=4.38$, 95% CI=[0.08, 0.20], $p_{adjusted} < .001$; Figure 1A, Table 4) and support for policies that enforce social distancing ($b=0.12$, $t(900)=3.60$, 95% CI=[0.05, 0.18], $p_{adjusted} < .001$; Figure 1A, Table 4). These findings replicated Study 1 and added further evidence that people's propensity for collectivism (relative to individualism) is positively associated with beliefs that

social distancing is effective in preventing COVID-19 and support for social distancing government policies. Robustness checks show that these results remained statistically significant without the covariates (Supplemental Table 6). Parallel exploratory analyses using individualism as a predictor can be found in the Supplemental Table 7-8.

Second, our results demonstrate that collectivist orientations were positively associated with prosocial intentions and policy support (Figure 1B; Table 3). Further, the relative collectivism-individualism score was positively associated with prosocial behavioral intention ($b=0.10$, $t(945)=3.17$, 95% CI=[0.03, 0.15], $p_{adjusted=}.002$; Figure 1B, Table 4) and policy support ($b=0.09$, $t(900)=2.83$, 95% CI=[0.03, 0.15], $p_{adjusted=}.005$; Figure 1B, Table 4). In other words, people who have relatively higher collectivist tendencies also reported higher levels of prosocial intentions and policy support. Robustness checks show that these results were also statistically significant without the covariates (Supplemental Table 9). Therefore, Study 2 replicated Study 1 findings on the link between collectivist self-construals and cognitions related to social distancing, and showed that people with higher collectivist self-construal had higher intentions to cooperate during the pandemic.

Study 3

One limitation regarding both Study 1 and Study 2 is that participants were recruited through Mturk, and may not represent the population they are sampled from (Walters et al., 2018). As such, the main aim of Study 3 (preregistered at [link blinded for review]) is to replicate findings from Studies 1 and 2 on social distancing in a U.S. nationally representative sample, and additionally examine cognitions related to mask wearing and vaccination

Study 3 Methods

Participants

Study 3 was conducted between May 26th and June 11th, 2020. This study included a sample of 1074 participants representative of U.S. adults 18 years or older, collected by the Social Science Research Solutions (SSRS) opinion panel. Data were collected through online surveys as well as phone interviews. This sample included residents from each U.S. state. Survey weights were developed by SSRS and were used to ensure that participants matched the U.S. population on key demographic variables (parallel analyses using unweighted sample are included in the Supplemental Materials). Additional descriptions on this study are published here [citation blinded for review]. On average, participants were between 18 and 99 years old (Mean=51.82, Median=51, SD=19.73,), mostly white (70.11%; African American: 14.99%, Asian: 3.54%, American Indian or Alaska Native: 0.74%), female (51.30%, male: 48.42%). On average, participants received 14.79 (SD=2.75) years of education.

Measures

In Study 1 and Study 2, we measured both collectivism and individualism orientations in the participants, and found that collectivism is an overall stronger predictor for all outcome variables. As such, we focused exclusively on collectivism and did not examine individualism in Study 3.In addition, Study 1 examined the effect of I-C on people's descriptive norm perceptions surrounding social distancing. In Study 3, we examined the effect of I-C on people's injunctive norms (i.e. whether a behavior is approved by family and friends) surrounding social distancing and mask wearing. We expected to observe similar relationships with injunctive norms, such that people with higher collectivistic self-construals would perceive social distancing and mask wearing as more approved of by family and friends.

Collectivism self-construal scale. Same as the one used in Study 1 (MacDonald's omega=0.63).

Social distancing beliefs. Individuals' beliefs that social distancing is effective at preventing the spread of coronavirus were measured through the following questions on a four-point scale (strongly disagree – strongly agree): how much do you disagree or agree that if you maintain social distance every day for the next two weeks, 1. you will protect more vulnerable people in our society; 2. you will help the healthcare system so that people who need urgent medical care will receive it; 3. you will slow the spread of the coronavirus; 4. it will prevent you from transmitting coronavirus to others (MacDonald's omega=0.94).

Social distancing injunctive norms. Participants' perceptions of the injunctive norms surrounding social distancing were measured through the following question on a four-point scale (strongly disagree – strongly agree): How much do you disagree or agree that if you maintain social distance every day for the next two weeks, your family and friends will approve of your decision?

Social distancing federal-level policy support. Participants' support for federal-level social distancing policies (e.g., policies that restrict the gathering of people) was measured on a four-point scale (do not support at all - support very much) using seven items (MacDonald's omega=0.92). See Methodology Document for a list of these items.

Social distancing state-level policy support. Participants' support for state-level social distancing policies was measured on a four-point scale (do not support at all - support very much) through the following items (MacDonald's omega=0.84): 1) your state government should restrict the gathering of people to curb the spread of coronavirus; 2) your state government should move quickly in loosening restrictions on businesses (Reversed); 3) your state government should allow most businesses to re-open even if there is some risk to health (Reversed).

Mask wearing beliefs. Participants' beliefs that mask wearing is effective at preventing the spread of coronavirus were measured on a four-point scale (strongly disagree – strongly agree) through five questions (If you wear face covering in public places every day for the next two weeks: 1. you will protect more vulnerable people in our society; 2. you will help the healthcare system so that people who need urgent medical care will receive it; 3. you will slow the spread of the coronavirus; 4. it will prevent you from transmitting coronavirus to others; 5. you will be less likely to get sick; MacDonald's omega=0.94).

Mask wearing injunctive norms. Participants' perceptions of injunctive norms surrounding mask wearing were measured through the following question on a four-point scale (strongly disagree – strongly agree): How much do you disagree or agree that if you wear a mask or other face covering in public places every day for the next two weeks, your family and friends will approve of your decision?

Vaccine intentions. Participants' intentions to get vaccinated was measured through the following question on a four-point scale (very unlikely – very likely): If you were able to get a vaccine for coronavirus today, what is the likelihood that you would get vaccinated?

Weight Construction

For all analyses, the Study 3 sample was weighted to correct for known biases due to sampling and non-response. Sample weights were provided by SSRS. According to SSRS, survey data are weighted to account for systematic nonresponse along known parameters such as age, race, gender, region, and education.

Statistical Analysis

Similar to Study 1 and Study 2, and consistent with the primary hypotheses outlined in the pre-registration for Study 3, we estimated seven OLS models to investigate the association

between participant-level collectivism and cognitions related to social distancing, mask wearing, and vaccination. Consistent with the preregistration, for each OLS model, we first tested if race, state, education, age, political party, and gender were significantly associated with each DV[1]. The variables significantly associated with the DV were included as covariates in the model associated with the respective DV.

We also tested the robustness of each model without covariates and found similar results (Supplemental Table 12). All continuous predictors are mean-centered and scaled by 1 standard deviation. Multiple comparisons were corrected using the Benjamini–Hochberg procedure. For each model, we checked that the residuals are normally distributed.

Study 3 Results

Social distancing cognitions. Similar to Study 1 and Study 2, participants generally reported positive cognitions related to social distancing (Table 1). Replicating the findings from Studies 1 and 2, collectivism was positively associated with beliefs that social distancing is effective (b=0.19, t(947)=6.50, 95% CI=[0.14, 0.25], $p_{adjusted} < .001$) and that social distancing is approved by family and friends (injunctive norms; b=0.13, t(947)=4.17, 95% CI=[0.07, 0.19], $p_{adjusted} < .001$; Figure 1A, Table 5). These results indicated that participants with higher collectivist self-construals tended to report stronger beliefs that social distancing is effective and that social distancing is approved by family and friends.

Results from both Studies 1 and 2 demonstrated a positive link between collectivism and support for public policies that enforce social distancing. In Study 3, we differentiated between

[1] Although we had proposed to include current job status as a potential covariate in the analysis, our collected sample included a large amount of missing value for this variable (n=452). We therefore did not include job status as a potential covariate in the main analyses. Parallel analyses that included job status as a covariate showed similar findings (Supplemental Table 11).

state-level and federal-level policy support, and examined whether collectivism was positively associated with both levels of policy support. The results indicated that collectivism was positively associated with both federal- and state-level policy support (federal-level: b=0.12, t(441)=2.97, 95% CI=[0.04, 0.21], $p_{adjusted}$=.003; state-level: b=0.12, t(451)=3.08, 95% CI=[0.04, 0.20], $p_{adjusted}$=.003; Figure 1A, Table 5). This finding replicates the results from Studies 1 and 2, suggesting that individuals who report higher levels of collectivism also report stronger support for policies that enforce social distancing at both state and federal levels. Parallel analyses that did not include covariates showed similar results (Supplemental Table 12).

Mask wearing cognitions. Consistent with our hypothesis, collectivism was positively associated with beliefs that mask wearing is effective (b=0.20, t(947)=6.54, 95% CI=[0.14, 0.26], $p_{adjusted} < 0.001$) and that mask wearing is approved of by family and friends (b=0.12, t(944)=3.80, 95% CI=[0.06, 0.18], $p_{adjusted} < 0.001$; Figure 1C, Table 5). These findings suggest that individuals with higher collectivist self-construals have stronger beliefs that mask wearing is effective and approved of by family and friends (i.e., injunctive norm perceptions). Parallel analyses that did not include covariates showed similar results (Supplemental Table 12). Together, Study 3 findings suggest that people with higher collectivist self-construal had more positive cognitions related to social distancing and mask wearing, and were more likely to support public policies enforcing these practices.

Vaccine intention. Consistent with our hypothesis, collectivism was positively associated with people's intention to get vaccinated if COVID-19 vaccines were available (b=0.17, t(942)=5.69, 95% CI=[0.11, 0.23], $p_{adjusted} < 0.001$; Figure 1D, Table 5). These findings suggest that individuals with higher collectivist self-construals have stronger intentions to get COVID-19 vaccines if they were available. Together, Study 3 findings suggest that people with higher

collectivist self-construal had more positive cognitions related to social distancing, mask wearing, and vaccination. They were also more likely to support public policies enforcing social distancing and mask wearing.

Study 4

Study 4 combined several publicly available datasets to investigate the association between country-level collectivism and the country-level growth rate of COVID-19 in 69 countries.

Study 4 Methods

Data

Numbers of newly confirmed COVID-19 cases and deaths in each country were downloaded from an open data repository hosted by the European Centre for Disease Prevention and Control (https://github.com/owid/covid-19-data). Our current results are based on data up until Nov 20th, 2020. We examined the growth rate of the COVID-19 for the first thirty days[2]. For confirmed cases, we included countries with at least 15 days of data, starting with at least 100 reported confirmed cases as "day 1" (Berg et al., 2020; Salvador et al., 2020). For deaths, we included countries with at least 15 days of data, starting with at least 5 reported deaths as "day 1".

Data for the primary independent variable, country-level collectivism, were obtained from the Hofstede Insights Cultural Dimensions Website (https://www.hofstede-insights.com/product/compare-countries/). At the societal level, individualism and collectivism are conceptualized on the same dimension, where collectivism describes societies in which

[2] Parallel analyses that used the first sixty days (instead of thirty days) of data suggested similar results to those reported in the main paper, see Supplemental Materials.

individuals form into strong, cohesive groups. On the other hand, countries that score low in collectivism are characterized by loose ties between individuals, and that everyone is expected to look after his or her immediate family.

We also included data that might plausibly be related to either individualism and COVID-19 growth rate, and thus might render the relation between individualism and COVID-19 growth rate spurious. First, several demographic factors (i.e. population, population density, and median age of the population) that might contribute to COVID-19 growth rate were included (Coro, 2020). Second, richer countries may have better medical conditions and be able to conduct more testing and better take care of the patients, thus, GDP, number of hospital beds per thousand people, and average health care spending per capita were included as control variables. Third, political regimes (i.e. authoritarian and democratic) may relate to how a government can pool resources and enforce regulations on individual behaviors (Kavanagh & Singh, 2020). We therefore included the democracy index as a control variable. Fourth, two indicators of population health were included as they may affect the susceptibility to contract the disease, including diabetic prevalence, male smoker prevalence, female smoker prevalence, and life expectancy. Fifth, we included the other cultural orientation variables provided by Hofstede as controls, including power distance, masculinity, long-term orientation, and uncertainty avoidance (Hoftede et al., 2010). Finally, as different countries are affected by COVID-19 at different times, we included the date of the "first day" of each country as a covariate.

Statistical analysis

Estimating growth rate. The growth rate of COVID-19 confirmed cases and death were estimated using an exponential growth model ($\log[y]=a * e^{r*t}$) where the y variable represents the total number of confirmed cases or death, respectively, and t refers to the day since "day 1".

Seven countries were excluded for having bad model fits when estimating growth rate (bad model fit defined as adjusted $R^2 < 0.30$). For confirmed cases, the first day in which cumulative confirmed cases was at least 100 was set as "day 1" (Berg et al., 2020). For deaths, the first death in which cumulative deaths was at least 5 was set as "day 1".

Linking collectivism with growth rate. We estimated two ordinary least square models to separately examine the role of collectivism in the growth rate of COVID-19 confirmed cases and deaths. Both models included aforementioned control variables, due to their theoretical and empirical relevance to COVID-19 growth rate. All continuous predictors were grand mean-centered and standardized. For each model, we checked that the residuals are normally distributed.

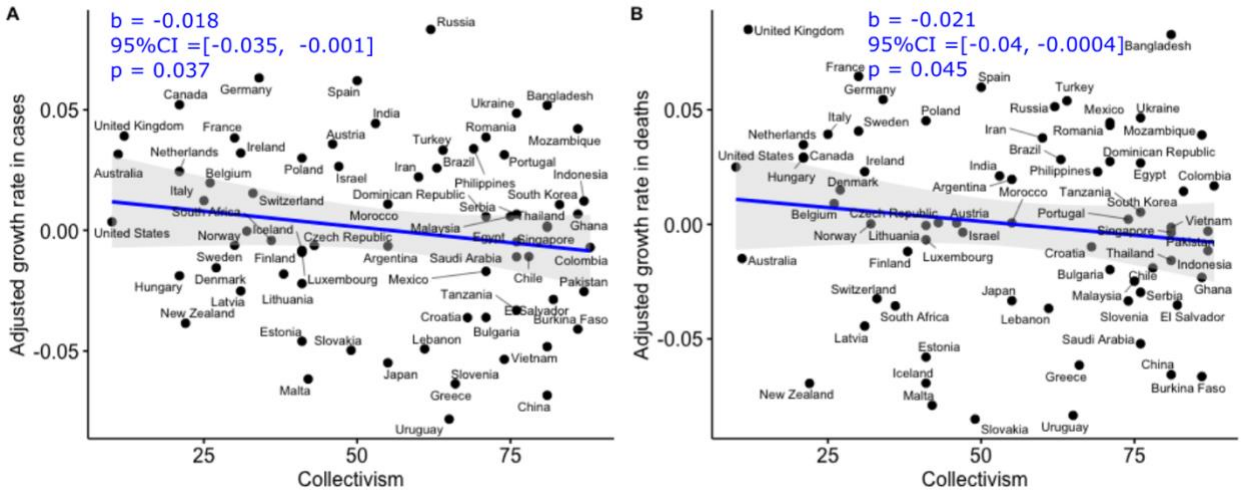
Study 4 Results

Collectivism and growth rate of confirmed cases. We first constructed an ordinary least squares regression model to examine the relation between country-level collectivism and the growth rate of COVID-19 confirmed cases, controlling for demographic and economic factors such as population and GDP (see Methods for details). There was a significant negative association between collectivism and growth rate in confirmed cases (b=-0.018, t(51)=-2.15, 95% CI=[-0.035, -0.001], p=.037; Figure 2A; Table 6a). This finding suggests that more collectivist countries tended to have lower growth rates in confirmed COVID cases, whereas more individualist countries tended to have a higher growth rate in confirmed cases in the first thirty days since day 1 (defined as at least 100 confirmed cases).

Collectivism and growth rate of confirmed deaths. In addition to confirmed cases, we also investigated the relation between country-level collectivism and the growth rate of COVID-19 confirmed deaths. Similar to growth rate of confirmed cases, our analysis suggested a

significant negative association between collectivism and growth rate in confirmed deaths (b=-0.021, t(51)=-2.05, 95% CI=[-0.04, -0.0004], p=.045; Figure 2B; Table 6b). This finding suggests that more collectivist countries tended to have lower growth rates in confirmed COVID deaths, whereas more individualist countries tended to have a higher growth rate in confirmed deaths in the first thirty days.

Figure 2. Scatter plots showing the associations between country-level collectivism and growth rates in (A) COVID-19 confirmed cases and (B) deaths, controlling for population, population density, population median age, diabetes prevalence, GDP, healthcare spending per GDP, democracy index, masculinity, uncertainty avoidance, long-term orientation.



General Discussion

Many challenges faced by humans require large-scale cooperation for long-term communal benefits at the expense of short-term self-interest. In the case of the COVID-19 pandemic, we are currently relying on large-scale cooperative behaviors (e.g., social distancing, mask wearing, and vaccination) to limit transmission (Shook et al., 2020; Van Bavel et al.,

2020). What motivates people's cooperative behavior in these social dilemmas? Across four studies, we demonstrated that collectivism, a cultural variable that characterizes the extent to which people and society value relationships and working together to achieve collective goals, was positively associated with 1) intentions to practice social distancing, prosocial behavior, and get COVID-19 vaccinations; 2) beliefs that social distancing and mask wearing are effective at preventing the spread of the disease, 3) normative perceptions that social distancing and mask wearing are both commonly practiced and approved by others; and 4) support for public policies that enforce social distancing and support vulnerable populations. In addition, collectivism at a country level was negatively associated with the growth rate of both confirmed COVID cases and deaths.

Our findings yield both theoretical and practical implications. Prior studies have demonstrated that collectivist cultural orientation is associated with higher levels of cooperation in social dilemmas (van Dijk et al., 2013), such as environmental protection and consumer choice (Arnocky et al., 2007; Mancha & Yoder, 2015; Wu et al., 2019). The current studies demonstrated that a collectivist cultural tendency is also associated with support for cooperative prevention behaviors in the context of COVID-19. Moreover, we observed positive associations between collectivism and prosocial behavioral intentions as well as policy support. Taken together, these findings provide converging evidence that collectivist cultural construal contribute to prosocial behavior and cooperation in real-world social dilemmas, where these behaviors often bring larger benefits to the community compared to each participating individual.

In addition, our results highlight another route through which collectivism could contribute to positive cognitions – a stronger perception of norms favoring prevention behaviors.

New norms are formed as people adapt their behaviors in respond to COVID-19. Our results showed that collectivists tended to report higher descriptive and injunctive norms surrounding COVID-19 preventive behaviors: they reported that more people were engaged in social distancing and wearing masks, and that these behaviors had higher levels of approval from family and friends. Both descriptive and injunctive norms are important determinants of behavioral intentions (Ajzen, 1985). With regard to cultural differences, due to sensitivity to local social norms, people with stronger collectivist self-construals may be faster at adopting new social norms (Jacobson, 2010; Takano & Sogon, 2008). The role of how quickly people adopt norms have not been extensively examined in prior studies on culture and cooperation, nor studies of public health behaviors. The current study extends previous work and highlights that, in some cases, collectivism could contribute to cooperation through stronger perceived norms.

Our success in reducing COVID-19 transmission relies on people voluntarily adopting prevention behaviors. A number of studies have investigated messaging strategies that have potential in promoting preventive behaviors in response to COVID-19 (Everett et al., n.d.; Figueroa et al., 2021; Hacquin et al., 2020; Ma & Miller, 2021; Pink et al., 2020; Sobande, 2020). The current study highlights the importance of considering culture when designing such messages. It might be fruitful to develop culturally tailored health messages for sub-populations (Kandula et al., 2012; Kreuter & McClure, 2004; Luttrell & Petty, 2020; Markus, 2016; Pasick et al., 1996). Different persuasion appeals may be differentially effective for people with individualistic vs. collectivistic cultural orientations. For example, strategies such as self-persuasion ("why would you wear a mask") and value appeals (e.g., individual health and wellbeing) were found to be more persuasive for individualists (Hornikx & O'Keefe, 2009; Li et

al., 2020), and may be particularly effective at promoting behaviors among people with stronger individualist tendencies.

As with all studies, our results should be interpreted in the context of strengths and limitations. The strengths of the current study include (1) utilizing both individual- and country-level data; (2) including a U.S. nationally representative sample; and (3) preregistering the measures, exclusion criteria, analyses, and hypotheses in Studies 2 and 3. However, given that different countries were affected by COVID-19 at different times and levels, our individual-level analyses sampled only U.S. participants, though our country-level analysis mitigates this concern to some degree. In addition, in our country level analyses (Study 4), we were not able to control for variables such as specific COVID-related policies as data was not publicly available for all countries in our analyses. To mitigate this limitation, we controlled for authoritarianism and power distance in our analyses.

In sum, our results demonstrated that individuals with predominantly collectivistic self-construal generally showed beliefs, perceived norms, and intentions more favorable to COVID-19 preventive behaviors. At the societal level, collectivistic countries showed slower growth rate in COVID-19 deaths and confirmed cases compared to individualistic countries. These findings point to the importance of considering culture when designing public policies and public health persuasion campaigns during crises like the COVID-19 pandemic that can put self-interest at odds with the common good.

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Tables

Table 1. Study 1 Ordinary Least Square model results of linking participant-level collectivism and cognitions surrounding social distancing, controlling for age, gender, race, education, political orientation, and experimental condition.

	Intentions	Beliefs	Descriptive norms	Policy support
(Intercept)	0.29 ***	0.24 **	-0.05	0.29 ***
	[0.12, 0.45]	[0.08, 0.41]	[-0.22, 0.12]	[0.13, 0.46]
Collectivism	0.20 ***	0.31 ***	0.14 ***	0.24 ***
	[0.13, 0.26]	[0.24, 0.37]	[0.08, 0.21]	[0.17, 0.30]
Age	0.13 ***	0.03	0.11 **	0.07 *
	[0.07, 0.20]	[-0.03, 0.10]	[0.04, 0.18]	[0.00, 0.13]
Gender				
(reference level: Female)				
Male	-0.31 ***	-0.18 **	0.12	-0.25 ***
	[-0.44, -0.17]	[-0.31, -0.05]	[-0.01, 0.26]	[-0.38, -0.12]
Other	0.38	-0.21	0.12	-0.13

	[-0.70, 1.46]	[-1.28, 0.86]	[-0.98, 1.22]	[-1.19, 0.93]
Would rather not say	0.29	0.83	-1.06	0.40
	[-1.04, 1.62]	[-0.49, 2.15]	[-2.42, 0.30]	[-0.90, 1.71]
Race				
(reference level: White)				
American Indian or Alaska Native	-0.23	-0.24	-0.13	-0.24
	[-0.86, 0.40]	[-0.86, 0.39]	[-0.77, 0.51]	[-0.86, 0.37]
Asian	0.14	0.11	0.11	0.19
	[-0.11, 0.39]	[-0.13, 0.36]	[-0.15, 0.36]	[-0.05, 0.43]
Black or African American	-0.03	-0.19 *	0.16	-0.13
	[-0.22, 0.15]	[-0.38, -0.01]	[-0.03, 0.35]	[-0.32, 0.05]
Native Hawaiian or Other Pacific Islander	0.72	0.24	0.68	0.17
	[-1.14, 2.59]	[-1.60, 2.08]	[-1.22, 2.58]	[-1.66, 1.99]
Other	-0.40	-0.53 **	-0.12	-0.51 *
	[-0.81, 0.01]	[-0.94, -0.13]	[-0.54, 0.30]	[-0.91, -0.11]
Education	-0.04	-0.05	0.15 ***	-0.02

	[-0.11, 0.02]	[-0.11, 0.02]	[0.09, 0.22]	[-0.08, 0.05]
Political orientation				
(reference level: Liberal)				
Conservative	-0.38 ***	-0.35 ***	0.12	-0.56 ***
	[-0.53, -0.23]	[-0.49, -0.20]	[-0.03, 0.27]	[-0.71, -0.42]
Moderate	-0.04	-0.11	-0.02	-0.15
	[-0.22, 0.14]	[-0.29, 0.08]	[-0.21, 0.17]	[-0.33, 0.03]
Experimental condition				
(reference level: no message control)				
Autonomous	0.05	0.10	-0.07	0.09
	[-0.15, 0.26]	[-0.10, 0.30]	[-0.28, 0.14]	[-0.11, 0.29]
Message control	0.00	-0.02	-0.04	0.14
	[-0.20, 0.20]	[-0.22, 0.18]	[-0.24, 0.17]	[-0.06, 0.34]
Humor	-0.09	-0.08	-0.20	0.03
	[-0.29, 0.12]	[-0.28, 0.12]	[-0.41, 0.01]	[-0.17, 0.23]
Norm	0.08	0.09	-0.07	0.04
	[-0.13, 0.28]	[-0.11, 0.29]	[-0.27, 0.14]	[-0.16, 0.24]

R^2	0.13	0.14	0.09	0.16

Note: See Supplemental Materials for details on the experimental conditions. All continuous predictors are mean-centered and scaled by 1 standard deviation. P values for the collectivism measure were adjusted.*** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Table 2. Study 1 Ordinary Least Square model results of linking the composite score (collectivism vs. individualism) and cognitions surrounding social distancing, controlling for age, gender, race, education, political orientation, and experimental condition.

	Intentions	Beliefs	Descriptive norms	Policy support
(Intercept)	0.27 **	0.21 *	-0.06	0.27 **
	[0.10, 0.44]	[0.04, 0.38]	[-0.24, 0.11]	[0.10, 0.44]
Composite score (collectivism vs. individualism)	0.07 *	0.11 **	0.11 **	0.07 *
	[0.01, 0.14]	[0.05, 0.18]	[0.04, 0.17]	[0.01, 0.14]
Age	0.13 ***	0.02	0.10 **	0.06
	[0.06, 0.20]	[-0.04, 0.09]	[0.04, 0.17]	[-0.00, 0.13]
Gender (reference level: Female)				
Male	-0.32 ***	-0.20 **	0.12	-0.27 ***
	[-0.45, -0.19]	[-0.34, -0.07]	[-0.02, 0.25]	[-0.40, -0.13]
Other	0.43	-0.12	0.18	-0.07

	[-0.67, 1.53]	[-1.24, 0.99]	[-0.93, 1.28]	[-1.16, 1.02]
Would rather not say	0.27	0.79	-1.05	0.37
	[-1.09, 1.63]	[-0.58, 2.17]	[-2.41, 0.32]	[-0.97, 1.72]
Race				
(reference level: White)				
American Indian or Alaska Native	-0.27	-0.30	-0.13	-0.29
	[-0.91, 0.38]	[-0.95, 0.36]	[-0.78, 0.51]	[-0.93, 0.34]
Asian	0.15	0.14	0.10	0.21
	[-0.10, 0.41]	[-0.12, 0.40]	[-0.15, 0.36]	[-0.04, 0.46]
Black or African American	0.03	-0.09	0.20 *	-0.05
	[-0.15, 0.22]	[-0.28, 0.10]	[0.01, 0.39]	[-0.23, 0.14]
Native Hawaiian or Other Pacific	0.70	0.21	0.64	0.15
Islander				
	[-1.19, 2.60]	[-1.72, 2.13]	[-1.27, 2.55]	[-1.73, 2.03]
Other	-0.45 *	-0.61 **	-0.14	-0.57 **
	[-0.87, -0.03]	[-1.03, -0.19]	[-0.56, 0.28]	[-0.98, -0.16]
Education	-0.02	-0.02	0.13 ***	0.00

	[-0.08, 0.03]	[-0.08, 0.03]	[0.07, 0.18]	[-0.06, 0.05]
Political orientation				
(reference level: Liberal)				
Conservative	-0.37 ***	-0.32 ***	0.12	-0.54 ***
	[-0.52, -0.21]	[-0.48, -0.17]	[-0.03, 0.28]	[-0.70, -0.39]
Moderate	-0.03	-0.09	-0.01	-0.14
	[-0.22, 0.16]	[-0.28, 0.10]	[-0.20, 0.17]	[-0.32, 0.05]
Experimental conditions				
(reference level: no message control)				
Autonomous	0.07	0.13	-0.06	0.11
	[-0.14, 0.28]	[-0.09, 0.34]	[-0.27, 0.15]	[-0.09, 0.32]
Message control	0.01	0.01	-0.03	0.16
	[-0.19, 0.22]	[-0.20, 0.21]	[-0.24, 0.17]	[-0.04, 0.36]
Humor	-0.08	-0.07	-0.19	0.04
	[-0.28, 0.13]	[-0.28, 0.14]	[-0.40, 0.01]	[-0.17, 0.24]
Norm	0.09	0.12	-0.05	0.06
	[-0.11, 0.30]	[-0.09, 0.33]	[-0.26, 0.15]	[-0.15, 0.26]

R^2	0.09	0.07	0.08	0.11

Note: See Supplemental Materials for details on the experimental conditions. All continuous predictors are mean-centered and scaled by 1 standard deviation. P values for the composite score were adjusted. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Table 3. Study 2 Ordinary Least Square model results of linking collectivism with cognitions surrounding social distancing and prosocial behaviors.

	Social distancing		Prosocial behaviors	
	Beliefs	Policy support	Intention	Policy support
(Intercept)	0.00	0.01	-0.33 ***	0.00
	[-0.10, 0.11]	[-0.10, 0.12]	[-0.43, -0.22]	[-0.11, 0.10]
Collectivism	0.28 ***	0.28 ***	0.30 ***	0.30 ***
	[0.22, 0.35]	[0.21, 0.34]	[0.24, 0.36]	[0.24, 0.36]
Gender				
(reference level: Female)				
Male	-0.26 ***	-0.27 ***		-0.28 ***
	[-0.38, -0.13]	[-0.40, -0.15]		[-0.41, -0.16]
Other	0.78	0.95		1.12
	[-1.09, 2.65]	[-0.94, 2.83]		[-0.73, 2.97]
Would rather not say	-0.42	-0.31		-0.22

	[-1.26, 0.42]	[-1.15, 0.54]	[-1.06, 0.61]
Job status			
(reference level: No change)			
Hours loss & remote change	0.30	0.43 *	0.44 *
	[-0.05, 0.64]	[0.08, 0.78]	[0.09, 0.78]
Hours reduction	-0.01	0.05	0.25
	[-0.41, 0.39]	[-0.35, 0.46]	[-0.15, 0.64]
Newly unemployed	0.31 **	0.24 *	0.43 ***
	[0.10, 0.51]	[0.04, 0.44]	[0.23, 0.63]
Remote shift	0.30 ***	0.28 ***	0.25 ***
	[0.16, 0.44]	[0.14, 0.42]	[0.11, 0.39]
Experimental condition			
(reference level: No message control)			
Expository		0.39 ***	
		[0.24, 0.53]	
Narratives		0.36 ***	

			[0.22, 0.50]	
Race				
(reference level: White)				
American Indian or Alaska Native			0.15	
			[-0.53, 0.82]	
Asian			-0.09	
			[-0.28, 0.11]	
Black or African American			0.63 ***	
			[0.45, 0.81]	
Native Hawaiian or Other Pacific Islander			0.60	
			[-1.17, 2.38]	
Other			0.12	
			[-0.16, 0.41]	
R^2	0.11	0.11	0.19	0.13

Note: See Supplemental Materials for covariate selection criteria and details on experimental conditions. P values for the collectivism measure were adjusted. For the "job status" variable, "hour loss & remote change" indicate that participant's work hours were reduced and they have shifted to remote working. All continuous predictors are mean-centered and scaled by 1 standard deviation. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Table 4. Study 2 Ordinary Least Square model results of linking the composite score (collectivism vs. individualism) with cognitions surrounding social distancing and prosocial behaviors.

	Social distancing		Mask wearing	
	Beliefs	Policy support	Intention	Policy support
(Intercept)	-0.03	-0.02	-0.36 ***	-0.04
	[-0.14, 0.08]	[-0.13, 0.09]	[-0.47, -0.25]	[-0.15, 0.08]
Composite score (collectivism vs. individualism)	0.14 ***	0.12 ***	0.10 **	0.09 **
	[0.08, 0.20]	[0.05, 0.18]	[0.04, 0.16]	[0.03, 0.15]
Gender (reference level: Female)				
Male	-0.22 ***	-0.24 ***		-0.24 ***
	[-0.35, -0.09]	[-0.37, -0.11]		[-0.37, -0.11]
Other	0.88	1.04		1.22
	[-1.05, 2.81]	[-0.90, 2.99]		[-0.71, 3.16]

Would rather not say	-0.41	-0.28	-0.20
	[-1.27, 0.46]	[-1.16, 0.59]	[-1.07, 0.67]
Job status			
(reference level: No change)			
Hours loss & remote change	0.29	0.43 *	0.43 *
	[-0.06, 0.65]	[0.07, 0.79]	[0.07, 0.78]
Hours reduction	0.08	0.14	0.34
	[-0.33, 0.49]	[-0.28, 0.55]	[-0.07, 0.76]
Newly unemployed	0.32 **	0.26 *	0.46 ***
	[0.11, 0.53]	[0.05, 0.47]	[0.25, 0.66]
Remote shift	0.30 ***	0.28 ***	0.24 **
	[0.15, 0.45]	[0.13, 0.43]	[0.09, 0.39]
Condition			
(reference level: No message control)			
Expository		0.40 ***	
		[0.25, 0.54]	

Narratives			0.38 ***	
			[0.23, 0.53]	
Race				
(reference level: White)				
American Indian or Alaska Native			0.19	
			[-0.51, 0.90]	
Asian			-0.05	
			[-0.26, 0.16]	
Black or African American			0.80 ***	
			[0.62, 0.98]	
Native Hawaiian or Other Pacific Islander			0.61	
			[-1.25, 2.47]	
Other			0.17	
			[-0.13, 0.47]	
R^2	0.06	0.05	0.11	0.06

Note: See Supplemental Materials for covariate selection criteria and experimental conditions. P values for the composite score were adjusted. For the "job status" variable, "hour loss & remote change" indicate that participant's work hours were reduced and they have shifted to remote working. All continuous predictors are mean-centered and scaled by 1 standard deviation. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Table 5. Study 3 Ordinary Least Square model results of linking collectivism with cognitions surrounding social distancing, mask wearing, and vaccination.

	Social distancing				Mask wearing		Vaccination
	Beliefs	Injunctive norm	Federal policy support	State policy support	Beliefs	Injunctive norm	Intention
(Intercept)	0.14	0.19	0.82	0.49	0.14	-0.16	0.19
	[-0.40, 0.67]	[-0.36, 0.74]	[-0.23, 1.86]	[-0.09, 1.07]	[-0.40, 0.68]	[-0.71, 0.39]	[-0.35, 0.73]
Collectivism	0.19 ***	0.13 ***	0.12 **	0.12 **	0.20 ***	0.12 ***	0.17 ***
	[0.14, 0.25]	[0.07, 0.19]	[0.04, 0.21]	[0.04, 0.20]	[0.14, 0.26]	[0.06, 0.18]	[0.11, 0.23]
Race (reference level: White)							
American Indian or Alaska Native	0.84 *	0.47	1.43 *	-0.14	0.85 *	0.52	-0.09
	[0.10, 1.58]	[-0.28, 1.23]	[0.06, 2.80]	[-0.97, 0.69]	[0.10, 1.59]	[-0.24, 1.27]	[-0.84, 0.65]

	Asian	0.62 ***	0.34 *	0.64 **	0.57 **	0.63 ***	0.25	0.10
		[0.31, 0.93]	[0.02, 0.65]	[0.20, 1.08]	[0.18, 0.97]	[0.32, 0.95]	[-0.06, 0.57]	[-0.21, 0.42]
	Black or African American	0.13	0.03	0.28 *	0.11	0.11	0.14	-0.32 **
		[-0.07, 0.33]	[-0.17, 0.23]	[0.01, 0.55]	[-0.15, 0.38]	[-0.09, 0.31]	[-0.07, 0.34]	[-0.52, -0.12]
	Native Hawaiian or Other Pacific Islander	-0.14	-0.42	-0.35	0.13	-0.44	-0.03	0.14
		[-1.28, 1.01]	[-1.58, 0.75]	[-2.35, 1.65]	[-1.11, 1.37]	[-1.59, 0.72]	[-1.20, 1.14]	[-1.02, 1.29]
	Other	-0.08	-0.09	0.03	-0.02	0.05	-0.14	-0.06
		[-0.28, 0.12]	[-0.29, 0.11]	[-0.25, 0.31]	[-0.28, 0.24]	[-0.15, 0.25]	[-0.34, 0.07]	[-0.26, 0.14]
Education		0.03	0.02	0.06	0.01	0.03	0.09 **	0.07 *
		[-0.03, 0.09]	[-0.04, 0.08]	[-0.02, 0.15]	[-0.07, 0.09]	[-0.03, 0.09]	[0.02, 0.15]	[0.01, 0.13]
Political orientation (reference level: Liberal)								

	Conservative	-0.50 ***	-0.36 ***	-0.98 ***	-0.63 ***	-0.55 ***	-0.39 ***	-0.46 ***
		[-0.66, -0.34]	[-0.52, -0.19]	[-1.20, -0.76]	[-0.84, -0.41]	[-0.71, -0.38]	[-0.56, -0.23]	[-0.62, -0.29]
	Moderate	-0.16 *	-0.26 ***	-0.21 *	-0.29 **	-0.20 **	-0.19 *	-0.12
		[-0.31, -0.02]	[-0.41, -0.11]	[-0.42, -0.01]	[-0.48, -0.11]	[-0.35, -0.05]	[-0.34, -0.04]	[-0.27, 0.03]
	Refused	-0.07	0.56	0.50	1.18	-0.17	0.81	-0.96
		[-1.35, 1.22]	[-0.75, 1.87]	[-1.44, 2.45]	[-1.58, 3.93]	[-1.47, 1.13]	[-0.50, 2.13]	[-2.26, 0.34]
Gender (reference level: Female)								
	Male	-0.12	-0.13 *	-0.28 **	-0.35 ***	-0.10	-0.07	0.16 **
		[-0.24, 0.00]	[-0.25, -0.00]	[-0.45, -0.11]	[-0.51, -0.19]	[-0.22, 0.02]	[-0.20, 0.05]	[0.04, 0.29]
Age		0.08 *				0.09 **		0.19 ***
		[0.02, 0.15]				[0.03, 0.15]		[0.12, 0.25]
R^2		0.19	0.15	0.31	0.34	0.20	0.18	0.17

Note: See Supplemental Materials for covariate selection criteria. Statistics on the State variable (as a categorical control) were not shown. P values for the collectivism measure were adjusted. All continuous predictors are mean-centered and scaled by 1 standard deviation. *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

Table 6. OLS model results linking country-level collectivism and COVID-19 growth rates in confirmed cases and deaths.

	Growth rate (cases)	Growth rate (deaths)
(Intercept)	0.00	-0.01
	[-0.02, 0.01]	[-0.02, 0.01]
Collectivism	-0.01	0.00
	[-0.03, 0.02]	[-0.03, 0.03]
Population	0.02 **	0.01
	[0.01, 0.04]	[-0.01, 0.03]
Population density	-0.01	0.00
	[-0.03, 0.01]	[-0.02, 0.03]
Median age	-0.02 *	-0.03 **
	[-0.04, -0.00]	[-0.05, -0.01]
GDP	0.00	0.00
	[-0.01, 0.01]	[-0.01, 0.01]
Health spending per GDP	0.00	0.00
	[-0.01, 0.02]	[-0.02, 0.01]
Hospital beds per thousand	0.00	0.00
	[-0.02, 0.01]	[-0.02, 0.01]

Democracy index	0.01	0.00
	[-0.01, 0.02]	[-0.02, 0.02]
Diabetes prevalence	0.00	-0.01
	[-0.02, 0.02]	[-0.03, 0.02]
Male smokers	0.00	0.01
	[-0.01, 0.01]	[-0.01, 0.02]
Female smokers	0.02 *	0.02 *
	[0.00, 0.03]	[0.00, 0.03]
Life expectancy	0.01	0.02
	[-0.01, 0.03]	[-0.00, 0.04]
Masculinity	0.01	0.01
	[-0.01, 0.02]	[-0.01, 0.03]
Uncertainty avoidance	-0.02 *	-0.03 **
	[-0.03, -0.00]	[-0.05, -0.01]
Long term orientation	0.00	-0.01
	[-0.02, 0.01]	[-0.02, 0.01]
Power distance	-0.01	0.00
	[-0.03, 0.02]	[-0.03, 0.03]

First date	0.02 **	0.01
	[0.01, 0.04]	[-0.01, 0.03]
R^2	0.56	0.54

Note: All continuous predictors are mean-centered and scaled by 1 standard deviation. *** p < 0.001; ** p < 0.01; * p < 0.05.