RESEARCH ARTICLE

Outbreaks and Outgroups: Three Tests of the Relationship Between Disease Avoidance Motives and Xenophobia During an Emerging Pandemic

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Abstract

Given the persistent threat posed by infectious disease throughout human history, people have a sophisticated suite of cognitive and behavioral strategies designed to mitigate exposure to disease vectors. Previous research suggests that one such strategy is avoidance of unfamiliar outgroup members. We thus examined the relationship between dispositional worry about disease and support for COVID-19-related travel bans across three preregistered studies ($N = 764$) conducted at the outset of the pandemic in the United States and Singapore. Americans higher in Perceived Infectability were more supportive of travel bans, whereas Singaporeans higher in Germ Aversion were more supportive of travel bans. In Study 2, priming saliency of the pandemic increased support for travel bans from high (but not low) pandemic-risk countries. This prime did not increase general xenophobia. These results are consistent with threat-specific perspectives of outgroup avoidance, and provide an ecologically-valid test of the implications of perceived disease threat for policy-related attitudes and decision-making.

Keywords COVID-19 · Travel ban · Prejudice · Behavioral immune system · Disease avoidance

Introduction

Infectious diseases have posed one of the largest threats to human survival and welfare throughout history, and remain a significant cause of mortality worldwide today (Jones et al., 2008; Wolfe et al., 2007). In addition to the direct physical and economic consequences of disease morbidity and mortality (e.g., Acemoglu & Johnson, 2007; Cashdan, 2014), an emerging body of work suggests that disease

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burden has social and cultural implications as well (e.g., see Ackerman, Hill, & Murray, 2018; Murray & Schaller, 2016, 2017). In the intergroup domain, previous work suggests that pathogen threat induces xenophobic and ethnocentric responses (Faulkner et al., 2004; Green et al., 2010; Hamamura & Park, 2010; O'Shea et al., 2019). Here, we add to this intergroup work and report results from three preregistered studies performed during the early stages of an emerging global disease threat, during the time when the World Health Organization (WHO, 2020) first declared the COVID-19 coronavirus outbreak a global health emergency. We investigate how both dispositional sensitivity to disease threat and experimentally-induced reminders of the pandemic influenced support for restrictive travel bans during the outset of this emerging pandemic.

The Behavioral Immune System

In addition to our physiological immune system, humans (and other animals) are equipped with a type of "behavioral" immune system that motivates behaviors designed to minimize contact with potential disease vectors in the first place (Murray & Schaller, 2016; Schaller & Park, 2011).

A growing body of work now links the perceived threat of disease to a diverse suite of social psychological phenomena, including moral cognition, person perception, conformity, risk-taking, and social preferences (e.g., Ackerman et al., 2018; Makhanova et al., 2015; Mortensen et al., 2010; Murray & Schaller, 2012; Murray et al., 2019; Prokosch et al., 2019; Reid et al., 2012). Furthermore, the behavioral immune system has been linked to human behavior during previous pandemics. For example, research suggests that during the Ebola outbreak of 2014 there was a slight increase in prejudice towards gay men and women (Inbar et al., 2016), and that the Ebola outbreak may have led people to vote more conservatively in American and Canadian elections (Beall et al., 2016).

Disease threat also has implications for attitudes and reactions towards racial and cultural outgroups, given that unfamiliar outgroups may be implicitly perceived as carriers of diseases (e.g., Petersen, 2017). Much disease threat research has examined the predictive utility of dispositional concerns about disease threat as measured by the Perceived Vulnerability to Disease questionnaire (or PVD, Duncan et al., 2009). The PVD captures two distinct but related constructs via two subscales: Perceived Infectability and Germ Aversion. Perceived Infectability captures people's subjective beliefs about their personal vulnerability to being infected, whereas Germ Aversion captures immediate affective responses to pathogenic contexts (Wang et al., 2018). Relative to Perceived Infectability, Germ Aversion has been shown to be more associated with intergroup beliefs and attitudes. For instance, Germ Aversion (but not Perceived Infectability) has been shown to predict stronger explicit prejudicial attitudes (O'Shea et al., 2019), preferences for group-based social hierarchy (Duncan et al., 2009), more aversive reactions to interpersonal moral violations (Murray et al., 2019), and support for stricter immigration policies (Green et al., 2010). Experimental manipulations of disease threat also increase xenophobic responses, especially towards more unfamiliar cultural outgroups. For example, previous research suggests that pathogen primes increase participants' negative attitudes toward immigrants from unfamiliar countries (Faulkner et al., 2004) and have been shown to increase participants' perception of danger (White et al., 2014). Other previous work has found that experimental effects are moderated by dispositional disease worry (e.g., Ji et al., 2019; Makhanova et al., 2015).

At the cross-cultural level of analysis, individuals in cultures where the local threat of disease is higher are more likely to indicate that they would not want a racial outgroup member as a neighbor (Murray & Schaller, 2017), and there exist more distinct ingroup/outgroup boundaries and less inter-ethnic interaction in regions characterized by higher levels of disease (Fincher & Thornhill, 2008; Fincher et al., 2008). Early functional accounts of the relationship between disease threat and xenophobia posited that the behavioral immune system motivated avoidance of unfamiliar outgroups writ large, given that human adaptive immunity tends to be highly calibrated to one's local physical and social ecology (e.g., Miller et al., 2007), and given the asymmetric adaptive costs of a False Alarm versus a Miss in detecting disease cues (see Haselton & Buss, 2000; Haselton et al., 2015; Nesse, 2005). However, more recent analyses suggest that these xenophobic responses may simply be evoked to the extent that an outgroup member is perceived to pose a potential disease threat (van Leeuwen & Petersen, 2018; Peterson, 2017).

Overview of the Current Research

Three preregistered studies investigated how both dispositional worry about disease and experimental reminders of disease influence support for imposing restrictions on travel (i.e. "travel bans") for individuals from high disease-risk foreign countries. Studies 1A (United States) and 1B (Singapore) were conducted 1–2 days after the coronavirus reached the respective countries, providing a unique window to investigate how the behavioral immune system responds to an emerging local pathogen threat. Study 2 was conducted when the saliency of the outbreak was a small but growing concern for Americans. In Studies 1A and 1B, preregistered predictions were that greater dispositional worry about disease threat would predict greater support for travel bans on travelers coming from high disease-risk regions. In Study 2, additional preregistered predictions were that an experimental reminder of the emerging pandemic would increase support for travel bans on people from high disease-risk (but not low-risk) countries, and would also increase more general fear-based xenophobia. These studies thus offer an ecologically-valid test of the previously-theorized and documented relationship between disease threat and xenophobia in two cultural contexts (United States and Singapore) at different time points of a global pandemic.

Study 1: PVD and Support for Travel Bans

The preregistered predictions and analysis plans for all three studies, along with all data and materials are available at osf.io/rkxj4/?view_only=dbc38ac206e94a5884834cb60e89fd64. Studies were powered to detect a small-to-medium effect size with 80% power. We report all measures, manipulations and exclusions.[1]

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[1] Note that at the time of the Studies 1A and 1B preregistrations, COVID-19 was still commonly referred to as the "Wuhan Virus.".

Table 1 Descriptive Statistics and Correlations from Studies 1A (United States, Below Diagonal) and 1B (Singapore, Above Diagonal)

Measures	Study 1A M (SD)	Study 1B M (SD)	1	2	3	4	5	6
1. Perceived Infectability	3.50 (1.16)	4.09 (1.07)	-	.29***	.02	.15[+]	.09	.11
2. Germ Aversion	4.48 (0.99)	4.50 (1.01)	.25***	-	.32***	.34***	.23**	.35***
3. Wuhan travel ban	5.14 (1.58)	5.64 (1.71)	.31***	.21***	-	.71***	.41***	.84***
4. China travel ban	4.48 (1.88)	4.49 (1.93)	.34***	.18**	.67***	-	.58***	.92***
5. Asia/ Malaysia travel ban	4.02 (2.00)	2.68 (1.53)	.32***	.20**	.58***	.81***	-	.76***
6. Averaged travel ban	4.55 (1.63)	4.27 (1.46)	.36***	.22***	.82***	.94***	.91***	-

For 5., Study 1A measured travel ban on Asia and Study 1B measured travel ban on Malaysia

[+]$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$

Study 1A Method: American Sample

The Centers for Diseases Control and Prevention (CDC; 2020) announced the first documented case of the coronavirus in the United States on January 21, 2020. Study 1A was conducted on January 23, 2020. We pre-registered the predictions that participants higher in dispositional Germ Aversion would be significantly more likely to support travel bans on people coming in from Wuhan, any parts of China, and any parts of Asia more broadly. We did not make specific predictions regarding dispositional Perceived Infectability given that Germ Aversion has typically been shown to be more predictive of intergroup attitudes and beliefs than Perceived Infectability (e.g., O'Shea et al., 2019).

Participants and Procedure The preregistration goal was set at 250 participants, which would provide 80% power to detect $r = 0.18$ (two-tailed, $\alpha = 0.05$). A total of 277 MTurk workers participated; 36 participants did not pass an attention check and/or reported that they randomly responded to questions, leaving a final sample of 241 participants (40.2% women; $M_{age} = 35.44$).

Participants first read a description of the outbreak adapted from various news outlets. Participants then indicated if they had heard of the virus or not (51.5% yes, 12.9% unsure/ maybe, 35.7% no). Participants then indicated support for travel bans and completed the Perceived Vulnerability to Disease Questionnaire.

Support for Travel Bans Participants rated their support for travel bans on three items ($\alpha = 0.87$; 1 = strongly disagree; 7 = strongly agree): "The US government should impose a travel ban to prevent travelers from [Wuhan, China/ any parts of China/ any parts of Asia] from entering US." The three items correlated strongly with one another (see Table 1) and were averaged to form an overall index of travel ban support.

Perceived Vulnerability to Disease PVD measures individual differences in people's dispositional concern about infectious diseases with two subscales (Duncan et al., 2009):

Perceived Infectability (7 items; $\alpha = 0.82$) and Germ Aversion (8 items; $\alpha = 0.73$), all using a 7-point scale (1 = strongly disagree; 7 = strongly agree). Perceived Infectability measures individuals' perceptions of their own susceptibility to infectious diseases (e.g., "If an illness is 'going around,' I will get it"). Germ Aversion measures discomfort and fear of contexts in which disease transmissions are particularly likely (e.g., "I prefer to wash my hands pretty soon after shaking someone's hand").[2]

Study 1A Results

Zero-order correlations between dispositional worry about disease and travel ban support can be seen in Table 1 (below diagonal). As shown, both Germ Aversion and Perceived Infectability were significantly correlated with each level of travel ban. We preregistered a series of regression analyses with Perceived Infectability and Germ Aversion as simultaneous predictors and the three travel ban items as separate dependent variables. The averaged index of travel ban support was included in another regression as an exploratory dependent variable.

Primary Analyses As shown in Table 2, Perceived Infectability significantly and unexpectedly predicted support for all travel bans. Results for Germ Aversion were weaker and less consistent. Germ Aversion significantly uniquely predicted support for travel bans on Wuhan, Asia, and the composite index, but not on China.

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[2] Two items from the Germ Aversion subscale were modified from the original scale to be more reflective of current culture. One item was changed from "I avoid using public telephones because of the risk that I may catch something from the previous user" to "I avoid using public bathrooms." Another item was modified from "My hands do not feel dirty after touching money" to "My hands do not feel dirty after touching door handles." These items were modified because public telephones and cash are less commonly used nowadays.

Table 2 Standardized Regression Beta Weights Predicting Travel Bans in Studies 1A and 1B

Predictors	Supports for Travel Bans			
Study 1A	Wuhan	China	Asia	Averaged
Perceived Infectability	.27***	.32***	.29***	.33***
Germ Aversion	.15*	.10	.13*	.14*
Study 1B	Wuhan	China	Malaysia	Averaged
Perceived Infectability	-.08	.06	.03	.01
Germ Aversion	.34***	.32***	.22*	.35***

*$p < .05$. **$p < .01$. ***$p < .001$

Exploratory Analyses Given that only approximately half of the participants were aware of the coronavirus outbreak at the time of the study, there could be differences among those who were aware vs. unaware of the virus. Participants were grouped into those who indicated awareness of the virus ($n = 124$) and those who were unsure or unaware ($n = 117$). The averaged index of travel bans support was used as the dependent variable.

We ran a series of exploratory bootstrapped moderation analyses (5000 iterations) separately for Perceived Infectability and Germ Aversion with awareness as moderator. There was a significant interaction between Perceived Infectability and awareness in predicting support for travel bans ($b = -0.36$, $SE = 0.17$, $p = 0.037$, 95% CI [-0.71, -0.02]). Among those who were unaware of the outbreak, Perceived Infectability was a strong significant predictor ($b = 0.72$, $p < 0.001$). For those who were aware of the outbreak, Perceived Infectability was also a significant, but weaker, predictor ($b = 0.35$, $p = 0.001$). Germ Aversion did not interact significantly with awareness ($b = 0.02$, $SE = 0.22$, $p = 0.923$, 95% CI [-0.41, 0.45]). Within this American sample, then, Perceived Infectability emerged a stronger predictor for individuals with less information about the disease.

Study 1B Method: Singaporean Sample

Study 1B investigated the unexpected Perceived Infectability relationships found in Study 1A in another geographic and cultural context: Singapore. We pre-registered that both Perceived Infectability and Germ Aversion would predict greater support for stricter travel bans. The first documented case of the coronavirus in Singapore was announced on January 23, 2020. Study 1B was conducted in Singapore between January 24 and January 28, 2020. Singapore was chosen as a second sample because it provides a rich comparison given that the epicenter of the coronavirus outbreak at the time was geographically closer to Singapore than the United States (and much more salient to Singaporeans given that Singapore and China have high frequency mutual international travel).

The procedure was identical to Study 1A, with two exceptions. First, attention and randomness checks were omitted, and therefore all participants who completed the study were included. We omitted attention checks because naïve participants who are less familiar with research studies tend to fail attention checks more often than more experienced MTurk participants (Hauser & Schwarz, 2016). Second, participants were asked to rate their support for travel bans on Malaysia as opposed to Asia broadly. Malaysia is a neighboring country of Singapore with shared natural resources, close economic ties, and similar cultural backgrounds. This change provides a stringent test of the magnitude of the potential xenophobic protective response since Malaysia and Singapore have strong bilateral relations. Supporting travel bans on Malaysia would be considered an extreme response.

Participants and Procedure Participants were recruited via social media (e.g., Twitter, Facebook). Because it was unclear how many participants could be potentially recruited in this manner, pre-registration goal was set to at least 100 participants and ending on January 28, 2020. A total of 138 participants in Singapore (62.3% women; $M_{age} = 31.70$) completed the study. Of the 138 participants, 136 were aware of the virus and 2 were unsure. This sample size provided 80% power to detect a true relationship of $r = 0.24$ (with two-tailed $\alpha = 0.5$).

All participants read a similar description of the coronavirus outbreak as Study 1A, with slight alteration to fit the Singaporean context. Afterward, participants completed measures on travel bans and PVD.

Support for Travel Bans Participants rated their support for three travel bans (1 = strongly disagree; 7 = strongly agree): "The Singaporean government should impose a travel ban to prevent travelers from [Wuhan, China/ any parts of China/ Malaysia] from entering Singapore." The three items correlated strongly with one another (see Table 1) and were averaged to form a singular index ($\alpha = 0.80$).

Perceived Vulnerability to Disease We used the same items as Study 1A (Perceived Infectability $\alpha = 0.87$; Germ Aversion $\alpha = 0.73$).

Results

Zero-order correlations between disease worry and travel ban support are shown in Table 1 (above diagonal). Germ Aversion was consistently associated with each travel ban parameter (all p's < 0.01), whereas Perceived Infectability was not.

As in Study 1A, we preregistered a series of multiple regressions to investigate the unique effects of both PVD

subscales. Results are shown in the bottom half of Table 2. Germ Aversion emerged as a significant predictor of all travel ban-related dependent variables, $\beta s \geq 0.22$, $ps < 0.05$. As pre-registered, Germ Aversion predicted more restrictive policies even towards Singapore's neighboring country of Malaysia. Contrary to Study 1 and our pre-registered prediction, Perceived Infectability was not a significant positive predictor for any travel ban measure within this sample, $\beta s \leq 0.06$, $ps > 0.36$.

Studies 1A and 1B Discussion

These two studies were conducted almost immediately after the first case of COVID-19 was documented in two separate countries. We examined whether chronic sensitivities to diseases predicted support for restrictive travel bans. Studies 1A and 1B diverged in which facet of disease sensitivity predicted travel ban support. In Study 1A, Perceived Infectability was more predictive of travel ban supports among Americans whereas Germ Aversion was more predictive in Study 1B among Singaporeans. Although we can only speculate, one potential reason may be the immediacy of the outbreak. Almost all Singaporean participants were aware of the virus, and the close proximity with China made Singapore a more vulnerable target than the United States. As such, Germ Aversion may have been a stronger predictor among Singaporeans because the emerging disease threat was more contextually salient. We discuss other possible explanations for this difference in the General Discussion.

Study 2

Study 2 was conducted on March 6, 2020 when the pandemic was more salient among Americans. The study was designed to test whether experimentally-manipulated salience of the emerging pandemic increases both support for travel restrictions and/or general xenophobia. The manipulation did not mention anything regarding travel or transmission of the virus. Instead, it reported statistics and photos of individuals dealing with the virus along with the frequency of cases and death within the United States. We preregistered the following specific hypotheses:

H₁ Participants reminded of the pandemic threat will report more support for travel bans pertaining to two countries that are closely associated with cases of the Coronavirus (China and Italy), relative to both accident threat and control conditions.

H₂ Participants who are reminded of the pandemic threat will report higher levels of generalized xenophobia compared to participants in either of the two control conditions.

H₃ A higher *composite* PVD score will predict higher levels of fear-based xenophobia (given the somewhat inconsistent results of studies 1a and 1b, where Perceived Infectability predicted US attitudes towards the travel ban in the US, and Germ Aversion predicted Singaporean attitudes for a travel ban).

Method

Participants and Procedure We preregistered a collected sample size of 500 in order to retain about 150 participants per condition after exclusions. To detect an effect size $f = 0.2$ with 80% power, a total sample of 246 was needed across all three conditions. After exclusions (failed English comprehension, inattention to prime, acknowledged dishonesty) the final sample consisted of 385 American participants recruited from Amazon's Mechanical Turk (43.4% women; $M_{age} = 38.49$; 75.8% White/Caucasian). Participants were asked to respond to whether they believed COVID-19 started in China ("yes," "no," "unsure"; 99.5% indicated "yes"), whether or not people in the USA were infected (97.4% "yes"), and if they were aware that people in the USA died from infection (94.8% "yes").

Participants were randomly assigned to one of three conditions. In the coronavirus prime condition ($n = 134$), participants were provided a brief description of the coronavirus outbreak with accompanying photos of public health officials. In the second condition ($n = 115$), participants were provided with a brief description of how people accidentally poison themselves, with photographs demonstrating how easy it is to be poisoned. Afterward, in both the disease and accident prime, participants were instructed to describe their reactions to the primes and what they learned from it. The third condition was a control condition ($n = 136$) where participants had to write about how they were feeling. They did not write down what they had learned from the prime. After the manipulation, participants completed the measures below and demographics questions and were debriefed and compensated upon completion.

General Xenophobia Participants completed the Fear-Based Xenophobia scale (Van Der Veer et al., 2011). This 9-item measure assesses generalized wariness towards interacting with outgroups ($\alpha = 0.97$); a sample item is "Interacting with immigrants makes me uneasy" (1 = strongly disagree; 7 = strongly agree).

Travel Bans Participants then responded to the following statement "The US government should impose a travel ban to prevent travelers from the following nations from entering the US." The four nations were China, Italy, Canada,

Table 3 Descriptive Statistics for Travel Bans on More and Less Severe Nations Across Conditions

Condition	High Risk Nations (China & Italy)	Low Risk Nations (Canada & Mexico)
COVID-19	4.84 (2.01) $_a$	3.00 (1.86) $_a$
Accident	3.76 (2.27) $_b$	2.81 (1.97) $_a$
Control	3.67 (2.06) $_b$	2.63 (1.80) $_a$

Different letter subscripts within each column indicate significant differences

and Mexico (order was randomized). These four nations were intended to reflect two high-risk countries (China and Italy) and two low-risk (and more geographically proximate countries: Canada and Mexico). Participants rated their agreement on a 7-point scale (1 = strongly disagree; 7 = strongly agree). As expected, support for bans from China and Italy were highly correlated ($r = 0.75$) as were support for bans from Canada and Mexico ($r = 0.74$), and these scores were combined (as preregistered) to create two composites for the analyses reported below (see Supplementary Materials for analyses by country and additional exploratory analyses).

Perceived Vulnerability to Disease The PVD scale was used to measure participant's vulnerability to disease: global ($\alpha = 0.81$), Perceived Infectability ($\alpha = 0.85$) and Germ Aversion ($\alpha = 0.73$).[3]

Results and Discussion

Travel Bans Descriptive statistics across conditions are shown in Table 3. A pre-registered one-way ANOVA was conducted to assess participant's support for having a travel ban on China and Italy (composite) across the three conditions (see Fig. 1). As predicted, there was a significant effect of condition on the travel ban support, $F(2, 382) = 12.60$, $p < 0.001$, partial $\eta^2 = 0.06$. Bonferroni post-hoc tests revealed that people in the pandemic threat condition ($M = 4.84$, $SD = 2.01$) were more supportive of imposing travel bans than participants in both the accident (Cohen's $d = 0.50$, $M = 3.76$, $SD = 2.27$, $p < 0.001$) and control condition ($d = 0.57$, $M = 3.67$, $SD = 2.06$, $p < 0.001$). The two control groups did not differ significantly. Post-hoc analyses revealed no evidence for moderation of these

[3] We also included several exploratory measures. We asked how concerned participants were of the coronavirus (1: Not at all – 100: Very). Participants also rated their agreement for wearing masks: "I would wear a face mask in public to ensure that I would not get sick" and "I would wear a face mask in public if I was sick" (0: Strongly Disagree – 100: Strongly Agree). Analyses of these variables are presented in the Supplementary Materials.

experimental effects by gender (see Supplementary Online Material).

As noted in the preregistration, we made no predictions about support for travel restrictions on individuals from low-risk countries. A one-way ANOVA revealed no effect of experimental condition on support for travel bans on Canada and Mexico, $F(2, 382) = 1.38$, $p = 0.253$, partial $\eta^2 = 0.007$. Although mean differences between conditions were in the same direction as those for the high-risk countries, pairwise comparisons revealed that these differences between the disease condition and either of the two control conditions did not approach significance (p's > 0.29). The same pattern of results emerged when analyzing each of the countries individually (see Supplementary Online Material).

Xenophobia Inconsistent with Hypothesis 2, a pre-registered one-way ANOVA did not find significant differences across the three conditions for generalized xenophobia ($M_{COVID} = 2.79$, $SD = 1.77$; $M_{accident} = 2.99$, $SD = 1.91$; $M_{control} = 3.02$, $SD = 1.74$), $F(2, 382) = 0.672$, $p = 0.511$, partial $\eta^2 = 0.004$. No pairwise comparisons approached significance (ps > 0.83).
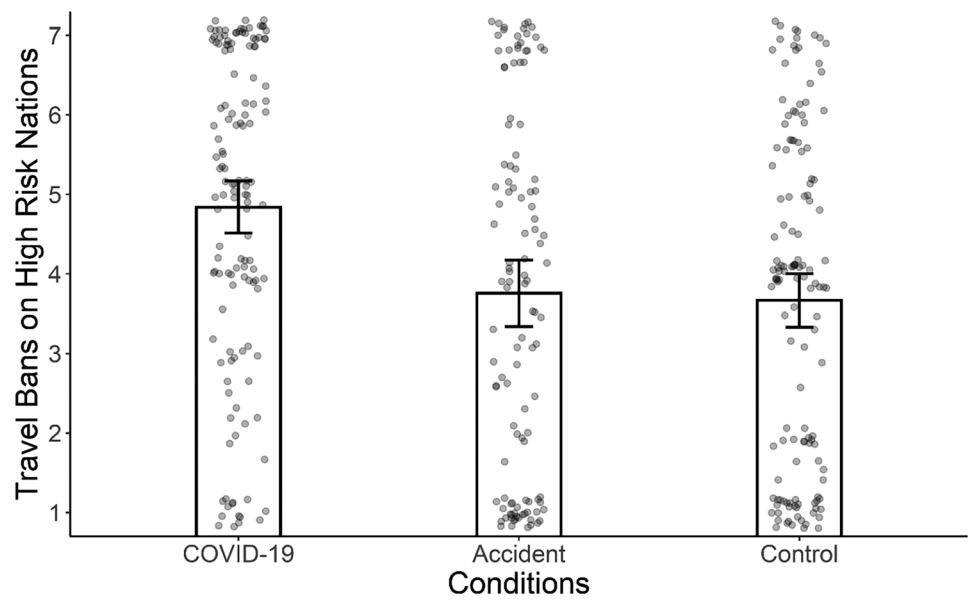
PVD and Travel Bans The correlations between PVD (Perceived Infectability, Germ Aversion, and their composite), xenophobia, and travel ban measures are shown in Table Four. Consistent with the third preregistered prediction, the PVD composite was significantly positively associated with generalized xenophobia ($r = 0.20$, $p < 0.001$) as well as support for travel bans on more severely afflicted countries (ps < 0.05). Further, both Germ Aversion and Perceived Infectability were each individually significantly associated with support for these travel bans (see Table 4).

Furthermore, multiple linear regressions were conducted to assess individual differences towards disease on xenophobic and travel ban measures. When predicting travel ban supports for more high-risk countries (China and Italy), Germ Aversion ($\beta = 0.18$, $p < 0.001$) was a stronger predictor than Perceived Infectability ($\beta = 0.11$, $p = 0.039$). However, the opposite pattern emerged for low-risk countries: Perceived Infectability ($\beta = 0.26$, $p = 0.001$) was a stronger predictor than Germ Aversion ($\beta = 0.11$, $p = 0.031$). For generalized xenophobia, Perceived Infectability ($\beta = 0.18$, $p = 0.001$) was a significant predictor but not Germ Aversion ($\beta = 0.07$, $p = 0.203$).

Does PVD Moderate Priming Effects? To test whether the effects of condition on attitudes to travel bans were moderated by either Germ Aversion or Perceived Infectability, we ran a series of exploratory bootstrapped moderations (5000 iterations). The two control conditions (accident and control) did not differ significantly from one another, and they were combined into one control condition to simplify the analysis. For the high-risk country composite (Italy and China),

Fig. 1 Support for Travel Bans on High Risk Nations (China and Italy) between Conditions

the condition by Germ Aversion interaction was nonsignificant ($b = 0.19$, $SE = 0.19$, $p = 0.34$, 95% CI [-0.19, 0.57]), while the main effect of the dichotomous condition variable remained significant ($b = 1.10$, $SE = 0.22$, $p < 0.001$, 95% CI [0.66, 1.53]), as did the main effect of Germ Aversion, ($b = 0.33$, $SE = 0.11$, $p = 0.004$, 95% CI [0.10, 0.55]).

For the low-risk country composite (Canada and Mexico), there emerged a condition by Germ Aversion interaction ($b = 0.34$, $SE = 0.17$, $p = 0.049$, 95% CI [0.002, 0.68]), a nonsignificant main effect of condition, ($b = 0.27$, $SE = 0.20$, $p = 0.18$, 95% CI [-0.12, 0.65]), and a nonsignificant main effect of Germ Aversion ($b = 0.18$, $SE = 0.10$, $p = 0.08$, 95%CI [-0.02, 0.37]). Analysis of conditional effects revealed that participants higher in germ aversion reported more approval for travel bans in the experimental condition relative to the control conditions (conditional effect of condition at +1 SD for Germ Aversion ($b = 0.75$, $SE = 0.31$, $p = 0.016$, 95% CI [0.14, 1.37]), whereas those lower in Germ Aversion did not meaningfully differ between conditions (effect at -1 SD: $b = -0.08$, $SE = 0.26$, $p = 0.77$, 95% CI [-0.60, 0.44]). This interaction is consistent with the interpretation that people with higher Germ Aversion are

more inclined to overgeneralize sources of possible disease threats. Running similar analyses with Perceived Infectability as the moderator variable revealed no evidence for moderation of condition by Perceived Infectability for either high- or low-risk countries (p's > 0.16).

In sum, results from this study suggest that experimentally-manipulated reminders of the emerging virus led to greater support for travel bans for individuals from high-risk countries. This effect did not extend to support for travel bans for individuals from low-risk countries or to a measure of generalized xenophobia. Individual differences in perceived disease vulnerability predicted higher levels of support for both travel bans and higher generalized xenophobia.

General Discussion

In three studies—which were conducted at the onset (Studies 1A and 1B) and in the midst (Study 2) of the emerging COVID-19 pandemic—we found that those who scored higher in dispositional worry about disease reported stronger preferences for restrictive travel bans on several regions of

Table 4 Descriptive Statistics and Correlations among All Variables in Study 2

	M (SD)	1	2	3	4	5
1. PVD Global	3.97 (0.95)	-				
2. Perceived Infectability	3.22 (1.23)	.81***	-			
3. Germ Aversion	4.71 (1.15)	.78***	.27***	-		
4. Xenophobia	2.93 (1.80)	.20***	.20***	.11*	-	
5. Ban on China & Italy	4.10 (2.17)	.23***	.16**	.21***	.50***	-
6. Ban on Canada & Mexico	2.81 (1.88)	.30***	.29***	.18****	.68***	.67***

$^*p < .05$. $^{**}p < .01$. $^{***}p < .001$

Asia (despite the then-highly-localized pandemic). We also found that an experimental manipulation of the pandemic's salience increased support for a travel ban on high-risk nations (China and Italy), but not low-risk nations (Canada and Mexico). These results from the United States and Singapore suggest that dispositional disease concerns as well as reminders of disease threat influence support for restrictive travel bans. These findings conceptually replicate results from previous investigations of the implications of disease threat for intergroup processes (e.g., Aarøe et al., 2017; Faulkner et al., 2004; Navarrete & Fessler, 2006) within the context of a novel disease threat.

The current studies contribute to extant research by further establishing the relationships between disease threat and xenophobia during a very real and exigent global disease threat. Recent work investigating this link has begun to tease apart the potential psychological mechanisms underlying this relationship. Some recent work suggests, for example, that aversion to foreign *norms* rather than aversion to physical contact with foreigners per se can account for the relationship between perceived disease threat and xenophobia (e.g., Karinen et al., 2019). The current work cannot adjudicate between these potential cognitive mediators, or otherwise inform the conversation about the likely "structure" of the behavioral immune system (e.g., van Leeuwen & Petersen, 2018). Thus, the contribution of the current work lies not in its conceptual novelty but in its ecological validity, and in documenting the potential implications of perceived disease threat for policy-related judgment and decision-making.

Subtle but important differences between the current studies deserve note. In Study 1A at the early onset of the pandemic, higher Perceived Infectability predicted stronger and more generalized support for travel bans (extending to a whole continent) particularly among Americans who were unaware of the disease. In Study 1B among Singaporeans (the majority of whom were well-aware of the COVID-19 disease even at the early onset of the pandemic), Germ Aversion (but not Perceived Infectability) predicted travel ban supports. Consistently in Study 2, Perceived Infectability predicted generalized xenophobia and travel ban support directed at countries with fewer cases, but Germ Aversion was more predictive of bans on countries with more cases. These findings across the three studies suggest that when pathogen threat is unclear or unknown, Perceived Infectability may be the stronger predictor of outgroup-related attitudes and policies. Conversely, Germ Aversion may be more predictive of prophylactic attitudes for more familiar or proximal disease threats. However, any interpretation of this pattern of correlations alone remains speculative.

These results also conceptually replicate recent work that suggests Perceived Vulnerability to Disease is related to higher COVID-19 concern and anxiety (McKay et al., 2020; Oliver-La Rosa et al., 2020). The correlational

relationships reported in the current studies did not control for other dispositional variables that might account for this relationship. However, previous work suggests that dispositional disease concern is a relatively unique predictor of social attitudes, which has effects largely independent of the predictive effects of more generalized dispositional threat concern (e.g., Kerry et al., 2020; Murray & Schaller, 2012). More specific to the current results, other work suggests that the relationship between Perceived Vulnerability to Disease and COVID-19 concern still emerges when controlling for personality traits such as neuroticism, conscientiousness, and extraversion (Makhanova & Shepherd, 2020). It is thus unlikely that the correlations reported here are artifacts of such potential confounds.

Furthermore, differences in the predictive utility of the PVD subscales may also be an artifact of the different cultures sampled. Americans and Singaporeans in Studies 1A and 1B differed in Perceived Infectability (with Singaporeans scoring significantly higher, $t(377) = 4.88$, $p < 0.001$) but not in Germ Aversion ($t(377) = 0.18$, $p = 0.858$). However, assessments of ones perceived infectability may not carry the same psychological weight between cultural contexts. One of the central dimensions on which the two cultures studied here vary is individualism/collectivism (e.g., one recent assessment scores Singapore a 20 on individualism, whereas the United States scores a 91; from: www.hofstede-insights.com). Collectivist cultural practices themselves are thought to develop and persist at least in part due to the threat of disease within the local ecology (Fincher et al., 2008). Indeed, some work suggests that group-level collectivism may serve as a type of psychological buffer against the perceived threat of disease, and that the link between perceived vulnerability to infection and xenophobia is stronger in more individualist regions (Kim et al., 2016). Thus, while objective assessments of perceived infection risk may be higher (and even potentially more accurate) in more collectivist contexts, this assessed risk may have relatively less psychological potency. However, we urge caution in over-inference based upon the current correlations alone.

Regardless, these findings further highlight the behavioral immune system's tendency to be over-sensitive to threats by overgeneralizing potential threats and implicitly favoring a false-alarm error over a potentially costly missed threat (a phenomenon sometimes referred to as the smoke detector principle; e.g., Nesse, 2005). In all three studies, participants with greater dispositional concern regarding infectious diseases were more likely to support travel bans on people coming from countries with high risk of infectious disease but also from neighboring (and lower risks) countries with close geographical proximity. In Study 2, results of the experimental manipulation were more target-specific, with an experimental main effect emerging for high-risk countries only.

However, results from exploratory analyses provided tentative evidence for an overgeneralization effect here as well,

whereby participants higher in Perceived Infectability predicted support for travel restrictions from low-risk countries as well. This prejudice toward foreigners may reflect the assumption that travelers from another region may carry pathogens that are more prevalent in their home ecologies, and not in the areas where they are traveling, which has been suggested to be a feature of the behavioral immune system (Schaller & Park, 2011). In essence, travelling from one area to another increases the risk of the transmission of pathogens that are not native to one's ecology. This introduction of foreign, unknown pathogens poses a potential health risk and may consequently heighten xenophobic sentiment and support for more restrictive policies against travelers from other regions.

Consistent with previous work (Faulkner et al., 2004), Study 2 showed that generalized xenophobia was positively related to dispositional worry about disease. However, inconsistent with previous work and with one of our preregistered predictions, participants in the disease threat condition did not report higher generalized xenophobia. We can only speculate why this is the case. One possibility could be that the measure assessed general xenophobia, absent a specific group target (van der Veer et al., 2011); thus, it may have been difficult for participants to mentally represent specific immigrant groups. Other well-powered work has indeed failed to find effects of experimental manipulations of disease threats on target-absent xenophobia (Ji et al., 2019). Future research could use more direct and target-specific self-reported measures (Axt, 2018). Given increased reporting of physical assaults and racial slurs directed at Asian Americans (Li & Nicholson, 2021; Russel, 2020), more research is needed to uncover the effect of COVID-19 saliency in outgroup bias.

Conclusion

Within a week after Study 1B was run (January 2020), Singapore declared a travel ban that prevented people with recent travels in any part of China from entering the country (Johnson, 2020). Within a week of Study 2 (March 2020), the former President of the United States declared a suspension on travel to and from Europe (Quinn, 2020). However, there was substantial disagreement between individuals about what level of danger justified travel restrictions and how widely such restrictions should be applied. The present research suggests that individual differences in concerns about disease, as well as acute saliency of disease threat, may have influenced public opinion, with more concerned individuals more likely to favor restrictions and more likely to generalize threats beyond high-risk regions. This research provides a glimpse into the implications of the behavioral immune system for support of policies restricting international movement during an emerging global health threat.

Availability of Data and Material

https://osf.io/rkxj4/?view_only=dbc38ac206e94a5884834cb60e89fd64

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Author Contributions JG designed and ran studies 1A, B. All authors conceptualized and helped designed the second study. JM and JG analyzed the data and wrote the majority of the manuscript. NK and DM provided secondary data analysis and as well as edits and suggestions for the entire manuscript.

Declarations

Ethics Approval All studies were approved by the authors Institutional Review Board.

Consent to Participate All participants were first provided an informed consent before they engaged in the three studies.

Consent for Publication All authors consent for the current work to be published.

Conflict of Interest The authors declare no competing interests.

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