The double bind of communicating about zoonotic origins: Describing exotic animal sources of COVID-19 increases both healthy and discriminatory avoidance behaviors

Mark LaCour[1], Brent Hughes[2], Micah B. Goldwater[3], Molly E. Ireland[1], Darrell A. Worthy[4], Jason Van Allen[1], Nick Gaylord[5], Garrett Van-Hoosier[1], & Tyler Davis[1]

[1]Department of Psychological Sciences, Texas Tech University

[2]Department of Psychology, University of California Riverside

[3]School of Psychology, University of Sydney

[4]Department of Psychological and Brain Sciences, Texas A&M University

[5]Independent research consultant

Author Note

Address correspondence to Mark LaCour (mark.lacour@ttu.edu) or Tyler Davis (tyler.h.davis@ttu.edu), Department of Psychological Sciences, Texas Tech University, PO Box 42051, Lubbock, TX, 79409.

Abstract

Many novel diseases are of zoonotic origin, likely including COVID-19. Describing diseases as originating from diverse exotic animals can increase risk perceptions and protective avoidance behaviors, but may also activate stereotypes, increasing discriminatory behaviors and disease stigma. Data from the first several weeks of the US COVID-19 pandemic tested how communications about zoonotic disease origins affect people's risk perceptions, health behaviors, and stigma. Participants (N = 677) who read news articles describing exotic animals (e.g., snakes) as sources of COVID-19 viewed the virus as riskier and reported stronger intentions to engage in preventative behaviors (e.g., handwashing), relative to those who read about a familiar source (pigs). Reading exotic origin descriptions was associated with stronger intentions to avoid Asian individuals and animal products, both of which contributed to greater stigma for COVID-19. Results have implications for public health communicators who aim to increase risk perceptions without activating stigma or prejudice.

Keywords: risk perceptions, disease stigma, discrimination, health communication, public health, zoonosis

Beginning in November or December 2019 (Brüssow, 2020; Tuite & Fissman, 2020), a cluster of novel coronavirus infections arose surrounding a meat and seafood market in Wuhan, China. The first U.S. case was confirmed on January 21st, and by March 2020 there were over half a million cases worldwide. The current study began collecting experimental data on January 25th to investigate how communications surrounding the putative zoonotic (from animals) origins of the disease impacted people's risk perceptions, intentions to engage in behaviors to avoid contracting the virus, and COVID-19-related stigma. This early start provides fine-grained resolution on how communications about novel emerging diseases can impact behavior, and how attitudes and risk perception changed as the pandemic evolved.

Approximately 60% of new diseases (Jones et al., 2019), likely including COVID-19, are of zoonotic origin. Unlike communications about common human diseases like rhinovirus or influenza, the animal origins of emerging zoonotic diseases often play a prominent role in news coverage and public health communications. The potential origins of COVID-19 described by news sources and public health organizations like the CDC (2020),WHO (2020), and NFID (2020) early in the pandemic were diverse, and included information about coronavirus susceptibility in both exotic (e.g., snakes, bats, pangolins) and more familiar food sources (e.g., cattle, pigs). Conveying diverse animals as potential sources of zoonotic infection is known to increase subsequent risk perception and intentions to engage in disease avoidance behaviors, such as avoiding animals as potential disease reservoirs (Davis et al., 2017; Tapp et al., 2017). Thus, early reports conveying a wide range of exotic origins of COVID-19 may have helped amplify risk perceptions and disease prevention behaviors in the beginning of the pandemic.

Despite the effect that describing zoonotic origin has on increasing perceptions of risk to humans, the animal origin itself plays little role in the current epidemiology of coronavirus. Nonetheless, people behave *as if* origin matters. Previous studies on Ebola risk perception in largely non-affected populations show that descriptions emphasizing specific zoonotic origins were sufficient to increase risk perceptions and intentions to engage in disease avoidance behaviors (Davis et al., 2017). Risk perceptions associated with Ebola also positively correlated with xenophobic tendencies, including greater prejudice toward West Africans and undocumented immigrants, more support for restrictive travel policies, as well as general ethnocentrism (Kim et al., 2016). Xenophobic attitudes and behaviors like these were also observed being directed towards Latinx Americans during the 2009 H1N1 outbreak, also labeled "Mexican flu" by the media (McCauley et al., 2013). As such, it is important to understand the potential benefits and harms of describing the zoonotic origins of the current COVID-19 pandemic, now that the original zoonotic driver of the disease is largely irrelevant to the avoidance behaviors that reduce infection risk.

The news media's emphasis on exotic animal food sources as the origin of COVID-19, along with early labeling of the disease as the "Wuhan virus," may have exacerbated xenophobic attitudes and behaviors to the degree that it drew attention to what Western cultures view as exotic cuisine. Food neophobia and disgust are common when experiencing food outside a person's culinary norms (Martins & Pilner, 2005; Ritchey et al., 2003), particularly with novel animal products (Martins & Pilner, 2006). These experiences of disgust may generalize to cultures associated with novel or atypical foods. Further, in many Western countries, there are longstanding stereotypes about use of exotic meat like snakes, bats, cats, and dogs in East Asian cuisine, which increases the risk that communications about the possible exotic food sources of a

virus originating in China will reinforce discriminatory beliefs and behavior (Parker, 1994; Fong, 2007; Li, 2014). Specifically, discussing the exotic food origins of COVID-19—in particular the wide range of candidate animal sources that are outside of typical Western diets—has the potential to not only increase general risk perception and protective avoidance behaviors, such as handwashing and social distancing, but may also lead to avoidance of or hostility toward East Asians, as well as increased disease stigma.

Stigma impacts the public response to diseases and is a current area of concern in relation to COVID-19 (CDC, 2019). Greater internalized stigma regarding illness or poor health is associated with decreased health-seeking behaviors (Stangl et al., 2019; Vaugh-Sandler et al., 2014; Wang et al., 2015), including increased likelihood of discontinuing treatment (Kamaradova et al., 2016), lower quality of life, lower self-esteem, and greater psychological distress (Taft et al., 2009). In the case of sexually transmitted infections like HIV, disease stigma correlates with later and less frequent testing as well as failures to notify sex partners after a seropositive diagnosis, leading to higher rates of transmission and poorer treatment outcomes (Derlega et al., 2002; Frost et al., 2007; Lichtenstein, 2003; Morris et al., 2014). Although respiratory viruses are typically less stigmatized than sexually transmitted infections (Hood & Friedman, 2011), media reports have suggested that concerns about ostracism reportedly prevented people exposed to COVID-19 from notifying their contacts and school officials (Williamson & Hussey, 2020). Given the strong interrelations between stigma, stereotyping, and disgust (Terrizzi et al., 2010; Vartanian et al., 2013, 2016), the current study examined how COVID-19 stigma was associated with zoonotic origins, risk perception, and intentions to engage in both positive (hygiene, social distancing) and negative (racial discrimination) avoidance behaviors related to the disease. We also examined how these factors related to stigma

while controlling for known individual differences in variables related to disease stigma, such as Asian stereotypes (Lin et al., 2005) and disgust sensitivity (Haidt et al., 1994).

In the present study, we examined how descriptions of coronavirus that emphasized different animal origins—some familiar (e.g., pigs) and others exotic (e.g., snakes)—affected people's perceptions of COVID-19 risk, intentions to engage in avoidance behaviors, and stigma. We hypothesized that describing more exotic origins of the virus (e.g., snakes, bats, dogs, live animal markets) would result in greater risk perception and stronger intentions to engage in disease prevention behaviors, like handwashing. However, we also expected exotic origins to increase intentions to engage in xenophobic behaviors, like avoiding people of Asian descent. Finally, because of their strong associations with disgust and stereotyping, we expected that avoidance of meat, animals, and people of Asian descent would be associated with greater COVID-19 stigma.

Methods

Data were collected from January 25th 2020 to March 20th 2020. Participants were shown realistic mock news reports claiming either that dogs, snakes, pigs, bats, or food markets were the possible origin of COVID-19 (see Supplementary Materials). Participants were next asked to report their intentions to engage in four categories of disease avoidance behaviors: (1) hygiene-related behaviors, such as wearing masks, avoiding handshakes, washing hands, and wearing gloves; (2) social distancing behaviors, such as avoiding crowds, public transport, or domestic travel; (3) xenophobic avoidance behaviors, such as avoiding people of Asian descent and people who had recently traveled internationally; and (4) animal avoidance behaviors, such as intentions to avoid animal habitats and animal products such as meat.

Table 1

Participant Demographic Characteristics

Demographics	
Age	*M* = 38.7 (12.2)
Sex	
Male	415 (57.1%)
Female	306 (42.1%)
Other / Prefer not to say	6 (0.3%)
Ethnicity	
Asian-American	36 (5.0%)
Black or African-American	60 (8.3%)
Hispanic	46 (6.4%)
Native American or Alaskan American	4 (0.4%)
White or Caucasian American	565 (78.5%)
Other / Prefer not to say	9 (2.4%)
Education	
Middle or junior high school	1 (0.1%)
Some high school	4 (0.6%)
High school degree	87 (12.0%)
Some college	199 (27.5%)
College degree	337 (46.5%)
Some post-graduate work	25 (3.5%)
Post-graduate degree	72 (9.9%)
Income	
Less than $10,000	25 (3.5%)
$10,000 - $19,000	48 (6.6%)
$20,000 - $29,999	89 (12.3%)
$30,000 - $39,999	101 (13.9%)
$40,000 - $49,999	88 (12.1 %)
$50,000 - $59,999	96 (13.2 %)
$60,000 - $69,999	70 (9.7 %)
$70,000 - $79,999	57 (7.9%)
$80,000 - $89,999	37 (5.1%)
$90,000 - $99,999	38 (5.2%)
$100,000 - $149,999	59 (8.1%)

More than $150,000	17 (2.3%)

Note. Numbers are frequencies and percentages for participants' sex, ethnicity, education; mean and standard deviation are reported for age.

Participants

Participants ($N = 677$) were recruited through Amazon's Mechanical Turk platform (see Table 1 for demographics) to complete an online experiment. They were paid $2 and gave informed consent by continuing past an information sheet describing the goal of the study and contact information for the principle investigator. The protocol was approved by the Human Rights Protection Program of Texas Tech University.

Measures

All questionnaires consisted of statements which participants were asked to rate their agreement toward on a 7-point scale anchored at "strongly disagree" and "strongly agree." All items and descriptive statistics can be found in the Supplemental Materials.

COVID-19 risk perceptions. To measure COVID-19 risk perceptions, we asked participants 8 questions, e.g., "The coronavirus poses a serious risk," "The coronavirus should be taken very seriously" (Cronbach's $\alpha = 0.84$).

Disease avoidance behaviors. Participants were asked about their intentions to engage in four categories of disease prevention behaviors: (1) hygiene-related behaviors, such as wearing masks, avoiding handshakes, washing hands, and wearing gloves (4 items, Cronbach's $\alpha = 0.82$); (2) social distancing behaviors, such as avoiding crowds, public transport, or domestic travel (4 items, Cronbach's $\alpha = 0.88$); (3) xenophobic avoidance behaviors, such as avoiding people of Asian descent and people who had recently traveled internationally (5 items, Cronbach's $\alpha = 0.87$); and (4) animal avoidance behaviors, such as intentions to avoid animal habitats and animal products such as meat (4 items, Cronbach's $\alpha = 0.89$).

Disgust sensitivity. To assess individual differences in disgust sensitivity, we used a 26-item version of the D-scale from Haidt and colleagues (1994) (Cronbach's $\alpha = 0.89$).

Endorsement of Asian stereotypes. Individual differences in endorsement of Asian stereotypes were assessed using the 25-item questionnaire from Lin and colleagues (2005) (Cronbach's $\alpha = 0.94$)

Virus stigma. Perceived stigma for contracting COVID-19 was assessed using a 3-item questionnaire, e.g., "I would be ashamed to tell people if I contracted the coronavirus" (Cronbach's $\alpha = 0.88$).

Procedure

The experiment started with a demographic section. Afterwards, participants were randomly assigned to one of five between-subjects conditions where each participant would see a realistic news headline along with the first two paragraphs of a story covering the zoonotic origins of the virus, implicating either dogs, snakes, pigs, bats, or food markets in general. Participants were then asked about their perceived risks associated with COVID-19 and intentions to engage in hygiene-related disease prevention behaviors and avoidance behaviors, including social distancing, xenophobic avoidance, and animal avoidance. Next, participants answered questions about perceived stigma associated with contracting COVID-19, trait-level disgust, and endorsement of Asian stereotypes. The survey was administered in 4 different forms (see Table 3), which asked increasingly more questions. Participants were included or excluded from analyses depending on whether the relevant questions were included in the form they answered.

Table 3

Content and Date Ranges for Each Survey Form

Measures	Form A (*n* = 151) Jan. 25-27	Form B (*n* = 69) Jan. 31-Feb 1	Form C (*n* = 92) Feb. 7-8	Form D (*n* = 365) Feb. 17-March 20
Demographics	■	■	■	■
Familiarity with virus	■	■	■	■
Baseline transmission risk	■	■	■	■
Vignette	■	■	■	■
Perceived risk	■	■	■	■
COVID-19 stigma	■	■	■	■
Disease similarities	■	■	■	■
Animal stigma	■	■	■	■
Animal-human similarity	■	■	■	■
Vaccine questionnaire	■	■	■	■
News media diet	■	■	■	■
Disgust sensitivity	■	■	■	■
Expanded demographics		■	■	■
Avoidance behavior intentions			■	■
Asian stereotypes			■	■
Frequency, probability framing				■

Note. All dates are from 2020.

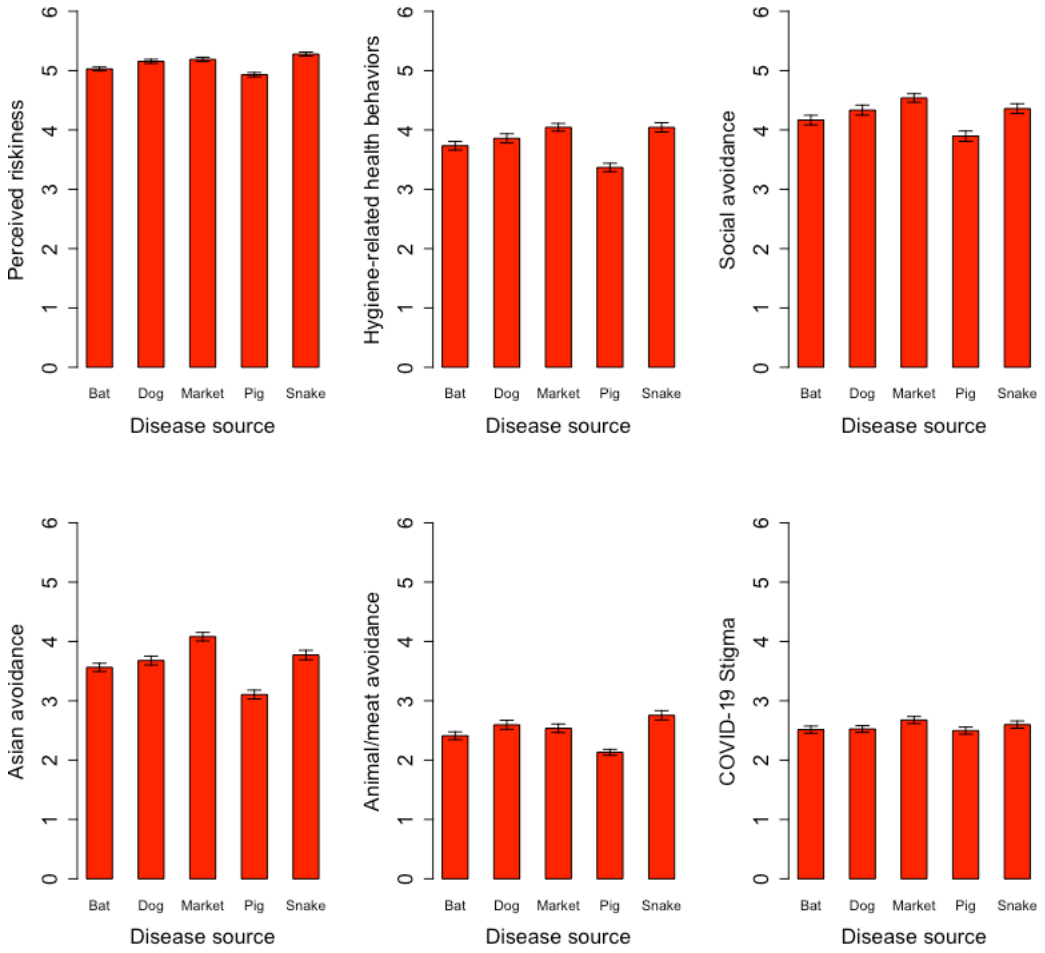
Several variables were measured but are not reported here: participants' familiarity with the virus; baseline assessments of the likelihood of contracting COVID-19 from various animals; perceived similarity between COVID-19 and other diseases; stigma associated with dogs, snakes, pigs, bats, and food markets; similarities between each of these sources and humans; and beliefs about vaccines in general, as well as the possibilities of developing a vaccine for COVID-19 specifically. We randomly asked participants to compare risks between influenza and COVID-19 in either a probability or frequency format and asked about their news consumption habits. All questions and accompanying descriptive statistics can be found in the Supplementary Materials.

Results

Animal origin descriptions were associated with significant differences in risk perceptions, $F(4, 515) = 3.07$, $p = .016$. $\eta_p^2 = .02$, such that participants viewed COVID-19 as less risky after reading about pigs compared to other species, Welch's $t(155.25) = 3.12$, $p = .002$, Cohen's $d = 0.34$. The disease origin descriptions were associated with significant differences in intentions to increase hygiene-related avoidance behaviors, $F(4,451) = 2.92$, $p = .021$, $\eta_p^2 = .03$, and xenophobic avoidance behaviors, $F(4,451) = 4.59$, $p = .001$, $\eta_p^2 = .04$. The descriptions had a modest effect on intentions to engage in animal avoidance behaviors, $F(4, 451) = 2.30$, $p = .058$, $\eta_p^2 = .02$. In each of these analyses, the disease origin descriptions were lower for pigs than other animals [hygiene-related: Welch's $t(142.33) = 3.08$, $p = .002$, Cohen's $d = 0.35$, social distancing: Welch's $t(130.07) = 2.10$, $p = .037$, Cohen's $d = 0.26$; xenophobic avoidance behaviors: Welch's $t(138.27) = 3.59$, $p < .001$, Cohen's $d = 0.42$; animal avoidance: Welch's $t(199.21) = 3.22$, $p = .002$, Cohen's d=0.30]. Interestingly, although disease origin affected xenophobic avoidance intentions, it did not have a significant effect on social distancing intentions, $F(4, 451) = 1.75$, $p = .138$, $\eta_p^2 = .02$, which are some of the more effective disease prevention behaviors once community spread occurs for a novel disease. Differences between origin descriptions for each of these avoidance measures are depicted in Figure 1.

Figure 1

Mean Risk Perceptions and Avoidance Intentions Across Disease Source Conditions



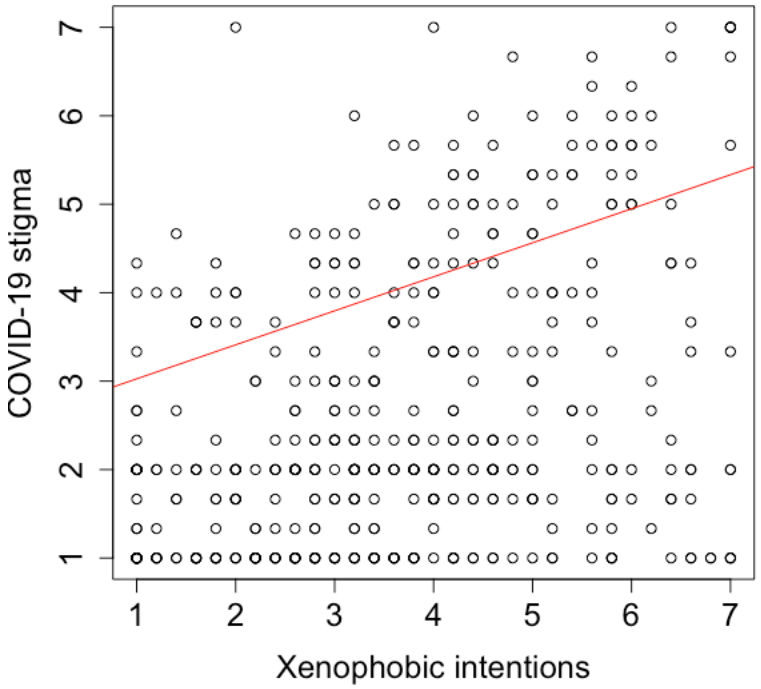
*Note***.** Error bars are standard errors. Conditions were news stories attributing COVID-19 to bats, dogs, food markets, pigs, or snakes.

Stigmatization of COVID-19 was assessed via three questions measuring general feelings of embarrassment and wanting to conceal a hypothetical COVID-19 infection (e.g., "I would be ashamed to tell people if I contracted the coronavirus."). There were no direct effects of disease origin description on stigmatization of COVID-19, $F(4,451) = 0.32$, $p = .868$, $\eta_p^2 = .002$. Multiple regression was used to test how each of the four disease avoidance categories above related to stigma, adjusting for effects of origin descriptions and weeks since data collection

began. All regression coefficients reported throughout are standardized. The resulting model (R^2 = .26) showed a positive association between COVID-19 stigma and xenophobic (β= 0.20, *SE* = .06, $t(446) = 3.23$, $p = .001$, see Figure 2) and animal ($\beta = 0.36$, *SE* = .05, $t(446) = 6.69$, $p <$ .001, see Figure 3) avoidance intentions. No other coefficients were significant.

Figure 2

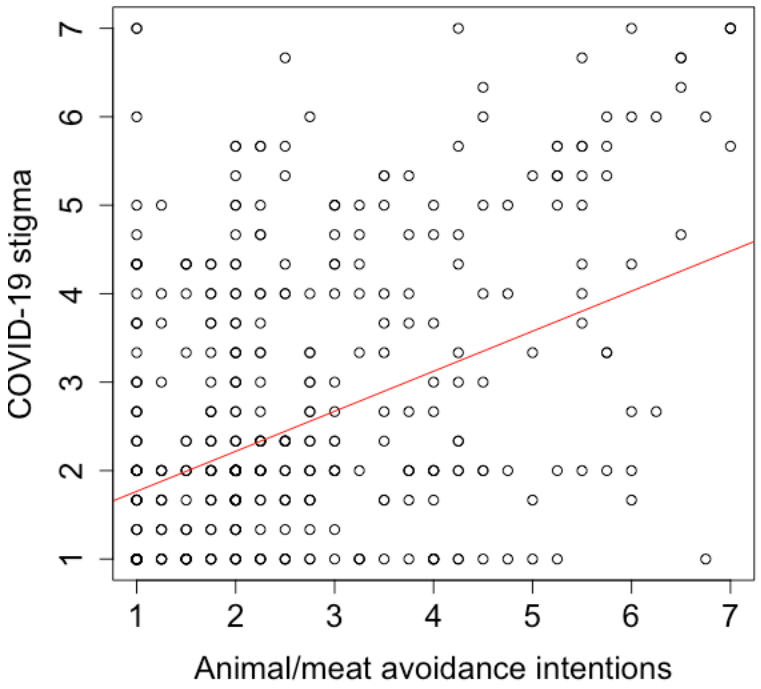
Relation Between COVID-19 Stigma and Intentions to Avoid People of Asian Descent and International Travelers



Note. The red line is the simple linear regression line fit between the two variables.

Figure 3

Relation Between COVID-19 Stigma and Intentions to Avoid Animals and Meat Products



Note. The red line is the simple linear regression line fit between the two variables.

Given animals and animal products are strong contributors to the disgust response, we also tested how individual differences in disgust affected the relation between avoidance intentions and disease stigma. The previous effects remained when trait disgust was added into the model as a covariate, $R^2 = .27$, $\beta_{Asian} = 0.20$, $SE = .06$, $t(442) = 3.18$, $p = .002$; $\beta_{animal} = 0.34$, $SE = .05$, $t(442) = 6.23$, $p < .001$.

These results have urgent implications for public health, as increased disease stigma can lead to increases in disease spread through a variety of mechanisms, from underreporting and non-social distancing to lower rates of testing and treatment seeking (see Stangl et al., 2019).

Indeed, although we did not see a direct effect of disease origin description on stigma, two of the factors that origin descriptions did affect (animal and xenophobic avoidance behaviors) had substantial effects themselves on disease stigma, suggesting a potential indirect effect of disease origin description on disease stigma via intentions to engage in specific avoidance behaviors. Consistent with this hypothesis, a follow-up mediation analysis showed that disease origin (pig versus not-pig) had a significant indirect effect on stigma through both animal (bootstrapped 95% CI [-0.39, -0.08]) and xenophobic (bootstrapped 95% CI [-0.42, -0.11]) avoidance intentions. These results provisionally suggest that perceived exoticness of food origins may increase salience of the animal and cultural origins of the disease, which then increases stigmatization.

The effect of xenophobic disease avoidance intentions on disease stigma remained when controlling for endorsement of Asian stereotypes. In a model testing the simultaneous effects of Asian stereotyping and xenophobic behavior intentions on disease stigma, both variables showed significant main effects: endorsing Asian stereotypes [β= 0.23, SE = .05, $t(412) = 4.85$, $p < .001$] and intentions to avoid Asian people or foreign travelers [β= 0.27, SE = .05, $t(412) = 5.67$, $p < .001$]. These results suggest that endorsement of Asian stereotypes and xenophobic disease avoidance intentions, while inter-related, nonetheless have independent effects on disease stigma.

Time-Dependent Effects

Given that the prevalence of COVID-19 cases changed considerably in the US over the course of the experiment, it may be useful to examine how risk perception, intentions to engage in avoidance behaviors, and stigma changed over the course of the survey period (January 25th through March 20th). To analyze time-dependent effects, we conducted regression models with

each measure as the dependent variable and the number of weeks into data collection for each participant as the independent variable. As can be seen from Table 2, a number of factors changed significantly over time, showing significant linear and quadratic effects, including risk perceptions, hygiene, and social distancing behaviors. In contrast, xenophobic and animal avoidance behaviors as well as disease stigma remained stable over time. All time-dependent effects are plotted in Figure 4.

Table 2

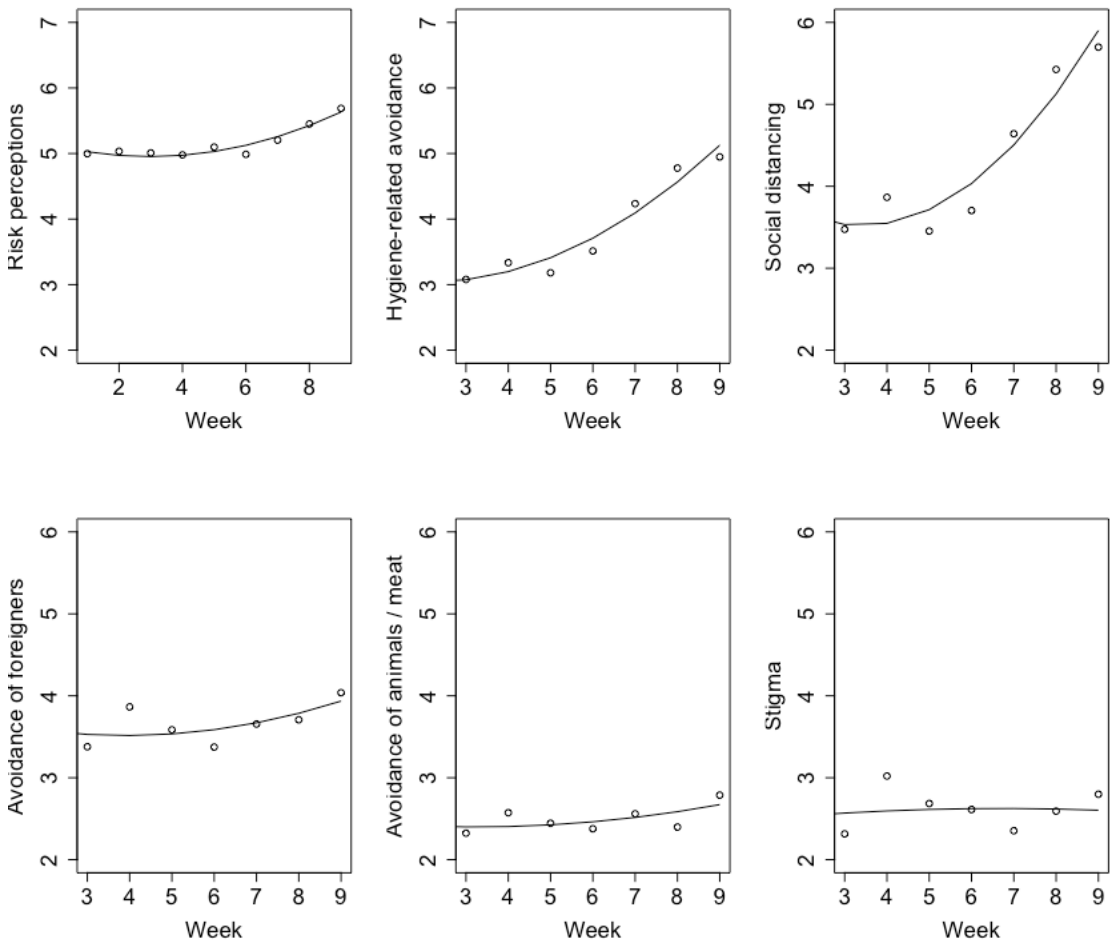
Polynomial Regression Models Predicting Perceived Risk, Avoidance Behaviors, and COVID-19 Stigma Over Time

Dependent variable	R^2	Effect	β	*S.E.*	*t*	*p*
Perceived risk	.18	β_{week}	-0.82	0.31	-2.64	.009*
		β_{week^2}	1.03	0.27	3.83	<.001*
Hygiene-related	.19	β_{week}	0.34	0.11	3.00	.003*
		β_{week^2}	0.20	0.09	2.27	.024*
Social distancing	.21	β_{week}	0.22	0.11	1.97	.050*
		β_{week^2}	0.32	0.09	3.62	<.001*
Xenophobic avoidance	.01	β_{week}	0.02	0.13	0.19	.852
		β_{week^2}	0.07	0.10	0.75	.453
Animal avoidance	.004	β_{week}	-0.04	0.16	-0.23	.822
		β_{week^2}	0.01	0.01	0.41	.682
COVID-19 stigma	.001	β_{week}	0.06	0.10	0.68	.497
		β_{week^2}	-0.005	0.01	-0.49	.627

Note. $*p < .05$

Figure 4

Intentions to Engage in Disease Prevention Behaviors and Perceived COVID-19 Stigma as a Function of Time



Discussion

The current results suggest that communications surrounding the putative zoonotic origins of a disease can impact the public's response in diverse ways. Experimental data from the first weeks of the US coronavirus outbreak showed that subtle changes in the species described as potential zoonotic origins of COVID-19 influenced several variables relevant to the public's response, including risk perception, preventative hygiene-related behaviors, and avoidance of animals. For each of these variables, describing a more familiar origin species (pigs) led to considerably lower risk perception and avoidance. Describing more exotic origins of COVID-19, such as bats, snakes, and dogs, led to considerably higher risk perception and protective

avoidance behaviors, but also increased intentions to engage in ineffective and potentially discriminatory behaviors, such as avoiding people of Asian descent and foreign travelers. Consistent with our hypothesis that describing exotic zoonotic origins could activate cultural biases against the disease and thus increase its stigmatizing effects, mediation analyses suggest that intentions to avoid people of Asian descent can then spillover into increased disease stigma, which past outbreaks suggest may delay treatment and increase disease spread (Inbar et al., 2009; Stangl et al., 2019).

Although the effects of zoonotic origin on health behavior intentions likely generalize to other infectious diseases, the present results are of immediate relevance to the global COVID-19 pandemic. Much of the early coverage of COVID-19 focused on the zoonotic source of the disease. Reports emphasized the consumption and handling of snakes, bats, and a host of other exotic animals in Chinese food markets. According to our data, such communications may have increased general risk perception and protective disease avoidance behaviors, such as handwashing. However, the strong emphasis on the wide range of animals used in Chinese cuisine may have activated common Western stereotypes regarding people of Asian descent, leading to maladaptive avoidance behaviors and possible discrimination. Such communications also may have led to avoidance of animals and animal products that would likely have little effect outside of the spatio-temporal context in which active animal-to-human disease transmission occurred. These two factors—avoidance of Asians and animals/animal products—may have also contributed to disease stigma, which can affect a wide range of public health behaviors related to containing the novel coronavirus that causes COVID-19. Therefore, it is possible that, while communications on the origins of a novel zoonosis create a compelling and

attention-grabbing narrative, they nonetheless encourage reasoning errors and inappropriate behaviors as such origins are not immediately relevant to the epidemiology of COVID-19.

The current results are important for understanding how stigma arises for novel diseases, and how it may interact with intentions to engage in particular avoidance behaviors. Stigma has been studied extensively with diseases like HIV/AIDS, where it is known to contribute to a variety of irrational reactions to non-risky contact, such as not wanting to touch objects people with HIV have touched (Fischer et al., 2019; Rozin et al., 1992, 1994). Origins of stigma for HIV/AIDS are known to arise from its association with death and stigmatized behaviors like drug use, risky sex, and homosexuality (Pryor et al., 1999). In these cases, the connection between stigma and avoidance behaviors is assumed to flow from stigma to avoidance: Stigmatizing HIV/AIDs leads people to avoid any contact, no matter how indirect, with people they see as contagion risks. In contrast, in the present case, stigma for COVID-19 may flow from avoidance intentions themselves. Indeed, although zoonotic descriptions did not have a direct impact on disease stigma, they did influence intentions to avoid Asian people, foreign travelers, and animals/animal products, and these intentions were associated with greater COVID-19 stigma. It is possible that for a novel disease, where the only cue to stigmatization is its origins and associations with death, intentions to avoid salient aspects of its origin (people from that culture) or food/animal products could themselves cause increases in disease stigma. Such similarity-based effects are a known part of reasoning about contagion (Rozin et al., 1986) and are potentially a generalization of the disgust responses. Future research on novel infectious diseases will be needed to address how avoidance intentions both influence and flow from stigmatization, and how these relationships change as concepts of a disease become crystalized (as in HIV/AIDs).

As with any data linked with a specific event, such as a disease outbreak or natural disaster, it is unclear whether these results will generalize to other times and places. Most of our participants grew up in the US, and all of them lived there at the time of data collection. Data were also collected during the first weeks of the US outbreak, when available information and disease rates were changing rapidly on a daily basis. Results, therefore, may not generalize to other cultures. However, we speculate that the core findings will extend to other outbreaks of zoonotic origin, at minimum. Given that a majority of novel viruses originate in animals (Jones et al., 2008), it is probable that there will be chances to replicate or falsify the effects reported here in future outbreaks (albeit likely on smaller scales).

In conclusion, we show that conveying exotic zoonotic origins for a novel disease, such as COVID-19, can not only lead to increases in overall risk perception and adaptive hygienic behaviors, but also to maladaptive behaviors such as avoiding a culture associated with the origin of the disease. The tendency to avoid cultures, in particular, is associated with stigma for a disease, which can affect the efficacy of efforts to slow the spread of a pandemic and present a barrier to treatment. This is a critical finding as it suggests that how the origins of a disease are described at the beginning of a pandemic—by public health organizations, political leaders, and the media—may have significant downstream effects well beyond the point when the origins of a disease have any relevance to disease transmission and a disease is spreading person-to-person globally.

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News prompts shown to participants:

Dogs could be the source of the Wuhan coronavirus outbreak (CNN Health)

The nagging question on everyone's mind today is whether coronavirus has already landed on U.S. shores. The virus outbreak, which began in the city of Wuhan in China, has become an issue of great concern worldwide, particularly after its rapid spread.

Using samples of the virus isolated from patients, scientists in China have determined the genetic code of the virus and used microscopes to photograph it. The pathogen responsible for this pandemic is a new coronavirus. Given dogs are the source of some coronaviruses, it is possible that dogs may be the original source of the newly discovered coronavirus that has triggered an outbreak of the deadly infectious respiratory illness in China this winter.

Snakes could be the source of the Wuhan coronavirus outbreak (CNN Health)

The nagging question on everyone's mind today is whether coronavirus has already landed on U.S. shores. The virus outbreak, which began in the city of Wuhan in China, has become an issue of great concern worldwide, particularly after its rapid spread.

Using samples of the virus isolated from patients, scientists in China have determined the genetic code of the virus and used microscopes to photograph it. The pathogen responsible for this pandemic is a new coronavirus. Given snakes are the source of some coronaviruses, it is possible that snakes may be the original source of the newly discovered coronavirus that has triggered an outbreak of the deadly infectious respiratory illness in China this winter.

Pigs could be the source of the Wuhan coronavirus outbreak (CNN Health)

The nagging question on everyone's mind today is whether coronavirus has already landed on U.S. shores. The virus outbreak, which began in the city of Wuhan in China, has become an issue of great concern worldwide, particularly after its rapid spread.

Using samples of the virus isolated from patients, scientists in China have determined the genetic code of the virus and used microscopes to photograph it. The pathogen responsible for this pandemic is a new coronavirus. Given pigs are the source of some coronaviruses, it is possible that pigs may be the original source of the newly discovered coronavirus that has triggered an outbreak of the deadly infectious respiratory illness in China this winter.

Bats could be the source of the Wuhan coronavirus outbreak (CNN Health)

The nagging question on everyone's mind today is whether coronavirus has already landed on U.S. shores. The virus outbreak, which began in the city of Wuhan in China, has become an issue of great concern worldwide, particularly after its rapid spread.

Using samples of the virus isolated from patients, scientists in China have determined the genetic code of the virus and used microscopes to photograph it. The pathogen responsible for this pandemic is a new coronavirus. Given bats are the source of some coronaviruses, it is possible that bats may be the original source of the newly discovered coronavirus that has triggered an outbreak of the deadly infectious respiratory illness in China this winter.

Food markets could be the source of the Wuhan coronavirus outbreak (CNN Health)

The nagging question on everyone's mind today is whether coronavirus has already landed on U.S. shores. The virus outbreak, which began in the city of Wuhan in China, has become an issue of great concern worldwide, particularly after its rapid spread.

Using samples of the virus isolated from patients, scientists in China have determined the genetic code of the virus and used microscopes to photograph it. The pathogen responsible for this pandemic is a new coronavirus. Given food markets are the source of some coronaviruses, it is possible a food market may be the original source of the newly discovered coronavirus that has triggered an outbreak of the deadly infectious respiratory illness in China this winter.

All survey items with descriptive statistics

- Familiarity with the virus
  - Q118 - How likely are you to catch coronavirus? (*M* = 2.60, *SD* = 1.49)
  - familiar.w.virus - How familiar are you with the coronavirus? (*M* = 4.03, *SD* = 0.93)
- Baseline
  - wild.animal - How likely are you to get corona virus from being bitten by a wild animal? (*M* = 2.13, *SD* = 1.60)
  - contaminated.food - How likely are you to get corona virus from eating contaminated food? (*M* = 2.99, *SD* = 1.90)
  - wild.area - How likely are you to get corona virus from being in the same area as a wild animal? (*M* = 2.19, *SD* = 1.55)
  - interacting.w.ppl - How likely are you to get corona virus from interacting with people? (*M* = 4.99, *SD* = 1.67)
  - dog.base - How likely are **dogs** to carry a new disease that can be spread to humans? (*M* = 3.08, *SD* = 1.57)
  - snake.base - How likely are **snakes** to carry a new disease that can be spread to humans? (*M* = 2.88, *SD* = 1.68)
  - pig.base - How likely are **pigs** to carry a new disease that can be spread to humans? (*M* = 4.06, *SD* = 1.71)
  - bat.base - How likely are **bats** to carry a new disease that can be spread to humans? (*M* = 4.54, *SD* = 1.76)
  - market.base - How likely are **food markets** to contain a new disease that can be spread to humans? (*M* = 4.31, *SD* = 1.57)
- COVID-19 risk perceptions (Cronbach's alpha = 0.77)
  - risk1 - The coronavirus poses a serious risk. (*M* = 5.84, *SD* = 1.17)
  - risk2 - The coronavirus should be taken very seriously. (*M* = 6.26, *SD* = 1.01)
  - risk3 - I am at risk for contracting the coronavirus. (*M* = 3.76, *SD* = 1.66)
  - risk4 - The coronavirus is a deadly disease. (*M* = 5.67, *SD* = 1.24)
  - risk5 - There is a significant probability that I or someone I know will contract coronavirus. (*M* = 3.40, *SD* = 1.73)
  - risk6 - The coronavirus is a severe disease. (*M* = 5.76, *SD* = 1.25)
  - risk7 - I am worried that I will contract the coronavirus. (*M* = 3.63, *SD* = 1.86)
  - risk8 - I am changing my behavior (e.g., how often I go outside, my travel plans) to lower my risk of contracting the coronavirus. (*M* = 3.82, *SD* = 2.07)
- Avoidance behaviors
  - Hygiene-related avoidance (Cronbach's alpha = 0.82)
    - avoid1 - Because of the coronavirus outbreak, I plan on wearing a face mask more often. (*M* = 2.68, *SD* = 1.75)
    - avoid3 - Because of the coronavirus outbreak, I plan on decreasing how much I shake hands with other people. (*M* = 4.45, *SD* = 2.17)
    - avoid6 - Because of the coronavirus outbreak, I plan on washing my hands more often. (*M* = 4.45, *SD* = 2.17)

583 ▪ avoid9 - Because of the coronavirus outbreak, I plan on wearing gloves
584 more often. (*M* = 5.16, *SD* = 2.00)
585 o Social distancing avoidance (Cronbach's alpha = 0.88)
586 ▪ avoid5 - Because of the coronavirus outbreak, I plan on avoiding people
587 who recently traveled from another state. (*M* = 4.14, *SD* = 2.15)
588 ▪ avoid11 - Because of the coronavirus outbreak, I plan on avoiding sick
589 people. (*M* = 5.15, *SD* = 1.86)
590 ▪ avoid12 - Because of the coronavirus outbreak, I plan on avoiding crowds.
591 (*M* = 4.39, *SD* = 2.08)
592 ▪ avoid13- Because of the coronavirus outbreak, I plan on avoiding public
593 transportation.
594 o Xenophobia-related avoidance (Cronbach's alpha = 0.87)
595 ▪ avoid2 - Because of the coronavirus outbreak, I plan on avoiding people
596 who have recently traveled to China. (*M* = 5.03, *SD* = 1.98)
597 ▪ avoid4 - Because of the coronavirus outbreak, I plan on avoiding people
598 who recently traveled from a foreign country. (*M* = 4.51, *SD* = 2.01)
599 ▪ avoid7 - Because of the coronavirus outbreak, I plan on avoiding people
600 who immigrated from China. (*M* = 3.28, *SD* = 2.04)
601 ▪ avoid8 - Because of the coronavirus outbreak, I plan on avoiding people of
602 Chinese descent. (*M* = 2.75, *SD* = 1.92)
603 ▪ avoid10 - Because of the coronavirus outbreak, I plan on avoiding people
604 of Asian descent. (*M* = 2.62, *SD* = 1.84)
605 o Animal, meat avoidance (Cronbach's alpha = 0.89)
606 ▪ avoid14 - Because of the coronavirus outbreak, I plan on avoiding eating
607 meat. (*M* = 2.18, *SD* = 1.55)
608 ▪ Avoid15 - Because of the coronavirus outbreak, I plan on avoiding
609 handling meat. (*M* = 2.39, *SD* = 1.64)
610 ▪ Avoid16 - Because of the coronavirus outbreak, I plan on avoiding
611 interacting with animals. (*M* = 2.51, *SD* = 1.72)
612 ▪ Avoid17 - Because of the coronavirus outbreak, I plan on avoiding going
613 to farms. (*M* = 2.87, *SD* = 1.89)
614 • Virus stigma (Cronbach's alpha = 0.88)
615 o Stigma1 - I would be ashamed to tell people if I contracted the coronavirus. (*M* =
616 2.70, *SD* = 1.75)
617 o Stigma2 - It would be embarrassing to contract the coronavirus. (*M* = 2.82, *SD* =
618 1.86)
619 o Stigma3 - If a friend of mine contracted the coronavirus, I would tell them not to
620 tell anyone unless it's necessary. (*M* = 2.18, *SD* = 1.66)
621 • Disease similarity
622 o Flu - How similar is coronavirus to **influenza ("the flu")**? (*M* = 4.96, *SD* = 1.38)
623 o Ebola - How similar is coronavirus to **ebola**? (*M* = 3.01, *SD* = 1.65)
624 o Cold - How similar is coronavirus to **the common cold**? (*M* = 4.14, *SD* = 1.70)
625 o Stomach.flu - How similar is coronavirus to **stomach flu**? (*M* = 3.44, *SD* = 1.61)
626 o Bird.flu - How similar is coronavirus to **"bird flu"**? (*M* = 4.44, *SD* = 1.50)
627 o Mad.cor - How similar is coronavirus to **"mad cow disease"**? (*M* = 2.63, *SD* =
628 1.61)

629 - Sars - How similar is coronavirus to **SARS**? (*M* = 4.86, *SD* = 1.77)
630 - Ecoli - How similar is coronavirus to **e.coli**? (*M* = 2.53, *SD* = 1.51)
631 - Salmonella - How similar is coronavirus to **salmonella**? (*M* = 2.41, *SD* = 1.50)
632 - Zika - How similar is coronavirus to the **Zika Virus**? (*M* = 3.19, *SD* = 1.68)
633 - Botulism - How similar is coronavirus to **botulism**? (*M* = 2.43, *SD* = 1.48)
634 • Animal stigma
635 - Dog1 - **Dogs** are dirty animals. (*M* = 2.98, *SD* = 1.70)
636 - Q119 - I avoid interacting with **dogs.** (*M* = 2.10, *SD* = 1.57)
637 - Q141 - **Dogs** are dangerous animals. (*M* = 2.47, *SD* = 1.53)
638 - Dog3 - I don't like **dogs**. (*M* = 1.90, *SD* = 1.50)
639 - Snake1 - **Snakes** are dirty animals. (*M* = 3.20, *SD* = 1.83)
640 - Q120 - I avoid interacting with **snakes.** (*M* = 5.36, *SD* = 1.84)
641 - Q142 - **Snakes** are dangerous animals. (*M* = 5.10, *SD* = 1.52)
642 - Snake3 - I don't like **snakes**. (*M* = 4.72, *SD* = 2.06)
643 - Pig1 - **Pigs** are dirty animals. (*M* = 4.80, *SD* = 1.82)
644 - Q121 - I avoid interacting with **pigs.** (*M* = 4.11, *SD* = 1.92)
645 - Q143 - **Pigs** are dangerous animals. (*M* = 2.93, *SD* = 1.57)
646 - Pig3 - I don't like **pigs**. (*M* = 2.93, *SD* = 1.72)
647 - Bat1 - **Bats** are dirty animals. (*M* = 4.58, *SD* = 1.86)
648 - Q122 - I avoid interacting with **bats.** (*M* = 5.71, *SD* = 1.63)
649 - Q144 - **Bats** are dangerous animals. (*M* = 4.53, *SD* = 1.81)
650 - Bat3 - I don't like **bats**. (*M* = 4.43, *SD* = 2.12)
651 - Store1 - **Food markets** are dirty places. (*M* = 3.63, *SD* = 1.69)
652 - Q124 - I avoid going to **food markets.** (*M* = 2.70, *SD* = 1.68)
653 - Q145 - **Food markets** are dangerous places. (*M* = 2.63, *SD* = 1.54)
654 - Store3 - I don't like **food markets**. (*M* = 2.62, *SD* = 1.59)
655 • Animal-human similarity
656 - Dog.sim - How similar are **dogs** to humans? (*M* = 3.49, *SD* = 1.73)
657 - Snake.sim - How similar are **snakes** to humans? (*M* = 2.00, *SD* = 1.23)
658 - Pig.sim - How similar are **pigs** to humans? (*M* = 3.39, *SD* = 1.77)
659 - Bat.sim - How similar are **bats** to humans? (*M* = 2.16, *SD* = 1.39)
660 - Market.sim - How similar are **food markets** to humans? (*M* = 2.40, *SD* = 1.74)
661 • Vaccines
662 - Vax.possible - How likely is it that a vaccine can be developed for the
663 coronavirus? (*M* = 2.72, *SD* = 1.53)
664 - Corona.vax.intention - If a vaccine was developed for the coronavirus and
665 approved by the FDA, how likely are you to get vaccinated? (*M* = 3.28, *SD* =
666 1.96)
667 - Flu.vax.past.behavior - Did you receive the flu vaccine last flu season? (*M* = 2.67,
668 *SD* = 1.81)
669 - Flu.vax.future - Are you going to receive the flu vaccine next flu season? (*M* =
670 3.19, *SD* = 1.55)
671 - Vax.skep.1 - Vaccines are harmful, and this fact is covered up or downplayed. (*M*
672 = 2.39, *SD* = 1.77)
673 - Vax.skep.2 - Vaccines are tampered with. (*M* = 2.33, *SD* = 1.69)
674 - Vax.skep.3 - Vaccine safety data are often fabricated. (*M* = 2.43, *SD* = 1.77)

    - Vax.skep.4 - Immunizing children is harmful and this fact is downplayed. (*M* = 2.20, *SD* = 1.69)
    - Vax.skep.5 - People have been deceived about vaccine efficacy. (*M* = 2.48, *SD* = 1.83)
    - Vax.skep.6 - Vaccine efficacy data are often fabricated. (*M* = 2.39, *SD* = 1.77)
    - Vax.skep.7 - People have been deceived about vaccine safety. (*M* = 2.53, *SD* = 1.92)
    - Vax.skep.8 - Government officials have covered up or downplayed the dangers of vaccines. (*M* = 2.41, *SD* = 1.82)
    - Vax.skep.9 - Academics (scientists, researchers) have covered up or downplayed the dangers of vaccines. (*M* = 2.38, *SD* = 1.78)
    - Vax.skep.10 - Pharmaceutical companies have covered up or downplayed the dangers of vaccines. (*M* = 2.64, *SD* = 1.93
    - Vax.skep.11 - I feel uncertain about the motives of those involved with vaccines (governments, pharmaceutical companies, etc.). (*M* = 2.68, *SD* = 1.88)
    - Vax.skep.12 - Vaccines weaken the immune system. (*M* = 2.47, *SD* = 1.74)
    - Vax.skep.13 - Multiple vaccines overwhelm an infant's immune system. (*M* = 2.96, *SD* = 1.88)
    - Vax.skep.14 - The side-effects of vaccines are unforeseeable. (*M* = 3.06, *SD* = 1.81)
    - Vax.skep.15 - Vaccines can lead to allergies. (*M* = 3.04, *SD* = 1.77)
    - Vax.skep.16 - Vaccinations can cause the illnesses they are intended to protect against. (*M* = 3.07, *SD* = 1.89)
- Freq/prob
    - Freq - The flu kills about 468,500 infected people, on average, per season worldwide. So far, the Wuhan Coronavirus (COVID-19) has killed 1,370 of infected people worldwide. How dangerous is the Wuhan Coronavirus compared to the flu? (*M* = 4.08, *SD* = 1.95)
    - Prob - The flu kills about 0.1% of infected people, on average, per season worldwide. So far, the Wuhan Coronavirus (COVID-19) has killed 2% of infected people. How dangerous is the Wuhan Coronavirus compared to the flu? (*M* = 5.96, *SD* = 0.94)
- News, media diet (Cronbach's alpha = 0.90)
    - News1 - I watch (or read) a lot of news. (*M* = 5.14, *SD* = 1.54)
    - News2 - I tend to hear about major events in the world right away. (*M* = 5.24, *SD* = 1.44)
    - News 3 – Where do you get your news?
- Disgust (Cronbach's alpha = 0.89)
    - D1 - You see someone put ketchup on vanilla ice cream, and eat it. (*M* = 2.41, *SD* = 1.79)
    - D2 - You are about to drink a glass of milk when you smell that it is spoiled. (*M* = 3.63, *SD* = 1.87)
    - D3 - You see maggots on a piece of meat in an outdoor garbage pail. (*M* = 4.14, *SD* = 1.60)
    - D4 - You are walking barefoot on concrete, and you step on an earthworm. (*M* = 3.83, *SD* = 1.90)

    - D5 - You see a bowel movement left unflushed in a public toilet. (*M* = 2.96, *SD* = 1.85)
    - D6 - While you are walking through a tunnel under a railroad track, you smell urine. (*M* = 3.15, *SD* = 1.64)
    - D7 - You see a man with his intestines exposed after an accident. (*M* = 4.37, *SD* = 1.63)
    - D8 - Your friend's pet cat dies, and you have to pick up the dead body with your bare hands. (*M* = 4.41, *SD* = 1.53)
    - D9 - You accidentally touch the ashes of a person who has been cremated. (*M* = 4.75, *SD* = 1.39)
    - D10 - You take a sip of soda, and then realize that you drank from the glass that an acquaintance of yours had been drinking from. (*M* = 3.62, *SD* = 1.79)
    - D11 - A friend offers you a piece of chocolate shaped like dog-doo. (*M* = 3.73, *SD* = 1.74)
    - D12 - As part of a sex education class, you are required to inflate a new unlubricated condom. (*M* = 5.80, *SD* = 0.77)
- Asian stereotypes (Cronbach's alpha = 0.94)
    - Saaas1 - Asian Americans seem to be striving to become number one. (*M* = 2.41, *SD* = 0.96)
    - Saaas2 - Asian Americans commit less time to socializing than others do. (*M* = 2.14, *SD* = 0.93)
    - Saaas3 - In order to get ahead of others, Asian Americans can be overly competitive. (*M* = 2.56, *SD* = 1.01)
    - Saaas4 - Asian Americans do not usually like to be the center of attention at social gatherings. (*M* = 2.58, *SD* = 0.88)
    - Saaas5 - Most Asian Americans have a mentality that stresses gain of economic power. (*M* = 2.48, *SD* = 0.93)
    - Saaas6 - Asian Americans can sometimes be regarded as acting too smart. (*M* = 2.32, *SD* = 1.00)
    - Saaas7 - Asian Americans put high priority on their social lives. (*M* = 2.23, *SD* = 0.81)
    - Saaas8 - Asian Americans do not interact with others smoothly in social situations. (*M* = 2.05, *SD* = 0.91)
    - Saaas9 - As a group, Asian Americans are not constantly in pursuit of more power. (*M* = 2.61, *SD* = 0.92)
    - Saaas10 - When it comes to education, Asian Americans aim to achieve too much. (*M* = 2.37, *SD* = 1.02)
    - Saaaas11 - Asian Americans tend to have less fun compared to other social groups. (*M* = 2.18, *SD* = 0.96)
    - Saaas12 - A lot of Asian Americans can be described as working all the time. (*M* = 2.70, *SD* = 0.95)
    - Saaas13 - The majority of Asian Americans tend to be shy and quiet. (*M* = 2.51, *SD* = 0.92)
    - Saaas14 - Asian Americans are not very "street smart". (*M* = 2.04, *SD* = 0.89)
    - Saaas15 - Asian Americans know how to have fun and can be pretty relaxed. (*M* = 2.94, *SD* = 0.85)

- Saaas16 - Most Asian Americans are not very vocal. (*M* = 2.34, *SD* = 0.88)
- Saaas17 - Asian Americans are a group not obsessed with competition. (*M* = 2.39, *SD* = 0.93)
- Saaas18 - Asian Americans spend a lot of time at social gatherings. (*M* = 2.42, *SD* = 0.79)
- Saaas19 - Oftentimes, Asian Americans think they are smarter than everyone else is. (*M* = 2.31, *SD* = 0.97)
- Saaas20 - Asian Americans enjoy a disproportionate amount of economic success. (*M* = 2.23, *SD* = 0.91)
- Saaas21 - Asian Americans are not as social as other groups of people. (*M* = 2.28, *SD* = 0.92)
- Saaas22 - Asian Americans are motivated to obtain too much power in society. (*M* = 2.07, *SD* = 0.91)
- Saaas23 - Most Asian Americans function well in social situations. (*M* = 2.98, *SD* = 0.81)
- Saaas24 - Many Asian Americans always seem to compare their own achievements to other people's. (*M* = 2.98, *SD* = 0.81)
- Saaas25 - Asian Americans rarely initiate social events or gatherings. (*M* = 2.23, *SD* = 0.88)