Risk Analysis, Vol. 42, No. 3, 2022 DOI: 10.1111/risa.13764

The Double Bind of Communicating About Zoonotic Origins: Describing Exotic Animal Sources of COVID-19 Increases Both Healthy and Discriminatory Avoidance Intentions

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Many novel diseases are of zoonotic origin, likely including COVID-19. Describing diseases as originating from a diverse range of animals is known to increase risk perceptions and intentions to engage in preventative behaviors. However, it is also possible that communications depicting use of exotic animals as food sources may activate stereotypes of cultures at the origin of a disease, increasing discriminatory behaviors and disease stigma. We used general linear modeling and mediation analysis to test experimental data on communications about zoonotic disease origins from the critical first two months leading up to the declaration of a global pandemic. Results suggest that communications about potential familiar food origins (pigs) affected people's risk perceptions, health behaviors, and COVID-19 stigma compared to more exotic food sources (e.g., snakes). Participants ($N = 707$) who read descriptions of exotic origins viewed the virus as riskier and reported stronger intentions to engage in preventative behaviors than those who read about familiar origins (pigs). However, reading exotic origin descriptions was also associated with stronger intentions to avoid Asian individuals and animal products. These results are critical for both theory and public policy. For theory, they are the first to experimentally demonstrate that zoonotic origin descriptions can impact intentions to engage in discriminatory behaviors for cultures viewed as the origin of a novel infectious disease. For policy, they offer clear, actionable insights on how to communicate about risks associated with a novel zoonosis while managing the potential impact on discriminatory behaviors and stigma.

KEY WORDS: Discrimination; disease stigma; health communication; public health; risk perceptions; zoonosis

1. INTRODUCTION

Beginning around November and 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. Because approximately 60% of new diseases are of zoonotic origin (Jones et al., 2008), likely including COVID-19, it is important to

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0272-4332/22/0100-0506$22.00/1

investigate how news coverage and public health messaging regarding zoonotic disease origins affects public behavior. 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 insight into how communications about novel emerging diseases can impact intentions to engage in disease avoidance behaviors during the public's initial reaction to an outbreak.

Encouraging the public to engage in appropriate behaviors during emergencies often requires a delicate touch as such communications can inadvertently cause unnecessary fear among the public (Pearce, Lindekilde, Parker, & Rogers, 2019). Seemingly minor aspects of a message, such as framing a decision as minimizing losses or maximizing gains, can affect public behavior (Keller & Wang, 2017). Public health experts advise against speculating about ongoing research and to instead focus solely on what is currently known (Allen, 2018). Despite this, news sources, which play a large role in the public's risk perceptions of novel diseases (Yang, Dillard, & Li, 2018), and public health organizations like the Centers for Disease Control and Prevention (2020), World Health Organization (2020), and National Foundation for Infectious Diseases (2020) described a diverse number of potential zoonotic origins of COVID-19 (e.g., cattle, camels, civets, dogs, pigs, cats) and the use of animals in food sold at the Wuhan market early in the pandemic. Many of these food sources would be considered exotic from a Western perspective. Since these perceptions of exoticness are associated with a disgust response (Martins & Pilner, 2006), it is possible that communications highlighting the cuisine associated with the initial COVID-19 transmissions created heightened fear and risk perceptions toward the disease.

Media reports in the first weeks of the pandemic discussed 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 that are potential disease reservoirs (Davis, Goldwater, Ireland, Gaylord, & Van Allen, 2017; Tapp et al., 2018). In this case, the emphasis on exoticness alone can increase risk perceptions and intentions to engage in disease avoidance behaviors (Scherer, Knaus, Zikmund-Fisher, Das, & Fagerlin, 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 origins 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 nonaffected populations have shown that disease descriptions emphasizing specific zoonotic origins were sufficient to increase risk perceptions and intentions to engage in disease avoidance behaviors (Davis et al., 2017 , 2020). Risk perceptions associated with Ebola were 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, Sherman, & Updegraff, 2016). Xenophobic attitudes and behaviors like these were also observed being directed toward Latinx Americans during the 2009 H1N1 outbreak, also labeled "Mexican flu" by the media (McCauley, Minsky, & Viswanath, 2013). Thus, 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 (Egolf, Hartmann, & Siegrist, 2019; Martins & Pilner, 2005; Ritchey, Frank, Hursti, & Tuorila, 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 the 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 (Fong, 2007; Li, 2014; Parker, 1994). 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, Keefer, Leonhard, & Nealon-Woods, 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, Winstead, Greene, Serovich, & Elwood, 2002; Frost, Parsons, & Nanín, 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; see Peprah & Gyasi, 2020). Concerns about the social consequences of reporting a positive test result may be justified, given that healthcare workers treating COVID-19 as well as people diagnosed with the disease have faced ostracism (lasting beyond the recommended quarantine period) and, in some cases, physical attacks and eviction (Bagcchi, 2020; Singh & Subedi, 2020). Additionally, there has recently been a surge in anti-Asian attacks widely believed to have resulted, in part, from rhetoric surrounding the COVID-19 outbreak, such as former U.S. President Donald Trump referring to the disease as "kung-flu" and "the Chinese virus" (Litam, 2020).

1.1. Study Objectives and Hypotheses

The present study examines how media messages that emphasized different animal COVID-19 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. It was 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. However, exotic origins were also expected to increase intentions to engage in xenophobic behaviors, like avoiding people of Asian descent. Given the strong interrelations between stigma, stereotyping, and disgust (Terrizzi, Shook, & Ventis, 2010; Vartanian, Thomas, & Vanman, 2013, 2016), the current study examined how COVID-19 stigma related to xenophobic disease responses and intentions to avoid animal products while adjusting for trait levels of disgust and endorsement of Asian stereotypes. We further hypothesized that COVID-19 stigma mediated the influence of disease origin messaging (e.g., focusing on snakes as the source) on xenophobic and animal avoidance intentions.

We also tested a number of relevant exploratory questions regarding the public's early conceptualization of the COVID-19 disease, including: Did people perceive the disease as emerging from culinary practices? Did people have prevignette beliefs about how likely each animal source was to be the origin of COVID-19? Finally, did people view COVID-19 as being more similar to other common respiratory diseases like influenza, relative to foodborne diseases like salmonella, or recent pandemics like Zika?

2. METHODS

2.1. Participants

We recruited 701 participants (age range 20–78, $M = 38.7$, $SD = 11.95$; 400 men, 296 women, and 5 others) through Amazon's Mechanical Turk (MTurk) platform to complete an online experiment (see Table I for broader demographics; Table II for regional statistics). MTurk is a widely used tool for collecting high quality data for research purposes, with some caveats about generalizability to the general population (Mortensen & Hughes, 2018).

Participants were recruited from January 25th, 2020 to March 20th, 2020. This time span captured the early dissemination of COVID-19-related information and the public's initial reactions. This time frame closely proceeded the first confirmed COVID-19 case in the United States and overlaps with the WHO's declaration of a global health emergency, its

Table I. Participant Demographic Characteristics

Demographics	Present sample	U.S. Population	Diff %
Age	$M = 38.73$ (11.95)	38.50	
Sex			
Male	400 (56.90%)	49.20%	7.7%
Female	298 (42.11%)	50.80%	−8.69%
Other / Prefer not to say	5 (0.14%)		
Ethnicity			
Asian American	35 (4.99 %)	5.70%	−0.71%
Black or African American	59 (8.42%)	12.80%	−4.38%
Hispanic	43 (6.13%)	18.40%	−12.27%
Native American or Alaskan American	3 (0.43%)	1.10%	−0.67%
White or Caucasian American	546 (77.89%)	72.00%	5.89%
Other/Prefer not to say	15 (2.14%)	NA	-
Education			
High school degree (or less)	88 (12.55%)	26.90%	−14.35%
Some college	194 (27.67%)	20.00%	7.67%
College degree	327 (46.65%)	28.90%	17.75%
Some postgraduate work	22 (3.14%)		
Postgraduate degree	70 (9.99%)	12.80%	−2.81%
Income			
> $10,000–19,000	71 (10.13%)	19.75%	−9.62%
$20,000–39,999	185 (26.39%)	23.50%	2.89%
$40,000–59,999	177 (25.25%)	17.50%	7.75%
$60,000–79,999	126 (17.97%)	12.25%	5.72 %
$80,000–99,999	69 (9.84 %)	8.75%	1.09%
$100,000 or more	73 (10.41%)	19.50%	−9.09 %

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

Table II. Means (Standard Deviations) of COVID-19 Related Variables across Four U.S. Regions and COVID-19 Outcomes from March 20th, 2019

Measure	Northeast ($n = 97$)	Midwest ($n = 100$)	South ($n = 177$)	West ($n = 106$)	F, p
Risk perceptions	4.81 (1.01)	4.56 (1.26)	4.87 (1.05)	4.85 (0.95)	2.02, 0.111
Hygiene	3.96 (1.50)	3.47 (1.58)	3.83 (1.53)	3.82 (1.57)	1.62, 0.185
Social distancing	4.39 (1.68)	3.88 (1.69)	4.33 (1.78)	4.32 (1.70)	1.72, 0.162
Xenophobic	3.84 (1.72)	3.24 (1.58)	3.66 (1.49)	3.67 (1.58)	2.36, 0.071
Animal, meat	2.43 (1.46)	2.22 (1.30)	2.42 (1.35)	2.59 (1.58)	1.05, 0.368
Virus stigma	2.40 (1.49)	2.31 (1.32)	2.50 (1.57)	2.85 (1.65)	2.51, 0.058
Cases (Deaths)	4,654 (34)	1,943 (20)	3,407 (55)	3,745 (117)	

Note: Consistent with the U.S. Census, we defined "Northeast" as CT, ME, MA, NH, RI, VT, NJ, NY, and PA, "Midwest" as IN, IL, MI, OH, WI, IA, KS, MN, MO, NE, ND, SD, "South" as DE FL, GA, MD, NC, SC, VA, WV, AL, KY, MS, TN, AR, LA, OK, TX, and "West" as AZ, CO, ID, NM, MT, UT, NV, WY, AK, CA, HI, OR, WA.

pandemic status on March 11th, and the U.S. declaration of a national emergency on March 13th. The experiment ended just after California became the first U.S. state to issue a stay-at-home order.

Participants were paid $2 and gave informed consent by continuing past an information sheet describing the goal of the study and contact information for the principal investigator. This study was approved by Texas Tech University's Human Research Protection Program. To screen for data quality, we removed any participant who failed a manipulation check, described in Section 2.3 below, resulting in removal of 17 participants. This removal did not affect the significance of any results and thus did not alter any of our conclusions (see Supporting Information File 2 for full sample results).

Table III. Items and Descriptive Statistics for COVID-19 Specific Measures

Measure	Text	*M* (*SD*)
Virus risk ($\alpha = 0.85$)		
	The coronavirus poses a serious risk.	5.48 (1.17)
	The coronavirus should be taken very seriously.	6.26 (1.01)
	I am at risk for contracting the coronavirus.	3.76 (1.66)
	The coronavirus is a deadly disease.	5.67 (1.24)
	There is a significant probability that I or someone I know will contract coronavirus.	3.40 (1.73)
	The coronavirus is a severe disease.	5.76 (1.25)
	I am worried that I will contract the coronavirus.	3.63 (1.86)
	I am changing my behavior (e.g., how often I go outside, my travel plans) to lower my risk of contracting the coronavirus.	3.82 (2.07)
Hygiene ($\alpha = 0.82$)		
	Because of the coronavirus outbreak, I plan on wearing a face mask more often.	2.68 (1.75)
	Because of the coronavirus outbreak, I plan on decreasing how much I shake hands with other people.	4.45 (2.17)
	Because of the coronavirus outbreak, I plan on washing my hands more often.	4.45 (2.17)
	Because of the coronavirus outbreak, I plan on wearing gloves more often.	5.16 (2.00)
Social distancing ($\alpha = 0.88$)		
	Because of the coronavirus outbreak, I plan on avoiding people who recently traveled from another state.	4.14 (2.15)
	Because of the coronavirus outbreak, I plan on avoiding sick people.	5.15 (1.86)
	Because of the coronavirus outbreak, I plan on avoiding crowds.	4.39 (2.08)
Xenophobic ($\alpha = 0.88$)		
	Because of the coronavirus outbreak, I plan on avoiding people who have recently traveled to China.	5.03 (1.98)
	Because of the coronavirus outbreak, I plan on avoiding people who recently traveled from a foreign country.	4.51 (2.01)
	Because of the coronavirus outbreak, I plan on avoiding people who immigrated from China.	3.28 (2.04)
	Because of the coronavirus outbreak, I plan on avoiding people of Chinese descent.	2.75 (1.92)
	Because of the coronavirus outbreak, I plan on avoiding people of Asian descent.	2.62 (1.84)
Animal, meat ($\alpha = 0.88$)		
	Because of the coronavirus outbreak, I plan on avoiding eating meat.	2.18 (1.55)
	Because of the coronavirus outbreak, I plan on avoiding handling meat	2.39 (1.64)
	Because of the coronavirus outbreak, I plan on avoiding interacting with animals.	2.51 (1.72)
	Because of the coronavirus outbreak, I plan on avoiding going to farms.	2.87 (1.89)
Virus stigma ($\alpha = 0.88$)		
	I would be ashamed to tell people if I contracted the coronavirus.	2.70 (1.75)
	It would be embarrassing to contract the coronavirus.	2.82 (1.86)
	If a friend of mine contracted the coronavirus, I would tell them not to tell anyone unless it's necessary.	2.18 (1.66)

α = Cronbach's alpha, *M* = means, *SD* = standard deviations

2.2. Measures

All questionnaires consisted of statements which asked participants to rate their agreement on a 7-point scale anchored at 1 = "strongly disagree" and 7 = "strongly agree," except in cases where we were asking about the likelihood of an event or participants' familiarity with the event, for example, COVID-19, in which case the scale was anchored accordingly with 1 = "very unlikely" and 7 = "very likely" or 1 = "very unfamiliar" and 7 = "very familiar." All items and descriptive statistics for COVID-19 specific measures can be found in Table III. The average numerical score for each scale was used for data analysis. Cronbach's alpha (α) and the average item-total correlations ($\bar{r}_{it}$) are reported for each measure below, where relevant.

2.2.1. Baseline Judgments of Disease Communicability

To assess baseline beliefs about COVID-19, participants were asked to rate the likelihood of contracting the virus under various circumstances. These included people's perceptions of how likely they were to contract COVID-19 from being bitten by a wild animal, eating contaminated food, being around a wild animal, and interacting with people. Participants were also asked, "How likely are [sources] to carry (or spread) a new disease that can be spread to humans?" for each of the primary source conditions (dogs, snakes, pigs, bats, or food markets).

2.2.2. . COVID-19 Risk Perceptions

To measure COVID-19 risk perceptions, participants were asked eight questions, for example, "The coronavirus poses a serious risk" and "The coronavirus should be taken very seriously" (Cronbach's $\alpha = 0.84$, $\bar{r}_{\text{it}} = 0.69$).

2.2.3. 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 (four items, Cronbach's $\alpha = 0.82$, $\bar{r}_{\text{it}} = 0.81$); (2) social distancing behaviors, such as avoiding crowds, public transport, or domestic travel (4 items, Cronbach's $\alpha = 0.88$, , $\bar{r}_{\text{it}} = 0.86$); (3) xenophobic avoidance behaviors, such as avoiding people of Asian descent and people who had recently traveled internationally (5 items, Cronbach's $\alpha = 0.87$, $\bar{r}_{\text{it}} = 0.82$); and (4) animal avoidance behaviors, such as intentions to avoid animal habitats and animal products such as meat (4 items, Cronbach's $\alpha = 0.89$, , $\bar{r}_{\text{it}} = 0.87$).

2.2.4. Ratings of Disease Similarity

Participants were asked to rate how similar COVID-19 is to a variety of other diseases, including respiratory diseases (e.g., influenza, the common cold), foodborne illnesses (e.g., SARS, *Escherichia coli*), recent pandemics (e.g., Zika virus), and other well-known illnesses (e.g., stomach flu).

2.2.5. Disgust Sensitivity

To assess individual differences in disgust sensitivity, the 26-item version of the *D*-scale from Haidt, McCauley, and Rozin (1994); Cronbach's $\alpha = 0.89$, $\bar{r}_{\text{it}} = 0.51$) was used. For example, "It bothers me to hear someone clear a throat full of mucous" and "Even if I was hungry, I would not drink a bowl of my favorite soup if it had been stirred with a used but thoroughly washed flyswatter." The complete list of items can be seen in Table IV.

2.2.6. Endorsement of Asian Stereotypes

Individual differences in endorsement of Asian stereotypes were assessed using the 25-item questionnaire from Lin, Kwan, Cheung, and Fiske (2005; Cronbach's $\alpha = 0.94$, $\bar{r}_{\text{it}} = 0.65$). For example, "Asian Americans commit less time to socializing than others do" and "When it comes to education, Asian Americans aim to achieve too much." The complete set of items can be seen in Table V.

2.2.7. Virus Stigma

Stigmatization of COVID-19 was assessed via three questions measuring general feelings of embarrassment and wanting to conceal a hypothetical COVID-19 infection, such as "I would be ashamed to tell people if I contracted the coronavirus" (Cronbach's $\alpha = 0.88$, $\bar{r}_{\text{it}} = 0.90$).

2.3. Design and Procedure

Participants completed the demographics section, baseline judgments of disease communicability, and then were shown a realistic news headline along with the first two paragraphs of a story covering a potential zoonotic origin of the virus. Participants were randomly assigned to one of five conditions, where the news story implicated bats (n = 146), dogs (n = 143), food markets (n = 144), pigs (n = 144), or snakes (n = 144) as the origin of the disease (see Supporting Information File 1). These animals were chosen *a priori* based on the range of animals described in news sources at the beginning of our study period. In the time surrounding our data collection, the news media covered dozens of animal species as possible COVID-19 sources, including all the sources used in the mock headlines. As of this writing, hundreds of species have not been ruled out (Lanese, 2021) and the true source is still unknown (Gorman, 2021). In

Table IV. Items and Descriptive Statistics for D-Scale from Haidt and Colleagues (1994)

Text	*M* (*SD*)
(R) I might be willing to try eating monkey meat, under some circumstances.	4.63 (1.76)
It would bother me to be in a science class, and to see a human hand preserved in a jar.	3.60 (1.88)
It bothers me to hear someone clear a throat full of mucous.	4.11 (1.60)
I never let any part of my body touch the toilet seat in public restrooms.	3.80 (1.91)
I would go out of my way to avoid walking through a graveyard.	2.92 (1.84)
(R) Seeing a cockroach in someone else's house doesn't bother me.	3.89 (1.64)
It would bother me tremendously to touch a dead body.	4.35 (1.64)
If I see someone vomit, it makes me sick to my stomach.	4.40 (1.54)
I probably would not go to my favorite restaurant if I found out that the cook had a cold.	4.74 (1.40)
(R) It would not upset me at all to watch a person with a glass eye take the eye out of the socket.	3.39 (1.79)
It would bother me to see a rat run across my path in a park.	3.71 (1.74)
I would rather eat a piece of fruit than a piece of paper.	5.81 (0.75)
Even if I was hungry, I would not drink a bowl of my favorite soup if it had been stirred with a used but thoroughly washed flyswatter.	4.67 (1.63)
It would bother me to sleep in a nice hotel room if I knew that a man had died of a heart attack in that room the night before.	4.41 (1.65)
You see someone put ketchup on vanilla ice cream and eat it.	4.47 (1.77)
You are about to drink a glass of milk when you smell that it is spoiled.	5.66 (1.23)
You see maggots on a piece of meat in an outdoor garbage pail.	5.95 (1.31)
You are walking barefoot on concrete, and you step on an earthworm.	4.93 (1.58)
You see a bowel movement left unflushed in a public toilet.	5.88 (1.13)
While you are walking through a tunnel under a railroad track, you smell urine.	5.24 (1.25)
You see a man with his intestines exposed after an accident.	6.13 (1.34)
Your friend's pet cat dies, and you have to pick up the dead body with your bare hands.	4.92 (1.82)
You accidentally touch the ashes of a person who has been cremated.	4.02 (1.92)
You take a sip of soda, and then realize that you drank from the glass that an acquaintance of yours had been drinking from.	3.63 (1.70)
A friend offers you a piece of chocolate shaped like dog-doo.	3.51 (1.85)
As part of a sex education class, you are required to inflate a new unlubricated condom.	3.01 (1.92)

M = means, *SD* = standard deviations

Table V. Items and Descriptive Statistics for Lin and Colleagues' (2005) Asian Stereotypes Scale

Text	*M* (*SD*)
Asian Americans seem to be striving to become number one.	2.40 (0.96)
Asian Americans commit less time to socializing than others do.	2.12 (0.92)
In order to get ahead of others, Asian Americans can be overly competitive.	2.56 (1.01)
Asian Americans do not usually like to be the center of attention at social gatherings.	2.57 (0.88)
Most Asian Americans have a mentality that stresses gain of economic power.	2.48 (0.93)
Asian Americans can sometimes be regarded as acting too smart.	2.31 (1.00)
Asian Americans put high priority on their social lives.	2.22 (0.81)
Asian Americans do not interact with others smoothly in social situations.	2.04 (0.90)
(R) As a group, Asian Americans are not constantly in pursuit of more power.	4.40 (0.92)
When it comes to education, Asian Americans aim to achieve too much.	2.36 (1.02)
Asian Americans tend to have less fun compared to other social groups.	2.17 (0.96)
A lot of Asian Americans can be described as working all the time.	2.70 (0.95)
The majority of Asian Americans tend to be shy and quiet.	2.50 (0.92)
Asian Americans are not very "street smart".	2.04 (0.88)
(R) Asian Americans know how to have fun and can be pretty relaxed.	4.06 (0.85)
Most Asian Americans are not very vocal.	2.33 (0.88)
(R) Asian Americans are a group not obsessed with competition.	4.62 (0.92)
Asian Americans spend a lot of time at social gatherings.	4.59 (0.79)
Oftentimes, Asian Americans think they are smarter than everyone else is.	2.29 (0.96)
Asian Americans enjoy a disproportionate amount of economic success.	2.22 (0.91)
Asian Americans are not as social as other groups of people.	2.26 (0.91)
Asian Americans are motivated to obtain too much power in society.	2.06 (0.91)
Most Asian Americans function well in social situations.	4.02 (0.81)
Many Asian Americans always seem to compare their own achievements to other people's.	2.47 (0.98)
Asian Americans rarely initiate social events or gatherings.	2.21 (0.87)

M = means, *SD* = standard deviations

Table VI. 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 ($n = 457$) Feb. 7- March 20
Demographics	■	■	■
Vignette	■	■	■
Perceived risk	■	■	■
COVID-19 stigma	■	■	■
Disgust sensitivity	■	■	■
Expanded demographics		■	■
Avoidance behavior intentions			■
Asian stereotypes			■

Note. All dates are from 2020.

the beginning of the pandemic, snakes received more coverage than other species, hence why we modeled our stimuli on a CNN article emphasizing snakes as a possible source (Berlinger, George, Griffiths, & Guy, 2020). Pigs, who are susceptible to the virus (Pickering et al., 2021), were covered as a possible animal source from the beginning as well (Williams, 2020). These two sources (snakes and pigs) served as a contrast between exotic and familiar food sources for people in the United States. The other sources, which were also known carriers of coronaviruses covered in the media, were chosen to cover a range of familiarity as cuisine for U.S. participants. Bats were in the news as possible sources when the 2019/2020 pandemic started. Dogs are more familiar animals to U.S. participants than snakes or bats, with pigs being used in cuisine (and associated with a recent large scale coronavirus outbreak in 2013; Lee, 2015) and not dogs. The food market category was added because a food market in Wuhan, China was the likely site of the outbreak, as reported in many news outlets at the time, and served as a superordinate category for all the other animal categories. After reading the mock news story, participants were required to correctly answer the question, "According to the news story you just read, what might be the source of the coronavirus?" as a manipulation check.

After completing the manipulation check, 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.

Because we added questions on each subsequent wave of the survey (Wave 2: January 31–February 1, Wave 3: February 7–March 20), not all participants answered the full set of questions that are analyzed here. As can be seen from Table VI, each of the three waves of the survey answered demographics questions, viewed the vignettes about food origins, and answered questions about the likelihood of contracting COVID-19 under various circumstances, perceived COVID-19 risks, similarities between COVID-19 and other illnesses, COVID-19 stigma, and disgust sensitivity. On the second wave of the survey, we expanded the demographics section to include more questions. On the third and final wave, which also had the largest sample size ($n = 457$), we added questions about disease avoidance behavior intentions and the Asian stereotypes questionnaire. These adjustments were made ad hoc during data collection in response to the authors' personal observations and hypotheses regarding the pandemic. No data were analyzed prior to completion of the full study; thus, the addition of questions was independent of the observed results.

2.4. Statistical Analysis Approach

Primary effects of condition were tested using one-way ANOVAs for each of the outcome measures (i.e., risk perceptions, hygiene-related, social distancing, xenophobic, animal-related avoidance behavior attentions). Planned comparisons used Welch's t-tests to examine whether pigs, a familiar Western food source, were different from other possible disease origins. We also report the full pairwise group comparisons using Tukey's "honestly significant difference" (HSD) correction throughout.

Table VII. Group Means (SD) for each Primary Measure. Sharing Superscripts Indicates the Absence of Statistical Significance between Groups Whereas Nonoverlapping Superscripts Indicates a Statistically Significant Difference between Groups after Applying Tukey HSD test criteria

	Disease source				
Dependent variable	Bat	Dog	Market	Pig	Snake
Risk perception	4.73 (1.02)^{a,b}	4.87 (1.14)^{a,b}	4.85 (1.10)^{a,b}	4.53 (1.09)^{a}	4.97 (1.01)^{b}
Hygiene	3.71 (1.56)^{a,b}	3.84 (1.66)^{a,b}	3.97 (1.36)^{a,b}	3.38 (1.49)^{a}	4.05 (1.69)^{b}
Social distancing	4.12 (1.72)^{a}	4.30 (1.82)^{a}	4.49 (1.53)^{a}	3.93 (1.84)^{a}	4.36 (1.76)^{a}
Xenophobic	3.51 (1.46)^{a,b}	3.65 (1.60)^{a,b}	4.01 (1.49)^{b}	3.11 (1.57)^{a}	3.78 (1.71)^{b}
Animal	2.35 (1.35)^{a,b}	2.58 (1.60)^{a,b}	2.41 (1.42)^{a,b}	2.09 (1.01)^{a}	2.73 (1.65)^{b}

SD = Standard deviation

Multiple regression was used to investigate predictors of COVID-19 stigma. These predictors included risk perceptions and disease avoidance behavior intentions while adjusting for the initial news stories participants were shown and the time at which the survey was completed. We also used multiple regression analyses to investigate how endorsement of Asian stereotypes and xenophobic behavior intentions are related to COVID-19 stigma. All regression coefficients reported throughout are standardized.

Mediation analysis, employing a bootstrap procedure (Preacher & Hayes, 2004), was used to test whether the indirect pathway from condition to stigma via avoidance behaviors was statistically significant. Finally, the three exploratory questions outlined above were analyzed using repeated measures ANOVA with Tukey's HSD reported for pairwise comparisons.

To examine whether outliers may have influenced any of our analyses, we retested all models excluding observations with a Cook's *D* value greater than $4/(n - k - 1)$ (Fox, 2008). In no case did the nature (patterns of statistical significance) of the results change based on such exclusions and thus we report only the full sample results.

3. RESULTS

3.1. Effects of Zoonotic Origins on Risk Perception, Avoidance Intentions, and Stigma

Animal origin descriptions were associated with significant differences in risk perceptions, according to a one-way ANOVA, $F(4, 498) = 2.45$, $p = 0.045$, $\eta^2 = 0.02$. The disease origin descriptions were associated with significant differences in intentions to increase hygiene-related avoidance behaviors, $F(4, 439) = 2.48$, $p = 0.043$, $\eta^2 = 0.02$, animal avoidance behavior, $F(4, 439) = 2.56$, $p = 0.038$, $\eta^2 = 0.02$, and xenophobic avoidance behaviors,[1] $F(4, 439) = 4.00$, $p = 0.003$, $\eta^2 = 0.04$. There was no significant effect of animal prompts on intentions to engage in social distancing, $F(4. 439) = 1.37$, $p = 0.243$, $\eta^2 = 0.01$. See Table VII for group means for each of these primary variables.

In each of these analyses (except with social distancing intentions, Welch's $t[126.49] = 1.76$, $p = 0.081$), the disease origin descriptions led to lower risk perceptions and avoidance intentions when pigs were presented as a possible origin compared to other sources (risk perceptions Welch's $t[147.19] = 2.65$, $p = 0.009$, Cohen's $d = 0.30$; hygiene avoidance Welch's $t[138.85] = 2.83$, $p = 0.005$, Cohen's $d = 0.32$; xenophobic avoidance Welch's $t[133.48] = 3.32$, $p = 0.001$, Cohen's $d = 0.39$; animal avoidance Welch's $t[195.28] = 3.17$, $p = 0.002$, Cohen's $d = 0.30$). Interestingly, although disease origin affected xenophobic avoidance intentions, it did not have a significant effect on general social distancing intentions, which are some of the more effective disease prevention behaviors once community spread occurs for a novel disease. There were no direct effects of disease origin description on stigmatization of COVID-19, $F(4, 695) = 0.31$, $p = .870$, $\eta^2 = 0.001$.

[1] Although we considered questions relating to avoiding foreign travelers and travelers to China as related to xenophobic behaviors in our *a priori* grouping (which is consistent with the psychometrics of the questionnaire), we also tested the xenophobic intentions model with only the questions relating to specific national or ethnic origins and found identical results: $F(4, 439) = 2.89$, $p = -.022$, $\eta_p^2 = 0.03$, with the pig group lower than all others, Welch's $t(146.35) = 2.86$, $p = 0.003$, Cohen's $d = 0.32$.

Table VIII. Regression Output for a Model Predicting Perceived COVID-19 Stigma with Each Experimentally Manipulated Animal Source (Dummy Coded), the Week of Data Collection, and the Four Avoidance Behaviors (Animals, Xenophobic, Social Distancing, and Hygienic) as Independent Variables

	Model 1		Model 2	
Variable	β (*SE*)	*p*	β (*SE*)	*P*
Dog	−0.07 (0.13)	0.695	−0.06 (0.13)	0.637
Food Market	0.04 (0.13)	0.767	0.03 (0.13)	0.823
Pig	0.11 (0.13)	0.409	0.10 (0.13)	0.468
Snake	0.11 (0.13)	0.424	0.10 (0.13)	0.485
Week	−0.02 (0.07)	0.798	0.005 (0.07)	0.943
Animal avoidance	0.33 (0.06)	<0.001	0.31 (0.06)	<0.001
Xenophobic avoidance	0.20 (.07)	0.002	0.20 (0.06)	0.002
Social distancing	−0.15 (0.09)	0.095	−0.19 (0.09)	0.043
Hygienic avoidance	0.14 (0.09)	0.113	0.14 (0.09)	0.115
Disgust			0.14 (0.04)	0.001

β = standardized beta coefficient, *SE* standard error

3.2. COVID-19 Stigma

We used multiple regression models to test how each of the four disease avoidance categories discussed above predict COVID-19 stigma (the dependent variable), while adjusting for effects of origin descriptions and weeks since data collection began. We found a positive association between COVID-19 stigma and xenophobic and animal avoidance intentions ($R^2 = 0.23$, $F[9, 434] = 14.49$, $p < 0.001$, see Table VIII). No other coefficients were significant. We tested whether these results hold while also adding trait disgust as a predictor in the model. The resulting model ($R^2 = 0.25$, $F[10, 432] = 14.06$, $p < 0.001$, see Table VIII) significantly improved model fit, according to a likelihood ratio test, $\chi^2(1) = 13.20$, $p < 0.001$, and showed that xenophobic and animal-related avoidance behaviors remained significant when adjusting for trait levels of disgust.

Next, we conducted mediation analyses to test whether the effect of disease origin on stigma was potentially mediated by the intentions to avoid animals (and animal products) as well as xenophobic behavior intentions. Consistent with this hypothesis, we found that disease origin (pig versus not-pig) had a significant indirect effect on stigma through both animal (bootstrapped 95% CI [−0.36, −0.07]) and xenophobic (bootstrapped 95% CI [−0.38, −0.09]) avoidance intentions. These results suggest that perceived exoticness of food origins may increase salience of the animal and cultural origins of the disease, which then increases stigmatization.

Due to the moderately high intercorrelations among some of our disease avoidance measures

Table IX. Inter-Correlations between Each Predictor Variable Used for Regression Models in Section 3.2

Variable	1	2	3	4	5
1. Week	1				
2. Animal avoidance	0.04	1			
3. Xenophobic avoidance	0.07	0.55*	1		
4. Social distancing	0.43*	0.47*	0.67*	1	
5. Hygiene avoidance	0.42*	0.57*	0.59*	0.85*	1
6. Disgust	0.04	0.28*	0.26*	0.28*	0.28*

*indicates statistical significance at the .05 level.

(Table IX), it is possible that there is some parameter instability for specific partial effect estimates (e.g., partial effects of animal or xenophobic avoidance intentions) in our above stigma models. Indeed, the variance inflation factors (VIFs) observed for these variables ranged from 1.06 to 4.81, which is in a range where some parameter instability is possible (Hair, Black, Babin, & Anderson, 2014). Thus, we also conducted a secondary analysis that employed a factor analytic approach to combine our avoidance measures into a single factor. In this respect, our overall goal is not to understand the unique partial effects of the constituent avoidance behaviors underlying stigma per se but to understand those behaviors as contributors to stigma beliefs. After removing regression outliers (see criteria in Section 2.4) and finding no univariate outliers to explain the large VIFs in the models above, the disease avoidance intention measures were combined into factor scores that would reflect their shared variance. Visually examining the scree plot suggested a one-factor solution was appropriate. We therefore used an oblique factor rotation to create factor scores for each participant. We repeated the same sequence of models as above. For the first model (R^2 = 0.16, F[6, 449] = 14.63, $p < 0.001$), factor scores relating to general avoidance intentions were still positively associated with disease stigma. VIFs also now ranged from 1.03 to 1.19, suggesting that the coefficient estimates in this model were reliable. For the second model (R^2 = 0.18, F[7, 445] = 14.05, $p < 0.001$), where disgust is added as a predictor, the factor scores were still positively associated with disease stigma and VIFs now ranged from 1.03 to 1.34.

3.3. Probing Early COVID-19 Conceptualization

Prior to seeing the vignettes, participants were asked how likely the following activities were to result in contracting COVID-19: being bitten by a wild animal, eating contaminated food, being in the same area as a wild animal, and interacting with people. There were significant differences between these possible transmission routes in terms of people's beliefs about their likelihood of driving COVID-19 infections, $F(3, 1489) = 552.7$, $p < 0.001$, $\eta_p^2 = 0.53$. Post hoc tests showed that perceptions of the likelihood of infection via person-to-person contact ($M = 4.98$, $SD = 1.68$) were associated with significantly greater perceptions of transmission likelihood compared to eating contaminated food ($M = 2.92$, $SD = 1.88$), which in turn was seen as a significantly more likely route compared to being bitten by a wild animal bite ($M = 2.10$, $SD = 1.46$) or interacting with a wild animal habitat ($M = 2.04$, $SD = 1.51$). The latter two were not statistically different from one another. This result suggests that, prior to seeing the vignettes, participants viewed COVID-19 as primarily arising from food contamination, compared to all other animal-related disease transmission routes.

There were also significant differences in prevignette judgments for the likelihood of contracting a novel disease from bats, dogs, food markets, pigs, and snakes, $F(4, 2800) = 271.8$, $p < 0.001$, $\eta_p^2 = 0.28$. Post hoc tests showed that each potential disease route was statistically different from the others in terms of their perceived likelihood to host a novel disease. Bats ($M = 4.51$, $SD = 1.76$) were seen as the most likely source, followed by food markets ($M = 4.29$, $SD = 1.57$), pigs ($M = 4.03$, $SD = 1.71$), dogs ($M = 3.04$, $SD = 1.54$), and snakes, ($M = 2.82$, $SD = 1.64$). Here, pigs were seen as intermediate in their likelihood of causing a new disease, being viewed as a less likely source than bats and food markets but more likely than dogs and snakes.

Perceived similarity between COVID-19 and other diseases is another mechanism by which we can probe early conceptualizations of COVID-19. Because these measures were taken after our vignettes, they can also give an indication of whether our manipulation fundamentally changed how people perceived these relationships. To simplify the analysis, we aggregated the different similarity judgments into three groups (respiratory: cold, flu, SARs, bird flu; food-borne: botulism, salmonella, *E. coli*, stomach flu; recent known pandemics: Ebola, Zika). In terms of average similarity judgments, there were significant differences between the groups, $F(2, 1{,}400) = 738.6$, $\eta_p^2 = .533$, $p < 0.001$, with people viewing COVID-19 as most similar to the respiratory viruses. Post hoc tests showed that each disease type was seen as significantly different from the other in terms of their similarity to COVID-19. Respiratory diseases ($M = 4.59$, $SD = 1.05$) were seen as most similar, followed by other recent pandemics ($M = 3.06$, $SD = 1.44$), and foodborne diseases ($M = 2.64$, $SD = 1.44$). These results did not differ by animal source condition, $F(8, 1{,}392) = 0.771$, $\eta_p^2 = .004$, $p = 0.118$, suggesting that the pig-related effect observed above was not due to people seeing COVID-19 as more like common respiratory diseases known to impact pigs.[2]

Interestingly, however, when looking at perceived disease similarities as predictors of our primary stigma variable, only perceived similarity to food borne illnesses was significant. We conducted a multiple regression model ($R^2 = 19$, F[3, 696] = 56.01, $p < 0.001$) with COVID-19 stigma as the dependent variable and perceived similarities COVID-19 and respiratory, foodborne, and recent diseases as the independent variables. Only the coefficient for foodborne diseases was statistically different from zero ($\beta = 0.45$, t[696] = 9.20, $p < 0.001$) while the coefficients for respiratory diseases ($\beta = -0.01$, t[696] = -0.407, $p = .68$) and recent epidemic diseases (β = -0.007, t[696] = -0.15, $p = .882$) were not. These results corroborate a key hypothesis of our study: Early COVID-19 stigma was heavily driven by

[2]The lack of a source condition effect is true when considering flu alone, which pigs were implicated as sources for recent pandemics (H1N1):$F(4{,}696) = 1.67$, $p = 0.15$, $\eta_p^2 = .0009$).

perceived animal-food relationships and thus perceived similarity to other animal and food related diseases increases stigma.

4. DISCUSSION

4.1. General Discussion

The current experimental data showed that subtle changes in the species described as the potential origin of COVID-19 influenced people's risk perceptions and disease avoidance behaviors. Focusing on a familiar origin species (pigs) led to lower risk perceptions and avoidance intentions. Focusing on more exotic origins (snakes) showed the opposite trend, with people reporting not only greater risk perceptions and disease avoidance intentions, but also increased intentions to engage in discriminatory behaviors, such as avoiding people of Asian descent. We hypothesized that emphasizing exotic disease origins activates cultural biases. Mediation analyses suggested that intentions to avoid people of Asian descent can spill over into increased disease stigma, which might delay treatment and increase disease spread (Inbar, Pizarro, Knobe, & Bloom, 2009; Stangl et al., 2019).

Emphasizing exotic disease origins also may have led to intentions to avoid animals and animal products that would likely have little effect on disease spread after a disease has reached global pandemic status. These two factors 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. Thus, while communications on the origins of a novel zoonosis create a compelling and attention-grabbing narrative, they may encourage reasoning errors and inappropriate behaviors.

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 (Fischer, Mansergh, Lynch, & Santibanez, 2019; Rozin, Markwith, & Nemeroff, 1992, 1994). Stigma for HIV/AIDS is known to arise from its association with death and stigmatized behaviors like drug use, risky sex, and same-sex intercourse (Pryor, Reeder, & Landau, 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 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 cues to stigmatization are its origins and associations with death, intentions to avoid salient aspects of its origin (people linked with 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, Millman, & Nemeroff, 1986) and are potentially a generalization of the disgust response. Future research on novel infectious diseases will be needed to address how avoidance intentions both influence and are influenced by stigmatization, and how these relationships change as concepts of a disease become crystalized (as in HIV/AIDs).

4.2. Extensions and Limitations

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. Many of our current results on how people generalize from communications likely depend on the large degree of uncertainty present early in the pandemic. Not only was the origin not known, but how exactly the novel coronavirus was transmitted was still unclear in the first months of the U.S. outbreak. Further, the current risk factors in the pandemic have greatly shifted. Currently, we would expect origins to have less of an impact on people's behavior, and animals and food products are not viewed as significant risks. Even practices that were widely endorsed in media like washing food packaging and hands have taken a back seat to recommendations to social distance and wear masks. These recommendations were absent from early communications on the novel coronavirus and thus were not included in our survey in its final version. As we have discussed in other recent work on communicating about zoonoses (Davis et al., 2017; Davis et al., 2020), once pandemics have shifted to person-to-person transmission, there is less utility in communicating about specific species origins and the degree to which people use such information to avoid disease risk likely changes accordingly. However, our core findings are likely to 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).

The measures used in this study showed satisfactory reliability, as measured by Cronbach's alpha and the average item-total correlation. However, some of the measures showed substantial variation in item averages and thus may have more nuanced factor structures. For instance, with COVID-19 risk perceptions, "There is a significant probability that I or someone I know will contract the coronavirus" and similar items had mean agreement ratings around 3.5 (on a 7-point scale). In contrast, items like "The coronavirus poses a serious risk," had mean agreement ratings around 5.5. There may be a distinction between how people conceptualize threats on a personal level versus a population level. It may be worthwhile for researchers to explore whether these more nuanced factor structures correspond to any important empirical distinction in risk perceptions or behavior.

One qualification to our results is that although we believe many of our current effects reflect people's beliefs about coronavirus in relation to food products, we did not explicitly mention food in the news vignettes. Thus, it is possible that emphasizing pigs affected people's perceptions via mechanisms other than food *per se*. One possibility is, because pigs are associated with more common respiratory viruses (e.g., influenza), the change in disease perceptions observed in the pig condition were from increasing people's perception that COVID-19 is like these more familiar viruses. Several of our results speak against this possibility. First, pigs were not viewed as likely vectors for novel diseases. Thus, beliefs about pigs carrying diseases in general do not track our condition effects in any of the primary measures. Second, although people viewed person-to-person as the most likely disease transmission route, food contamination sources were seen as the most likely among animal sources, suggesting participants were primed to interpret the news vignettes as relating to animals as food sources. Finally, our news vignettes did not impact people's perceived similarity of COVID-19 to influenza or other respiratory diseases. In fact, COVID-19 stigma was only significantly related to the degree to which people saw COVID-19 as similar to other foodborne diseases.

Another possible limitation to our study is that the plausibility of different COVID-19 origins fluctuated throughout the pandemic. As noted earlier, snakes were initially given the most coverage. However, other species such as pangolins and bats have become more central in the search for an origin, and many possible candidate species remain. We used realistic COVID-19 origin animals that are known carriers of coronaviruses and were receiving media coverage at the time of the study. The mock news articles conveyed to the participants that specific species were possible sources, but the actual source for initially spreading COVID-19 is still unknown. If a source is found, the other species used here will turn out to be retrospectively disproven as the origin of COVID-19. Our original expectation was that the origin species for the COVID-19 pandemic would be found. As of this writing, however, a source has yet to be identified, and we ended the data collection when we did because the origin species became less important due to the global person-to-person spread of COVID-19. The time-sensitive nature of the study would be expected to only affect the error variance. We did not observe any time-by-condition interactions, which suggests that studying the effect of origin over time does not bias any of our conclusions.

Our study also has limitations related to the sampling and self-report measures used. Most of the participants grew up in the United States, and all of them lived there at the time of data collection. Data were also collected during the first weeks of the U.S. outbreak, when available information and disease rates were changing daily. Results, therefore, may not generalize to other cultures, nor do they capture fine-grained interactions between the timing of the pandemic and the experimental manipulation of disease origin. As can be seen in Table I, most demographic characteristics of the present sample were within a few percentage points of the U.S. population as a whole, but there were slight deviations. These deviations between the sample and the general population should be taken into account when generalizing from the present results.

Finally, we collected self-reported intentions to engage in particular behaviors and did not observe the behaviors themselves. While there is evidence that self-reported behavioral intentions correlate with actual behaviors (e.g., Brewer et al., 2007), the relationship is imperfect. Notably, however, intentions alone can be consequential for public health. Regardless of whether they are ever actualized in behavior, attitudes and behavioral intentions guide the public discourse about health concerns and—particularly important for our findings regarding stigma and discriminatory behavior—can transmit incorrect or harmful beliefs throughout social networks (Scherer & Cho, 2003). Likewise, positive behavioral intentions can bolster public health even if many of the people expressing protective intentions (for example, to get a vaccine) fail to follow through on their plans (Salathé & Khandelwal, 2011).

5. CONCLUSION

In conclusion, we found that conveying exotic zoonotic origins for a novel disease, such as COVID-19, can increase not only overall risk perception and adaptive hygienic behaviors, but also maladaptive behaviors such as avoiding individuals descended from a region 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.

FUNDING

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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