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Travel medicine meets conservation medicine in st. kitts: Disinhibition, cognitive-affective inconsistency, and disease risk among vacationers around green monkeys (*Chlorocebus sabaeus*)

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Abstract

Despite concern about environmental protection, travelers often underestimate the contribution they may have to disease transmission to other species, as well as the risk of becoming infected themselves. Tourists in general tend to accept more physical risks when traveling than when at home, and much of this can be blamed on the temporary loss of situational awareness and loss of inhibition with a corresponding relaxed attitude toward safety. To better understand environmental attitudes and travel health knowledge and behaviors, a detailed survey of adult tourists was distributed on the island of St. Kitts, home to many green monkeys. Data from 1097 respondents were collected at two locations where cruise ship passengers typically visit the island. Results revealed that even though individuals with more positive environmental attitudes were more willing to take steps to mitigate tourism-related disease transmission, they were also more likely to report wanting to touch or feed a monkey/ape. Similarly, those more willing to prevent the spread of diseases (e.g., wear a mask and report any illnesses to park authorities) were actually more likely to want to touch or feed a monkey/ape. The human desire for physical contact with other species may be partly the result of biophilia, emotionally arousing events (like contact with exotic species) that can lead to further disinhibition, and social media platforms that provide opportunities for exhibitionism. The attitude-behavior incongruency identified here may also be explained through cognitive-affective inconsistency: environmentally-oriented individuals believe that it is prudent to take steps to prevent zoonotic disease transmission but also desire to touch or feed exotic species as it may be emotionally rewarding. Individuals for whom physically interacting with monkeys/apes may be emotionally rewarding may not alter their behavior in response to cognitive means of persuasion; techniques aimed at appealing to emotions may be more effective.

KEYWORDS

biophilia, exhibitionism, one health, tourism, vervet, zoonoses

1 | INTRODUCTION

Nature-based tourism and travel in general pose risks when humans can come into contact with nonhuman animals, both domestic and wild. From basic dermatological exposure to trauma from dangerous game species, animal-associated injuries and death can happen, especially from food-conditioned animals (Penteriani et al., 2017). Although most injuries originate from domestic animals (Gautret et al., 2007), injury and death can result from contact with many different species (Muehlenbein, 2018). Muehlenbein et al. (2020) describe 6470 animal bites and other exposures from a variety of species, reported between January 1, 2007 to December 31, 2018 to the GeoSentinel network, a clinician-based sentinel surveillance system of 68 specialized travel and tropical medicine sites in 29 countries, that monitors travel-related illness among international travelers and migrants. Although many human exposures to animals are caused by aggressive or defensive animals, many also result from humans initiating contact with animals. But why do so many humans initiate contact with animals, especially while traveling?

Tourists in general tend to accept more physical risks when traveling than when at home. Much of this can be blamed on the temporary loss of situational awareness and loss of inhibition with a corresponding relaxed attitude toward safety. This may result in, for example, an increased likelihood to have unprotected sex (Croughs et al., 2008), consume excessive amounts of alcohol (Cabada et al., 2011), and not comply with travel medical advice (Aldea et al., 2015). International travelers suffer from many health problems while on holiday (Steffen et al., 2003). Young men seem to be at higher risk of morbidity and mortality while traveling than any other age group or gender. Younger travelers seem to be more likely to incur physical risks (Leggat & Shaw, 2003). Males report more unintentional injuries (McInnes et al., 2002) and suffer from more animal-related fatalities, particularly encounters with venomous animals (Langley, 2005).

The risk of pathogen transmission from animals to travelers is not insignificant but is also not clearly known. There are at least 1415 infectious organisms that cause pathogenic disease in humans, and approximately 61% of them originate from animals (i.e., are zoonotic) (Taylor et al., 2001). Nonhuman animal populations serve as sources of many infectious organisms pathogenic to humans, from rabies and Yellow fever to Ebola and malaria (see Muehlenbein, 2016 for discussion). Transmission can occur when interacting with animals in a wide range of contexts, such as during guided nature-based tours or even at open markets (Jones-Engel et al., 2008; Schillaci et al., 2005, 2008). In addition to the direct risk they pose to travelers, transmission of these pathogens (and even some nonpathogenic infectious agents) may also impact those living in the home countries to which tourists return.

Tourists can also impact the wild animals they come to visit, from habituation and habitat destruction to pathogen transmission (known as anthroponoses; sometimes referred to as zooanthroponoses or reverse zoonoses) (Jones-Engel et al., 2001, 2006; Messenger et al., 2014; Schillaci et al., 2006). It should be noted that not all infectious organisms directly cause pathology. Therefore, human-primate interactions may also lead to the transmission of infectious agents that do not result in zoonotic diseases. Nevertheless, nonhuman primates appear particularly susceptible to human pathogens due to our phylogenetic relatedness which may facilitate more cross-species transmission events (see e.g., Engel et al., 2002) because of similar immune responses and cellular receptors (Davies & Pedersen, 2008; Woolhouse et al., 2012).

These (sometimes) endangered species may be immunologically naïve to human pathogens, and primate populations can be decimated quickly because of their slow reproductive rates (Muehlenbein & Ancrenaz, 2009; Muehlenbein & Lewis, 2013; Muehlenbein & Wallis, 2014; Muehlenbein et al., 2008, 2010; Muehlenbein, 2017). Of a selection of 800 human pathogens known to originate from animals, almost thirteen percent are thought to be shared with other primates (Cleaveland et al., 2001), and transmission events likely date back thousands of years or more (e.g., Hoppe et al., 2015). In the aforementioned study by Muehlenbein et al. (2020), there were a reported 1414 monkey bites and 231 other monkey exposures, the vast majority happening in Asia. Why do these interactions persist? Are travelers not educated about the risks of contact with animals? Are travelers totally unaware of the risk associated with animal contact? Is it general risk-taking during travel, disinhibition, exhibitionism for social media, or just a reflection of human captivation with the natural world?

The present study aimed to understand the relationships between current travel health and cognitive motivations for traveler engagement in risky behaviors, specifically contact with free ranging and pet primates. It was hypothesized that, despite being relatively educated and knowledgeable about risks of potential pathogen transmission, a majority of people on holiday will still seek direct interaction with nonhuman primates if allowed. It is known that those visiting wildlife sanctuaries underestimate their potential contribution to disease spread to other animals, as well as the risk of becoming infected themselves (Muehlenbein & Ancrenaz, 2009). For example, ecotourists concerned about environmental protection, and with recognized travel itineraries to view endangered species, are not adequately protected against many vaccine-preventable diseases (Muehlenbein et al., 2008). They are largely unaware of their true vaccination status, and they underestimate the risks they pose to other species. Furthermore, these same travelers to wildlife sanctuaries are oftentimes ill, showing specific signs and symptoms of infection (particularly those associated with respiratory diseases that can easily be transmitted to wildlife) (Muehlenbein et al., 2010). It should therefore not be surprising that holiday travelers, especially cruise ship passengers, should be prone to risky behaviors around ‘exotic’ species. Cruise ship passengers, which comprise the majority of the data set in the present analysis, may be a particularly interesting cohort given their largely relaxed and indulgent travel plans. Furthermore, the present analysis focuses specifically on human interactions with nonhuman primates, species often judged by humans as favorable for close interactions for a number of reasons, from their playful and human-like behaviors to their often cute appearance and exotic nature in general (Muehlenbein & Ancrenaz, 2009; Muehlenbein and Wallis, 2014; Muehlenbein, 2017). Insights into the psychology underlying tourists' desire to interact with primates is of particular relevance as international travel, and inevitably nature-based tourism, beings to resume amidst the COVID-19 pandemic.

2 | METHODS AND MATERIALS

To qualify travelers' willingness to have contact with nonhuman primates, travel health knowledge, attitudes, and practices (including health status and perceived risks), in addition to environmental values and opinions about potential preventative measures of pathogen transmission, a detailed survey of adult tourists was distributed in July 2015 (2 weeks) and March 2016 (1 week) on the beaches of Cockleshell Bay and South Friars on the Southeast peninsula of the island of Saint Kitts (St. Kitts). The research complied with protocols approved by the Human Subjects Committees of Indiana University-Bloomington, the University of Texas at San Antonio, and Ross University, and adhered to the legal requirements of St. Kitts. The data that support the findings of this study are available from the corresponding author upon reasonable request.

2.1 | Key survey measures

The anonymous survey was distributed to any tourists 18 years of age or older (English language only) at restaurants on Cockleshell Bay and South Friars beaches. These locations were chosen because they are the two primary locations where cruise ship passengers visit on the island. The surveys were distributed on iPads running iSurveySoft (https://www.harvestyourdata.com/). The survey included information on demographics (gender, age, occupation [that was later categorized], education, country of residence [that was later categorized by region]), vaccination status, travel health advice sought before traveling, current disease diagnoses, current symptomology, past direct contact with monkeys or apes (including if they had been bitten or scratched), and motivations for touching wild animals. Other detailed information was collected and organized as follows.

2.1.1 | Environmental attitudes and motivations

Participants completed four scales designed to measure attitudes toward and concern about the environment, as well as motivations to maintain the integrity of the environment. First, participants responded to six items to assess their positive and negative motivations for engaging in pro-environmental behaviors on a 7-point Likert-type scale (1 = *does not correspond at all*; 7 = *corresponds exactly*). These items were drawn from the Motivation Toward the Environment Scale (Pelletier et al., 1998). Positive motivations included: "For the pleasure I experience from contributing to the environment."; "Because being environmentally-conscious has become a part of my life."; and "Because I would feel bad/guilty if I did nothing to help the environment." Negative motivations included: "Because other people would be upset if I did not do it"; "For the recognition I get from others."; and "I don't know. I can't see how my efforts to be environmentally-conscious are helping the environment." Mean composites were formed for the positive motivations (Cronbach's $\alpha = 0.85$) and negative motivations (Cronbach's $\alpha = 0.75$); the composite for negative motivations was subtracted from the compositive for positive motivations to compute a variable representing positive motivations for engaging in environmental behaviors.

Environmental concern was measured using nine items responded to on a 5-point Likert-type scale (1 = *strongly disagree*; 5 = *strongly agree*). These items were drawn from the Revised New Ecological Paradigm Scale (Dunlap et al., 2000) and the Connectedness to Nature Scale (Mayer & Frantz, 2004). These included three items assessing concern about the environment, including: "Humans are severely abusing the environment."; "Despite our special abilities humans are still subject to the laws of nature."; and "The earth has only limited room and resources." The remaining six items measured disregard for the environment, including: "My personal welfare is independent of the welfare of the natural world."; "Humans have the right to modify the natural environment to suit their needs."; "The earth has plenty of natural resources if we just learn how to develop them."; "Human destruction of the natural environment has been greatly exaggerated."; "Humans were meant to rule over the rest of nature."; and "When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature." Mean composites were formed for environmental concern (Cronbach's $\alpha = 0.61$) and disregard (Cronbach's $\alpha = 0.72$). Again, the composite for environmental disregard was subtracted from that for environmental concern to compute a variable representing positive concern about the environment.

Participants completed another scale assessing concern about environmental problems that captured the extent to which these issues may have consequences for themselves and others. Drawn from the Environmental Motives Scale (Schultz, 2002), five items were responded to on a 5-point Likert-type scale (1 = *not important*; 5 = *supreme importance*): "I am concerned about environmental problems because of the consequences for (a) me, (b) my family, (c) people in my country, (d) all people, and (e) plants and animals. These items were combined into a mean composite representing concern about consequences of environmental problems for self and others (Cronbach's $\alpha = 0.94$).

Participants completed an additional scale designed to measure connectedness to the environment, based on items from the Connectedness to Nature Scale (Mayer & Frantz, 2004) and the Nature

Relatedness Scale (Nisbet & Zelenski, 2013). The scale included seven items responded to on a 5-point Likert-type scale (1 = *strongly disagree*; 5 = *strongly agree*): "I always think about how my actions affect the environment."; "My connection to nature and the environment is part of my spirituality."; "I take notice of wildlife wherever I am."; "My relationship to nature is an important part of who I am."; "I feel very connected to all living things and the earth."; "The natural world does not consist merely of physical phenomena but contains spiritual elements as well."; and "I think of the natural world as a community to which I belong." The items were formed into a mean composite of connectedness to nature (Cronbach's $\alpha = 0.91$).

2.1.2 | Risk-taking propensity

To examine the extent to which participants were prone to risk-taking, they responded to six items using a 5-point Likert-type scale (1 = *very unlikely*; 5 = *very likely*) from the Domain-Specific Risk-Attitude Scale (Weber et al., 2002). Specifically, participants were asked to indicate the likelihood that they would (a) periodically engage in a dangerous sport, (b) explore an unknown city or section of town, (c) drink heavily at a social function, (d) ignore some persistent physical pain by not going to the doctor, (e) regularly bicycle without a helmet, and (f) gamble with a day's income. Items were combined into a mean composite of risk-taking propensity (Cronbach's $\alpha = 0.79$).

2.1.3 | Awareness of disease transmission

To assess the extent to which participants were aware of disease transmission between humans and nonhuman primates, they answered two questions (yes or no). First, participants answered the question, "Do you think that humans can GIVE diseases to monkeys and apes?" Next, participants answered the question, "Do you think that humans can GET diseases from monkeys and apes?"

2.1.4 | Dependent measures

To measure the extent to which participants were likely to engage in safe behaviors with nonhuman primates, they indicated (a) whether they would touch or feed a monkey or ape if allowed (yes or no), (b) whether they would keep a monkey or ape as a pet if allowed (yes or no), and (c) the things they would be willing to do to prevent transmission of diseases from humans to monkeys/apes. Regarding (c), participants were asked whether or not they were willing to engage in the following behaviors to prevent disease transmission to nonhuman primates: (1) wear a mask, (2) disinfect shoes, (3) wash hands, (4) not enter a primate sanctuary if ill, (5) report illnesses to sanctuary/park employees, (6) donate a saliva/mucous sample, and (7) donate a blood sample. Responses to these items were summed such that a higher score represented a greater willingness to prevent disease transmission to nonhuman primates.

2.2 | Location and context

St. Kitts, or St. Christopher, is a small island nation (176 square kilometers/69 square miles) within the twin-island Federation of Saint Christopher and Nevis, located in the Leeward Islands of the lesser Antilles of the Eastern Caribbean (17.20° N, 62.45° W). The island was settled by the British who displaced the indigenous Carib population around 1624 (Hubbard 2002). While control of the island changed between the French and British, the island was permanently acquired by the British in 1713 (Dunn 1973), and later celebrated independence in 1983. The World Bank reports a 2019 population size of 52,834 and a gross domestic product of just over $1B (https://data.worldbank.org/country/st-kitts-and-nevis?view=chart; accessed June 11, 2021).

Today, tourism is St. Kitts' main economic activity, with the vast majority of visitors entering the country from the United States, Caribbean, United Kingdom, and Canada. In 2019 (most recent data available because of the COVID-19 pandemic), there were 163,604 air passenger arrivals and 1,049,322 cruise ship passengers (data provided by Therez Ambrose-Versailles, Ministry of Tourism, St. Kitts on Jan 4, 2021). This is a very young industry, however; until 2005 the country's main economic activity was agriculture, more specifically sugar cane monoculture. Over the last 15 years, travel and tourism have steadily increased in their contribution to the Federation's GDP: according to the World Bank, from 54.5% in 2015% to 62.3% in 2019. By comparison, the contribution of agriculture, which one dominated the economy, has contributed between 0.67% – 0.73% to the GDP since 2015 (St Kitts and Nevis Department of Statistics, Ministry of Sustainable Development; Food and Agriculture Organization Country Programming Framework 2020–2024).

The economic transition from sugar cane to tourism has altered the human-primate interface in St. Kitts in a myriad of ways. Today, there are an estimated 40,000 green monkeys (*Chlorocebus sabaeus*) on the island (Dore et al. in press). The original animals were brought by sailors as pets or trade goods, likely from Senegal, The Gambia, and Sierra Leone, in the mid-17th century (Denham, 1987; Dore, 2017; Labat, 1931; McGuire, 1974; Morris, 1914; Sade & Hildrech, 1965). For most of their history, the monkeys' range was restricted by sugar cane infrastructure (human activity and armed rangers who regularly shot the animals) to the Central Forest Reserve, which dominates the core of the mainland, and to the southeast peninsula—two places that were never suitable for growing sugar cane. In the last 15 years they have moved into agricultural and village areas and they are now considered a pest species by most farm owners and many local people (Dore, 2018; Dore et al., 2018).

Despite the problems monkeys create for the local agricultural community, St. Kitts is one of only three islands with green monkeys (the other two are Nevis and Barbados). Tourists enjoy seeing these animals, so the tourism industry capitalizes on presence of these monkeys (further frustrating local farmers; see Dore, 2018). Monkey images are ubiquitous on maps and murals and in videos encouraging people to visit the island. While the monkeys are used in tourism marketing and branding, there are relatively few opportunities for primate-based tourism, perhaps as a result of the industry's youth. In general, tourists' main activities include visits to one of about a dozen beaches on the Caribbean side and southeast peninsula of the island and historic sites such as the St. Kitts Scenic Railway, Romney Manor/Caribelle Batik (the first English settlement in the Caribbean) and Brimstone Hill Fortress, a UNESCO World Heritage Site. Nature-based tourism activities mainly include popular hikes such as Mt. Liamuiga, where tourists are likely to at least hear monkeys. Most tourists see monkeys either by chance on the roadside, on a hike in the forest, at one local beach bar that provisions the monkeys (Shipwreck Beach Bar), or in the cruise ship port via "monkey men," the locally recognized term for individuals who use baby monkeys to make money (Figure 1). Branded by the Ministry of Tourism as "primate petting vendors," these individuals charge money for photos of tourists holding and feeding infant or juvenile monkeys. In this case, unlike many places worldwide that prohibit such behavior, direct contact between tourists and monkeys is actually encouraged by some individuals and agencies on the island. There is no signage discouraging people to interact with the animals. To date, despite reports of a few monkey bites to tourists, there is no history of zoonoses from these animals affecting the tourists or local people, despite the fact that many local people also eat monkeys. There are no laws protecting monkeys, and animal cruelty laws are almost never enforced.

The present survey took place during two weeks in July 2015 and one week in March 2016. During 2015 and 2016, there were approximately one million visitors (with the vast majority being cruise ship passengers). In March 2016, there were 13,415 air arrivals (630 flights) and 121,978 cruise ship passengers (57 calls). In July 2015, there were 12,038 air arrivals (655 flights) and 42,332 cruise ship passengers (11 calls). There was a steep decline in tourism beginning in March 2020 because of the COVID-19 pandemic, with a hold on holiday flights and cruises until October 31, 2020, following testing, medical screening, and quarantine.

2.3 | Data analysis plan

All variables were first examined for normality using SPSS statistical software (Version 26). Skewness and kurtosis values were within acceptable range for all variables (Kim, 2013). All models were estimated using MPlus statistical software (Version 8). Before estimating the primary model, an exploratory factor analysis was conducted using oblique rotation to examine the factor structure of the key predictor variables: (a) positive motivations to engage in environmental behaviors, (b) environmental concern, (c) concern about environmental consequences for self and others, (d) connectedness to the environment, (e) risk-taking propensity, and (f) belief about disease transmission between humans and nonhuman primates (binary: get disease from primates and give to disease to primates variables). See Table 4 for factor analysis statistics.

This exploratory factor analysis was followed by a confirmatory factor analysis to examine factor loadings and appropriate model fit to the data. Several standard model fit indices were used to assess the fit of the latent factor structure. These included the $\chi2$ test of model fit, the comparative fit index (CFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR). Adequate model fit was determined by a non-significant $\chi2$ value ($p > 0.05$), a CFI value > 0.95, an RMSEA value < 0.08, and an SRMR statistic < 0.08. Given that $\chi2$ values are often inflated with large sample sizes, acceptable model fit was evaluated using all fit indices, even in the event of a significant $\chi2$ value (Kline, 2015).

The results of the exploratory factor analysis revealed an optimal three factor solution; model fit indices indicated good model fit: $\chi2(3) = 12.02$, $p = 0.01$; CFI = 0.99, RMSEA = 0.05, SRMR = .01. Factor loadings are displayed in Table 4. Factor 1 was labeled *positive environmental attitudes* and consisted of strong factor loadings from positive motivations to engage in environmental behaviors, environmental concern, concern about environmental consequences for self and others, and connectedness to the environment. Factor 2 was labeled *awareness of disease transmission* due to high loadings from beliefs that humans can get diseases from nonhuman primates and give diseases to nonhuman primates. The final factor consisted of only risk-taking propensity because this variable did not exhibit strong loadings on any latent factor; this variable is henceforth referred to as *risk-taking propensity*.

Based on the results of the factor analyses, *positive environmental attitudes* and *awareness of disease transmission* were modeled as latent factors in subsequent models, each indicated by the observed variables listed above for that respective factor. See Figure 2, Panel A for

FIGURE 1 Tourists often pose for photos with green monkeys on the island. Photo by Kerry Dore

a visual depiction of factor structure and factor loadings, which represent standardized regression coefficients (i.e., the unit change in the observed variable predicted for each unit change in the latent factor). In the first model, age, sex, and education were tested as predictors of positive environmental attitudes, awareness of disease transmission, or risk-taking propensity. Next, it was examined whether these variables predicted the dependent measures representing the likelihood of engaging in safe behaviors with nonhuman primates, controlling for age, sex, and education. Exploratory follow-up analyses were conducted to identify specific factors motivating unsafe behaviors with nonhuman primates. All *p* values were two-tailed and were considered statistically significant at $p < 0.05$.

3 | RESULTS

Descriptive results are presented in Tables 1–3. See Tables 5 and 6 for full statistics. Total sample size was 1097 respondents. Slightly over half of the participants were from the United States and the majority had a college degree (Table 1). As displayed in Table 2, only 47.3% had a current flu vaccine, 21.5% sought health advice before travel, and 38.3% were traveling with a current vaccine certificate. While only 10 respondents had a recent diagnosis with an infectious disease, 146 (13.3%) were experiencing symptoms of infectious disease (9.2% specifically reporting respiratory symptoms).

Many respondents (43.5%) touched a monkey or ape at some point in their lives and 2.8% were scratched or bitten. A high number of respondents reported belief that humans can get (87.3%) and give (79.1%) diseases from/to monkeys and apes. Unfortunately, a high number of people responded that they would touch or feed a monkey or ape if allowed (56.5%), and 14.6% would keep one as a pet.

Regarding correlational analyses, positive environmental attitudes, awareness of disease transmission, and risk-taking propensity were simultaneously regressed on age (continuous), sex (binary), and education (ordinal). Results revealed that individuals with more positive environmental attitudes tended to be older ($p = 0.001$), female ($p < 0.001$), and have a higher education ($p < 0.001$) compared to those with less positive environmental attitudes. Men reported greater awareness of disease transmission between humans and monkeys/apes than women ($p = 0.01$), but neither age ($p = 0.06$) nor education ($p = 0.10$) were significantly related to this variable. Those with higher risk-taking propensity were younger ($p < 0.001$) and more likely to be male ($p < 0.001$). Level of education was not significantly related to risk-taking propensity ($p = 0.79$).

3.1 | Primary model

See Figure 2, Panel B for depiction of the primary model. All key dependent measures were simultaneously regressed: likelihood of engaging

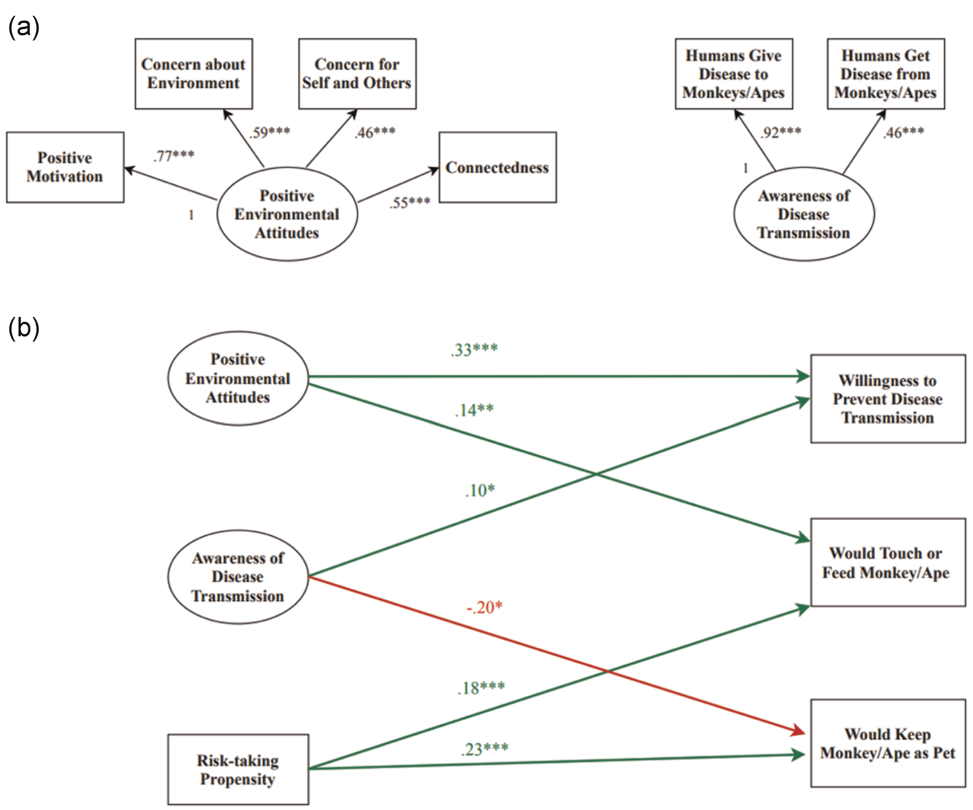

FIGURE 2 Factor loadings for latent factors (Panel A) and summary of significant results for primary model (Panel B). Only significant paths (regression coefficients) shown here; green lines denote positive relationships and red lines denote negative relationships. Included are standardized beta coefficients. $^*p < 0.05$, $^{**}p < .01$, $^{***}p < 0.001$.

TABLE 1 Characteristics of the Sample ($N = 1097$)

Sex: Men = 440; Women = 639; DNR = 18
Age (18–85): *M* = 44.98, *Mdn* = 46.00, *SD* = 15.39
Country of Origin
United States: 57.43% (*n* = 630)
Canada: 11.12% (*n* = 122)
United Kingdom: 8.57% (*n* = 94)
St. Kitts: 1.82% (*n* = 20)
Other: 21.06% (*n* = 231)
Occupation
Finance/Business: 23.15% (*n* = 254)
Medical/Healthcare: 10.57% (*n* = 116)
Student: 10.76% (*n* = 118)
Public/Education: 9.21% (*n* = 101)
Self-/Non-employed: 18.32% (*n* = 201)
Technical/Science/Manufacturing: 10.48% (*n* = 115)
Other: 17.50% (*n* = 192)
Highest Level of Education (DNR = 70)
Primary: 3.21% (*n* = 33)
Secondary: 11.59% (*n* = 119)
Professional Certificate: 13.53% (*n* = 139)
University: 44.01% (*n* = 452)
Graduate/Post-graduate: 27.65% (*n* = 284)
Previous Trips to View Monkeys/Apes: Yes = 123; No = 967; DNR = 7

DNR = did not respond.

TABLE 2 Health Information for the Sample

Received Flu Vaccine Last 12 Months (DNR = 6): Yes = 516 (47.30%); No = 575 (52.70%)
Sought Health Advice Before Trip (DNR = 4): Yes = 235 (21.50%); No = 836 (76.49%); N/A = 22 (2.01%)
Last Tuberculosis Test (DNR = 165)[a]
Unknown/"Years Ago": 26.07% (*n* = 243)
Never: 15.88% (*n* = 148)
> 10 Years Ago: 9.66% (*n* = 90)
4–10 Years Ago: 14.91% (*n* = 139)
2–3 Years Ago: 13.73% (*n* = 128)
Within Past Year: 19.53% (*n* = 182)
Immune: 0.22% (*n* = 2)
Traveling with Vaccine Certificate (DNR = 1)
Yes: 38.32% (*n* = 420)
Yes, but out of date: 2.01% (*n* = 22)
No, left at home: 24.09% (*n* = 264)
Does not have certificate: 35.58% (*n* = 390)
Recent Diagnosis with Infectious Illness (DNR = 1): Yes = 10 (0.91%); No = 1086 (99.09%)
Reported any Symptoms During Trip: Yes = 146 (13.31%); No = 951 (86.69%)
Reported Respiratory Symptoms[b] During Trip: Yes = 101 (9.21%); No = 996 (90.79%)
Symptoms Reported (*n* = 146)
Cough: 40.41% (*n* = 59)
Sore throat: 20.55% (*n* = 30)
Headache: 17.81% (*n* = 26)
Congestion: 15.75% (*n* = 23)
Sneeze: 13.01% (*n* = 19)
Fatigue: 10.96% (*n* = 16)
Diarrhea: 8.90% (*n* = 13)
Muscle aches: 6.85% (*n* = 10)
Vomiting: 6.16% (*n* = 9)
Other gastrointestinal symptoms: 5.48% (*n* = 8)
Flu-like: 5.48% (*n* = 8)
Other respiratory: 4.11% (*n* = 6)
Fever: 3.42% (*n* = 5)
Ever Touched a Monkey/Ape (DNR = 42): Yes = 459 (43.51%); No = 596 (56.49%)
Ever Scratched or Bitten by a Monkey/Ape (DNR = 5): Yes = 30 (2.75%); No = 1062 (97.25%)

DNR = did not respond.

[a]Requirements and access surrounding tuberculosis testing differ considerably between countries.

[b]Respiratory symptoms included cough, flu, sneezing, congestion, sore throat, and other respiratory symptoms.

in unsafe behaviors with nonhuman primates and willingness to prevent disease transmission to nonhuman primates on positive environmental attitudes, awareness of disease transmission, and risk-taking propensity. The dependent measures were also regressed on age, gender, and education to control for the effects of these variables. Both the likelihood of touching a monkey/ape and likelihood of keeping a monkey/ape as a pet variables were dichotomous, so binary logistic regression was utilized to compute odds ratios for the effects of each predictor on these outcomes.

Results revealed that both greater awareness of disease transmission ($p = 0.02$) and more positive environmental attitudes ($p < 0.001$) each predicted greater willingness to prevent disease transmission to nonhuman primates. Risk-taking propensity did not predict this outcome ($p = 0.25$). Additionally, younger individuals expressed greater willingness to prevent disease transmission ($p = 0.007$) but neither gender ($p = 0.16$) nor education ($p = 0.96$) predicted this outcome. Together the model accounted for 13.4% of the variance in willingness to prevent disease transmission to nonhuman primates.

While greater awareness of disease transmission did not significantly predict desire to touch a monkey/ape, (OR = 0.39, 95%

CI = [0.15, 1.00]), those with more positive environmental attitudes reported greater desire (OR = 1.50, 95% CI = [1.11, 2.03]) as did those with higher risk-taking propensity (OR = 1.50, 95% CI = [1.26, 1.78]). Younger individuals were also more likely to want to touch a monkey/ape, (OR = 0.97, 95% CI = [0.96, 0.98]), but this outcome was not significantly predicted by gender (OR = 0.97, 95% CI = [0.73, 1.30]) or education (OR = 0.95, 95% CI = [0.84, 1.08]). Together the model accounted for 16.4% of the variance in likelihood of wanting to touch a monkey/ape.

Greater awareness of disease transmission significantly predicted a lower likelihood of wanting to keep a monkey/ape as a pet (OR = 0.12, 95% CI = [0.03, 0.45]). While positive environmental attitudes did not significantly predict this outcome (OR = 1.23, 95% CI = [0.81, 1.87), higher risk-taking propensity predicted a greater likelihood of wanting to keep a monkey/ape as a pet (OR = 1.81, 95% CI = [1.41, 2.33]). Both younger individuals (OR = 0.94, 95% CI = [0.93, 0.96]), and those with less education (OR = 0.73, 95% CI = [0.61, 0.88]), were more likely to want to keep a monkey/ape as a pet. Gender did not significantly predict this outcome (OR = 1.00, 95% CI = [0.66, 1.51]). Together, the model accounted for 35.4% of the variance in likelihood of wanting to keep a monkey/ape as a pet.

3.2 | Follow-Up models

The first follow-up model tested whether awareness that humans can get/give diseases from/to monkeys and apes better predicted the dependent measures. Likelihood of engaging in unsafe behaviors with nonhuman primates and willingness to prevent disease transmission to nonhuman primates were simultaneously regressed on these two dichotomous variables (i.e., believing that humans can get/give diseases from/to monkeys and apes). Results revealed that having knowledge of human-to-nonhuman primate disease transmission significantly predicted greater willingness to take steps to prevent transmission ($\beta = 0.49$, $SE = 0.16$, $t = 2.99$, $p = .003$) but did not predict desire to touch a monkey/ape ($\beta = -0.001$, $SE = 0.04$, $t = -0.04$, $p = 0.97$ OR = 0.99, 95% CI = [0.71, 1.38]) or keep a monkey/ape as a pet ($\beta = .01$, $SE = 0.06$, $t = 0.24$, $p = .81$, OR = 1.06, 95% CI = [0.65, 1.72]). In contrast, knowledge of Nonhuman primate-to-human disease transmission did not significantly predict willingness to take steps to prevent transmission ($\beta = .04$, $SE = 0.04$, $t = 1.18$, $p = .24$) or desire to touch a monkey/ape, ($\beta = -0.06$, $SE = 0.04$, $t = -1.51$, $p = .13$, OR = 0.73, 95% CI = [0.49, 1.10]). However, awareness that humans can get diseases from Nonhuman primates did significantly predict reduced likelihood of wanting to keep a monkey/ape as a pet ($\beta = -0.10$, $SE = 0.05$, $t = -2.00$, $p = 0.045$, OR = 0.58, 95% CI = [0.34, 0.99]).

The second follow-up model examined relationships between the dependent measures. Specifically, it was tested whether willingness to take steps to prevent human-to-Nonhuman primate disease transmission predicted reduced likelihood of wanting to touch or keep a monkey/ape as a pet. Results revealed that, although greater willingness to prevent disease transmission did not significantly predict desire to keep a monkey/ape as a pet ($\beta = 0.05$, $SE = 0.05$, $t = 1.09$, $p = 0.28$, OR = 1.05, 95% CI = [0.96, 1.14]), it actually predicted *greater* desire to touch a monkey/ape ($\beta = .15$, $SE = 0.03$, $t = 4.61$, $p < .001$, OR = 1.15, 95% CI = [1.08, 1.23]).

TABLE 3 Descriptive Statistics for Key Variables[a]

Variable (Range)	*M*	*Mdn*	*SD*
Investment in preventing illness (# of Activities) (0–7)	3.74	4.00	1.99
Risk-taking Propensity (1–5)	2.62	2.55	.89
Motivation to engage in environmental behaviors (−3–6)	2.11	2.00	1.79
Importance of viewing wildlife on vacation (1–10)	5.23	5.00	2.69
Environmental concern (1–7)	5.71	6.00	1.52
Connectedness to nature (1–5)	3.73	3.86	.88
Positive environmental attitudes (−2.67–4)	1.23	1.17	1.16
Binary Variables	***Yes***	***No***	
Believes humans get disease from monkeys/ apes (DNR = 4)	954 (87.28%)	139 (12.72%)	
Believes humans give disease to monkeys/apes (DNR = 8)	861 (79.06%)	228 (20.94%)	
Would touch or feed a monkey/ape (DNR = 4)	618 (56.54%)	475 (43.46%)	
Would Keep monkey/ape as pet (DNR = 4)	160 (14.64%)	933 (85.36%)	

DNR = did not respond/

[a]See methods for individual scale items that comprise each composite measure.

TABLE 4 Results of factor analyses[a]

Latent Factor	β	p	λ	Total variance explained	Factor R^2
Positive environmental attitudes			2.09	34.8%	
Positive environment motivations	0.77	<.001			58.8%
Environmental concern	0.59	<.001			34.4%
Concern for self and others	0.46	<.001			20.7%
Connectedness toeenvironment	0.55	<.001			30.1%
Awareness of disease transmission			1.42	23.7%	
Humans get diseases from NHP	0.46	<.001			21.2%
Humans give diseases to NHP	0.92	<.001			78.2%

[a]Shown here are results of exploratory and subsequent confirmatory factor analyses. β = standardized factor loadings, λ = eigenvalue of sample correlation matrix. Factor R^2 refers to variance in observed variables explained by the latent factor.

TABLE 5 Relationships between Covariates and Predictors[†]

Parameter	β	SE	t	p	R^2
Positive environmental attitudes					33.0%
Age	0.13****	0.04	3.38	<0.001	
Sex (0 = female, 1 = male)	−0.16****	0.04	−4.45	<0.001	
Education	0.13****	0.04	3.63	<0.001	
Awareness of transmission					3.0%
Age	−0.12	0.06	−1.90	0.06	
Sex (0 = female, 1 = male)	0.12*	0.05	2.50	0.01	
Education	0.07	0.04	1.65	0.10	
Risk-taking propensity					20.2%
Age	−0.40****	0.03	−15.04	<0.001	
Sex (0 = female, 1 = male)	0.24****	0.03	8.66	<0.001	
Education	0.01	0.03	0.26	0.79	

**$p < 0.01$

*$p < 0.05$.; ***$p < 0.001$,

[†]Shown here are standardized regression coefficients (β), standard error (SE), t-values, p-values, and R^2.

4 | DISCUSSION

The results of the survey revealed that a diverse group of individuals spanning a wide age range and a large number of different occupations view monkeys and apes on their holidays. The education of the sample was high, with more than 70% of the participants reporting either undergraduate or graduate education. It is therefore unsurprising that knowledge about transmission of infectious diseases between humans and nonhuman primates was high, with 87.28% and 79.06% believing that humans can get/give diseases from/to monkeys and apes. Despite such supposed knowledge, and in juxtaposition with these results, most respondents did not seek health advice before travel, and more than 13% were experiencing symptoms of infectious disease (9.21% specifically reporting respiratory symptoms; respiratory pathogens are arguably those most easily transmitted to nonhuman animals). Yet more than 40% of participants reported having had direct contact with a monkey or ape, and 30 people had been bitten or scratched. Perhaps even more troubling is that over 50% of those reporting symptoms of infectious illness had direct contact with a monkey or ape, compared to 42% of those who reported no symptoms. Even among those who had been bitten or scratched, over 76% still desired to touch or feed a monkey or an ape, and 43% would keep one as a pet. This compared to 56% and 14% of those not injured who desired to touch a monkey or an ape, or keep one as a pet, respectively.

Why do even highly educated individuals who express knowledge about the potential for disease transmission still report willingness to have contact with exotic species and desire to keep them as pets? Is this the result of carelessness or egoism? Presumably, the more knowledgeable one is about disease transmission, the less likely someone should want to have direct contact of any kind with a species that may serve as a source or sink for human pathogens. This should be especially the case when someone believes they are sick (i.e., have signs or symptoms of infection). Simply put, knowledge, attitudes, and behaviors sometimes do not align when it comes to travelers around animals, and this seems to be particularly the case for animals like monkeys and apes.

4.1 | Why monkeys and apes?

Nonhuman primates are often portrayed in the media as playful, jovial, neotenous, and approachable (Muehlenbein & Wallis, 2014). As such, they are frequently anthropomorphized. They are generally frugivorous or folivorous, so seemingly unthreatening relative to carnivores. Images of people, from travelers to celebrities and even

TABLE 6 Relationships between Predictors and dependent variables†

Parameter	*β*	*SE*	*t*	*p*	*OR*	*95% CI*	R^2
Willing to prevent transmission							13.4%
Age	−0.09*	0.03	−2.70	0.01	–	–	
Sex (0 = female, 1 = male)	−0.05	0.03	−1.41	0.16	–	–	
Education	−0.002	0.03	−0.06	0.96	–	–	
Positive Environmental Attitudes	0.33*****	0.04	8.30	< 0.001	–	–	
Awareness of Transmission	0.10*	0.04	2.32	0.02	–	–	
Risk-Taking Propensity	−0.04	0.03	−1.14	0.25	–	–	
Desire to touch NHP							16.4%
Age	−0.26*****	0.04	−6.98	< 0.001	0.97	[0.96, 0.98]	
Sex (0 = female, 1 = male)	−0.01	0.04	−0.20	0.84	0.97	[0.73, 1.30]	
Education	−0.03	0.03	−0.79	0.43	0.95	[0.84, 1.08]	
Positive Environmental Attitudes	0.14***	0.05	2.88	0.004	1.50	[1.11, 2.03]	
Awareness of Transmission	−0.10	0.06	−1.68	0.09	0.39	[0.15, 1.00]	
Risk-Taking Propensity	0.18*****	0.04	4.69	< 0.001	1.50	[1.26, 1.78]	
Desire to Keep NHP as Pet							35.4%
Age	−0.41*****	0.05	−9.01	< 0.001	0.94	[0.93, 0.96]	
Sex (0 = female, 1 = male)	−0.001	0.05	−0.02	0.98	1.00	[0.61, 0.88]	
Education	−0.15***	0.04	−3.44	0.001	0.73	[0.61, 0.88]	
Positive Environmental Attitudes	0.06	0.06	1.00	0.32	1.23	[0.81, 1.87]	
Awareness of Transmission	−0.20*	0.09	−2.27	0.02	0.12	[0.03, 0.45]	
Risk-Taking Propensity	0.23*****	0.05	4.85	< 0.001	1.81	[1.41, 2.33]	

NHP = nonhuman primate.

*$p < 0.05$.; **$p < 0.01$,; ***$p < 0.001$,

†Shown here are standardized regression coefficients (β), standard error (SE), t-values, p-values, odds ratios (OR), 95% confidence intervals (CI), and R2.

primatologists, having direct contact with nonhuman primates are abundant on social media, distorting public understanding of nonhuman primate conservation (Ross et al., 2011). Tourist images with nonhuman primates have been condemned by the International Union for the Conservation of Nature Primate Specialist Group (Waters et al., 2021) as they give the impression that these animals are not dangerous and could make appropriate pets. Cultural factors also play a role in facilitating tourist-primate interactions. For example, near the Upper Rock Nature Reserve in Gibraltar, taxi and coach drivers have been reported to encourage interactions with macaques, despite clear warnings signs that such behavior is prohibited and may be dangerous (Fuentes, 2006). These interactions may even unintentionally promote aggressive macaque behavior, as aggression is often responded to with an offer of a food "reward" to placate the animal (Fuentes & Gamerl, 2005).

Primate-based tourism has a long history (Russon and Wallis 2014) and researchers have already provided detailed recommendations on how to minimize risks of pathogen transmission between humans and nonhuman primates, primarily through physical and behavioral barriers (Gilardi et al., 2015; Homsy, 1999; Macfie & Williamson, 2010; Muehlenbein & Wallis, 2014; Muehlenbein, 2017). Despite these recommendations and regulations at many primate sanctuaries, tourists frequently break these rules around nonhuman primates. Of 136 surveys conducted at Bwindi Impenetrable National Park, Uganda, tourists visiting wild mountain gorillas get closer than permitted and even indicate they might still engage in gorilla trekking activities if they are themselves ill (Hanes et al., 2019). Observational data from 53 treks with these same animals revealed distance rule-breaking 98% of the time (Weber et al., 2020), although on a positive note, of 243 surveys, more than 70% of respondents indicated they would be willing to wear a mask while gorilla trekking (ibid). Finally, among 101 observations of tourists tracking wild chimpanzees in Kibale National Park, Uganda, coughing and sneezing were common behaviors among participants (Glasser et al., 2020). Although not necessarily associated with disease transmission in this case, there have been outbreaks of respiratory diseases in this group of chimpanzees (Negrey et al., 2019).

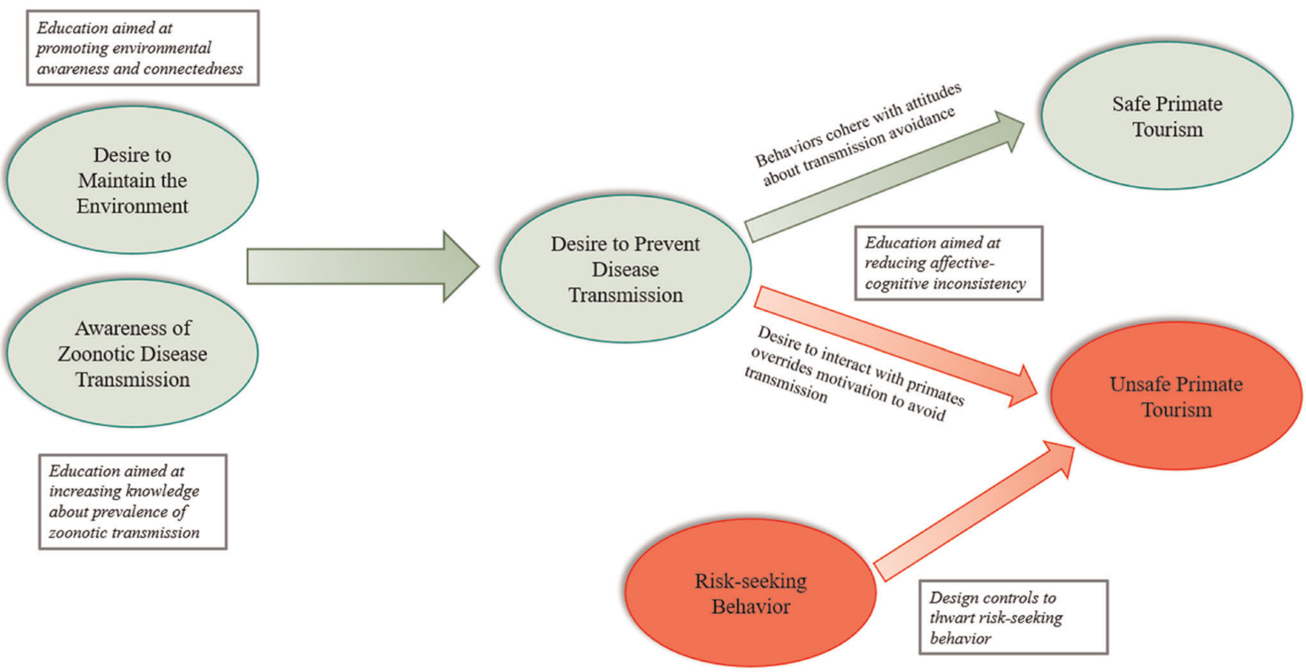

FIGURE 3 Theoretical model outlining educational strategies for mitigating tourism-related zoonotic disease transmission based on the results of the current study.

4.2 | Biophilia, touch, disinhibition, and exhibitionism

Human desire for physical contact with other species may be partly the result of biophilia, our innate tendencies to emotionally affiliate with other species (Kellert & Wilson, 1995; Wilson, 1984). Our general captivation with the natural world (Dunlap & Van Liere, 1978; Fromm, 1964; Leopold, 1949) may strengthen desire to specifically explore the environment through touch: the haptic somatosensory system of identifying and communicating tactile information (Gibson, 1966; Gordon et al., 2011). Our desires for physical contact with cute and furry animals (especially those not encountered in our home countries), combined with temporary loss of inhibition and situational awareness during travel may make it difficult for vacationers to behave rationally and keep a safe distance from wild animals. Signage even has to be placed on taxidermied museum specimens and working dogs to keep people from touching them (Milgrom, 2010), and children are more interested in zoo experiences when they can touch the animals (Kidd et al., 1995).

Despite regulations, potential fines, and advertised messaging, travelers often take opportunities to have direct contact with wildlife (Fuentes et al., 2008), bond with these animals through (hopefully) friendly encounters with deeply personal and profound experiences (Rose, 2011). Such emotionally arousing events can lead to further disinhibition (Martin & Kerns, 2011), with even more disinhibition in group settings (Diener, 1979). The same individuals expressing a kinship for or community with nature (Mayer & Frantz, 2004), who value their place in the biosphere (Schultz & Zelezny, 1999), and who have generally positive attitudes toward the environment (Stern & Dietz, 1994) are still capable of putting themselves and members of other species at risk. Humans often participate in self-destructive behaviors if they believe they are pursuing positive goals (Baumeister & Scher, 1988). Social media platforms provide opportunities for positive intermittent reinforcement and social acceptance, basic needs for human belonging (Baumeister & Leary, 1995). But travelers in pursuit of photos to share on social media (a form of exhibitionism; Maddox, 2017) often risk physical injury and even death (Flaherty & Choi, 2016), some associated with contact with animals (Bansal et al., 2018).

4.3 | Cognitive-Affective inconsistency: A model for understanding human and Nonhuman primat*e* interactions

The risks of disease transmission between humans and nonhuman primates (and other animal species) as well as the necessary physical barriers needed between us and other species have been well-characterized (Gilardi et al., 2015; Homsy,1999; Macfie & Williamson, 2010; Muehlenbein & Wallis, 2014; Muehlenbein, 2017). Here we present a theoretical education model (Figure 3) to better address the psychological disconnect between the desire for environmental protection and motivation for engaging in contact with potentially-vulnerable species. As might be expected, a reliable predictor of desire to engage in unsafe behaviors (e.g., touch or feed a monkey/ape) was greater risk-seeking. Moreover, those reporting greater propensity toward risk-taking were younger and more likely to be male. We also found that individuals more aware of the spread of infectious diseases between humans and nonhuman primates reported greater willingness to take steps to prevent zoonotic disease transmission (e.g., wear a mask and report any illnesses to park authorities), as well as a reduced likelihood of wanting to keep a monkey/ape as a pet. These latter findings are encouraging as they indicate that education about disease transmission may help motivate engagement in healthy behaviors and reduce the likelihood of engagement in risky behaviors, such as nonhuman primate pet ownership.

One particularly surprising finding, however, was that even though individuals with more positive environmental attitudes (e.g., connectedness to the environment) were more willing to take steps to mitigate tourism-related zoonotic disease transmission, they were also more likely to report wanting to touch or feed a monkey/ape. Similarly, a follow-up analysis revealed that individuals who were more willing to prevent the spread of zoonotic diseases were actually more likely to want to touch or feed a monkey/ape. In other words, more environmentally-oriented individuals also had a stronger desire to physically interact with monkeys and apes. Ignorance over the risks of wildlife contact therefore cannot explain peoples' continued desires to interact with nonhuman primates. These findings present complications for education, as they suggest that promoting pro-environmental attitudes may simultaneously increase motivation to prevent disease transmission, but also increase the likelihood of engaging in unsafe behaviors, like physical contact with nonhuman primates.

What is the source of this disconnect between attitudes and behavior? General carelessness may contribute to attitude-behavior inconsistency. Moreover, insights from the social cognitive sciences suggest that a major driver of attitude-behavior incongruency is underlying cognitive-affective inconsistency (Conner et al., 2020; Edwards, 1990; Kraus,1995; Zhou et al., 2013). This inconsistency arises when the cognitive components of an attitude (e.g., beliefs) are at odds with affective components of an attitude (e.g., one's feelings). For example, people may believe that it is unhealthy to eat certain foods, but they nonetheless do so because they enjoy the way that it makes them feel. Egoism may amplify the tendency to be driven by emotions compared to explicit attitudes (e.g., Sarlo et al., 2014). Applied to the current study, it seems that environmentally-oriented individuals *believe* that it is prudent to take steps to prevent zoonotic disease transmission, but they also *desire* to touch or feed monkeys and apes because these activities are emotionally rewarding.

Importantly, this framework also provides insights into how cognitive-affective inconsistency may be abated. Relevant to the current study, research finds that affective aspects of attitudes (e.g., feelings toward physical contact with monkeys/apes) respond to persuasive techniques that appeal to emotions rather than cognition (Edwards, 1990; Glasman & Albarracin, 2006; Mayer & Tormala, 2010; Olson & Zanna, 1993). Accordingly, individuals for whom physically interacting with monkeys/apes is emotionally rewarding—even if they are acutely aware of the risk—may not alter their behavior in response to cognitive means of persuasion, such as citing statistics about zoonotic disease transmission. Instead, techniques aimed at appealing to emotions, like an account of an individual monkey or ape negatively impacted by a tourism-derived infection may be more effective (e.g., Mayer & Tormala, 2010). Ideally, educational materials would include both cognitive and affective components. The need to implement such materials is now even more important in the wake of the SARS-CoV-2 virus pandemic. All Cercopithecine primates share the same set of twelve key amino acid residues as humans in the Angiotensin-Converting Enzyme 2 (ACE2) receptor (Melin et al., 2020) making them all susceptible to SARS-CoV-2 infection. We expect surveys like the present one to yield very different results when repeated in the future, as the current pandemic has likely made people more aware of the emergent potential of pathogens from wildlife.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

AUTHOR CONTRIBUTIONS

Michael Muehlenbein: conceptualization (lead); data curation (lead); formal analysis (equal); funding acquisition (lead); investigation (lead); methodology (lead); project administration (lead); resources (lead); software (lead); supervision (lead); writing original draft (lead); writing review & editing (lead). Kerry DOre: investigation (supporting); project administration (supporting); supervision (supporting); writing review & editing (supporting). Jeffrey Gassen: data curation (supporting); formal analysis (equal); visualization (lead); writing original draft (supporting); writing review & editing (supporting). Vy Nguyen: data curation (supporting); formal analysis (supporting); writing review & editing (supporting). Grace Jolley: data curation (supporting); formal analysis (supporting); writing review & editing (supporting). Christa Gallagher: data curation (supporting); funding acquisition (supporting); investigation (supporting); methodology (supporting); project administration (supporting); resources (supporting); supervision (supporting); writing review & editing (supporting).

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