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Public Perceptions of Human Physical Interactions, Exhibition, and Conservation of Tigers and Cheetahs

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**PUBLIC PERCEPTIONS OF HUMAN PHYSICAL INTERACTIONS, EXHIBITION,
AND CONSERVATION OF TIGERS AND CHEETAHS**

A Master's Thesis

Presented to

The Graduate College of
Missouri State University

In Partial Fulfillment

Of the Requirements for the Degree
Master of Science, Biology

By

Abbie Knudsen

December 2022

PUBLIC PERCEPTIONS OF HUMAN PHYSICAL INTERACTIONS, EXHIBITION, AND CONSERVATION OF TIGERS AND CHEETAHS

Biology

Missouri State University, December 2022

Master of Science

Abbie Knudsen

ABSTRACT

Tigers and cheetahs are common in the pet trade, public exhibits, and hands-on encounters with the public. Poor regulation of these experiences has resulted in numerous incidents worldwide in which a person was seriously injured or killed by captive big cats. Additionally, concerns for animal welfare have been raised by industry professionals. Prior research on primates has demonstrated exposing people to photographs of cats in different backgrounds can influence their attitudes about animals in captivity, but no study has addressed whether visual images affect human attitudes toward big cats. I used a survey that asked a series of questions about the suitability of keeping tigers and cheetahs in captivity, with each survey accompanied by a picture of tiger or cheetah in one of several backgrounds. Adult tigers were assessed as least happy when pictured in a circus, naturalistic zoo exhibit, or hard-surface exhibit, and adult cheetahs were evaluated as least happy when pictured on a leash or zoo background. In addition to the influence of the image characteristics, survey responses identified many significant trends in public perceptions of big cats as it relates to human physical interactions, exhibition, and conservation. For example, the majority of respondents believed that: scenarios where human interaction is permitted with tigers or cheetahs are unsafe, tigers and cheetahs are not appropriate to keep as pets, it should not be legal to own a big cat as a pet, and it is inappropriate for a tiger to perform tricks for the public's entertainment. Although our findings show limited influence of image characteristics on attitudes about tigers or cheetahs, the compiled survey results indicate that the public is concerned about the safety of people and welfare of big cats both in captivity and the wild.

KEYWORDS: big cat, tiger, cheetah, public perception, conservation, zoo

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In the interest of academic freedom and the principle of free speech, approval of this thesis indicates the format is acceptable and meets the academic criteria for the discipline as determined by the faculty that constitute the thesis committee. The content and views expressed in this thesis are those of the student-scholar and are not endorsed by Missouri State University, its Graduate College, or its employees.

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INTRODUCTION

Tigers and cheetahs are classified as endangered and vulnerable species, respectively, by the International Union for the Conservation of Nature Red List [1], but despite this designation both species of felids are present in the pet trade, public exhibits, and are available for hands-on encounters with the public. In the United States, tigers are more frequently maintained by private owners than cheetahs, and there have been unsubstantiated reports that up to 10,000 tigers may be kept as pets [2]. Both species of felids are frequently exhibited for public viewing at a wide variety of facilities, including accredited zoos, sanctuaries, and privately-owned roadside zoos. Tigers are unique in that they are the most populous species exhibited by circuses in Europe and North America [3]. In addition to public exhibits, some facilities also offer hands-on encounters for the public to pet, feed, or take photographs with big cats, including tigers and cheetahs [2].

Poor regulation of big cat ownership, exhibition, and encounters can be dangerous for the public. In 2003, Nyhus et al. [2] reviewed international media reports of tiger attacks on people and uncovered 59 incidents worldwide in which a person was seriously injured or killed by a captive tiger over a four-year period. At least 26 reported cases required emergency medical attention, and 12 incidents occurred during photographs with a tiger or during a tiger performance. Seven incidents in the United States resulted in death, six of which occurred at privately owned facilities and one of which occurred at a zoo not accredited by the American Zoo and Aquarium Association (AZA). An additional 12 people were killed by tigers internationally. Victims spanned across all age groups from three years old to adults and included both animal handlers and visitors. The authors suggest that private ownership of large, dangerous exotic animals is a public health concern and has broader implications for animal

welfare and conservation efforts; they support federal and/or state legislation that regulates private ownership and treatment of tigers in captivity

In the United States, the regulations governing private ownership, public contact, and exhibition of big cats (tigers, lions, cheetahs, leopards, etc.) vary greatly among states and local municipalities. The Animal Legal Defense Fund indicates that there are only five states (Washington, Oregon, Alaska, Hawaii, and Louisiana) with a full ban on the private ownership of big cats. At the other extreme, four states (Nevada, Wisconsin, North Carolina, and Alabama) have no state regulations to address the private possession of big cats. All remaining states have laws that allow commercial exhibition or private ownership of big cats with varying licensing requirements and/or exemptions [4]. States are generally responsible for regulation of ownership of exotic species, and there are few uniform federal regulations to protect the safety of the public and welfare of big cats in captivity in the United States.

Conservation and animal welfare efforts can be strongly affected by public attitudes [5]. In general, human perceptions are well-known to be influenced by exposure to visual images (e.g. in advertising . [6]), including perceptions about endangered species. For example, when study participants viewed “commercials” containing chimpanzees that were dressed and behaving like humans, they showed decreased understanding of the chimpanzees’ conservation status and reported they were less likely to donate to chimpanzee conservation efforts than when shown the same commercials with the animals in their natural habitats [7]. Another study of chimpanzees [8] showed that even still images can influence public attitudes depending on the background and other image characteristics. Survey participants viewing a photo of a chimpanzee in the company of a human were significantly more likely to find a chimpanzee appealing as a pet and to characterize the wild chimpanzee population as stable/healthy in spite

of chimpanzees' classification as endangered. Similarly, survey respondents viewing an image of a chimpanzee in a human-type setting were more likely to characterize the wild population as stable and healthy compared to participants that saw images of chimpanzees on other backgrounds. The authors suggest that images of chimpanzees in the media affect public attitudes about the species [8].

In 2014, Leighty et al. [9] built on the previous findings in the chimpanzee study [8] by expanding the research of public perceptions to other non-human primates. The authors found that survey participants were significantly more likely to find a primate desirable as a pet when it was viewed in an anthropomorphic setting while in contact with a human. Diverging from the chimpanzee study, they found no significant effect of human presence or context when survey participants were asked to characterize the conservation status of the pictured primate. However, the presence of a human in the photo caused a statistically significant increase in the number of participants that felt the primate was "sad" and "scared." Primates were most likely to be described as "happy" when no human was present in the photo, and particularly when shown in a forest habitat [9].

No study has similarly addressed whether visual images affect human attitudes toward big cats. A major goal of this study was to investigate whether perspectives of tigers and cheetahs by adult Americans would be influenced by specific image characteristics as previous research has demonstrated with primates. Similar to the model used in Ross et al. [8], I used a survey to quantify the impact of different image characteristics on public perceptions about tigers or cheetahs on issues of human physical interactions, exhibition, and conservation. Based on previous findings about primates, I hypothesized that big cats displayed in more natural backgrounds would be perceived as happier than those pictured in more artificial backgrounds.

Similarly, I expected exposure of big cats on more natural backgrounds to have negative influences on attitudes about human physical interactions with big cats and keeping big cats in captivity in general and positive influences on attitudes about conservation. In addition, to contribute to our general understanding of public attitudes to the issues above, I also quantified responses without respect to the images.

METHODS

Photographs

For surveys of attitudes about tigers, a separate series of photographs was created for tiger cubs and adult tigers. Photos showed a tiger cub (Figure 1): (A) sitting on a rock, (B) sitting on a rock adjacent to a human, and (C) being held by a human. Photos showed an adult tiger sitting in a (Figure 1): (D) white background, (E) naturalistic zoo exhibit, (F) hard-surface zoo exhibit with rock background, dead tree limbs and a hanging tire (hereafter, hard-surface exhibit), (G) circus setting (red and white striped backdrop and hoop), or (H) jungle habitat with no enclosure (hereafter, wild habitat).

For surveys of attitudes about adult cheetahs, a series of six composite images of adult cheetahs were created using Photoshop. Each image contained the same stock photograph of an adult cheetah with one of the following backgrounds (Figure 2): (A) a natural plains habitat with no enclosure, (B) an enclosure with a cheetah alone, (C) an enclosure with a cheetah sitting adjacent to a domestic mixed-breed dog (stock photo), (D) a cheetah on a leash with a human hand pictured holding the leash, (E) a cheetah sitting adjacent to a human keeper (stock photo), or (F) a cheetah on a white background. All cheetah enclosures had glass walls with a view of plants (trees and grasses), and the enclosure contained plants and a blue ball (hereafter, naturalistic zoo exhibit).

Surveys

Separate lists of survey questions were written to quantify attitudes about tigers and cheetahs. In December 2017, these two surveys were distributed online by SurveyMonkey to

adults aged 18 and older in the United States. Dixon and Turner [10] reported that their on-line

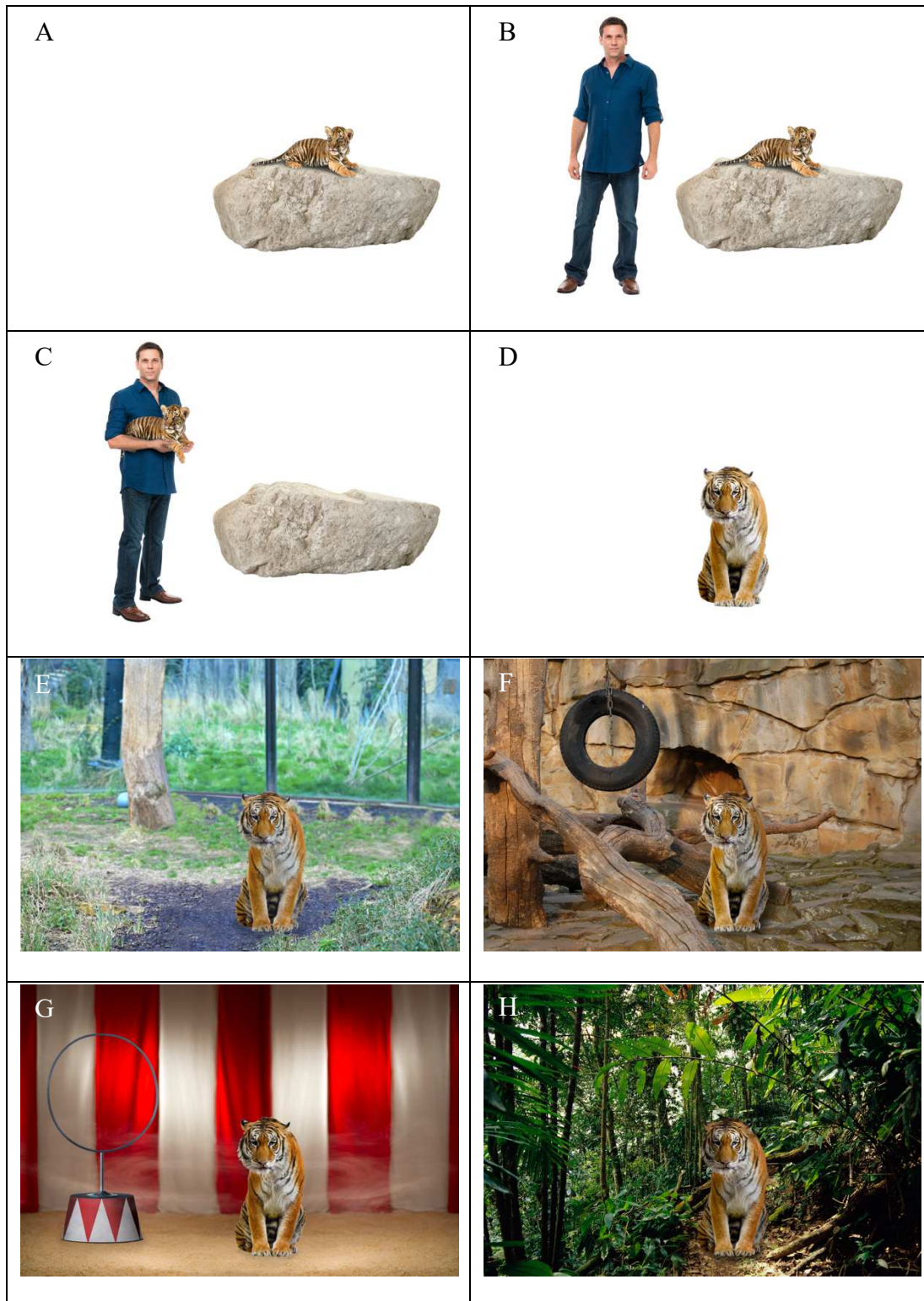


Figure 1. Composite images featuring a tiger cub or adult tiger on different backgrounds.



Figure 2. Composite images featuring an adult cheetah on different backgrounds.

survey had higher response rates than a paper survey sent by mail, and that the results of the two modalities did not differ significantly. Each survey respondent received only one of the two surveys (i.e. tiger or cheetah). Survey questions took a variety of formats, including multiple choice, Likert scale, written free response, and check-box questions.

For the tiger survey, a randomly-selected image of one of the eight tiger photographs

(Figure 1) was placed at the beginning of the survey. For the cheetah survey, a randomly-selected image of one of the six cheetah photographs (Figure 2) was placed at the beginning of the survey. The tiger survey contained 12 questions (Table 1), and the cheetah survey contained 10 questions (Table 2). The question “how happy is the cheetah/tiger in the photograph?” was the first question presented on all surveys. The question “on average, how frequently do you visit zoos, aquariums, nature centers, circuses, sanctuaries, or other venues that have live animals on display to the public?” was the last question on all surveys. The remaining questions were presented in a random order determined by SurveyMonkey. Likert scale questions contained a descriptor above the “1” and “5” selection to indicate to respondents the low and high end of the scale. For the question asking respondents to characterize the conservation status of tigers/cheetahs, a descriptor was provided above the “1,” “3,” and “5” selection to further define the scale. The order of “yes” or “no” answer options for all yes-no questions was randomized. For the question “how do you think it impacts a tiger/cheetah to have physical contact with the general public?,” the answer choice “no impact” appeared as the last answer choice, and the order of the remaining two answer choices was randomized. For the question regarding a presentation about cheetahs at a zoo, the answer choice “none of these outcomes justify bringing a cheetah out of its exhibit on a leash for a presentation” appeared as the last answer choice, and the order of the remaining answer choices was randomized. An A/B question format was used for the question “do you think it should be illegal/legal for people to keep a big cat, such as a tiger or cheetah, as a pet?,” and half of respondents saw the word “illegal” and half of respondents saw the word “legal.” Data for cheetahs and tigers were analyzed separately. To determine whether exposure to the different images influenced survey responses, I compared Likert score responses for the different images with a separate Analysis of Variance. Questions

Table 1. Questions presented on tiger survey. Format: Y/N – Yes or No, MC – multiple choice, Scale 1-5 – Rate answer on a fixed scale, FR – free response.

Question	Format
How happy is the tiger in the photograph?	Scale 1-5
Do you think it should be illegal/legal for people to keep a big cat, such as a tiger or cheetah, as a pet?	Y/N
How do you think it impacts a tiger to have physical contact with the general public? <ul style="list-style-type: none"> ○ Harmful/Stressful ○ Beneficial/Enjoyable ○ No Impact 	MC
How safe is it for the average adult to have physical contact with a captive tiger under the following conditions? (1) unrestrained adult tiger (2) unrestrained tiger cub (3) swimming with a tiger cub (4) adult tiger on a chain	Scale 1-5
How appropriate is it to have a tiger as a pet?	Scale 1-5
Resources for tiger conservation should be used on: <ul style="list-style-type: none"> ○ Programs that protect wild tigers ○ Programs that use captive tigers to educate the public ○ Both of the above but more resources should be used for wild tiger protection programs ○ Both of the above but more resources should be used for captive tiger education programs 	MC
Should the public have opportunities to have physical contact with tiger cubs? Why or why not?	Y/N, FR
How likely are you to donate money to tiger conservation?	Scale 1-5
How likely are you to watch a documentary about tigers?	Scale 1-5
Would it be appropriate for a tiger to perform tricks, such as jumping through a hoop, in a performance for the public's entertainment?	Scale 1-5
On a scale of 1 to 5, how would you characterize the current conservation status of tiger populations in the wild?	Scale 1-5

Table 1 Continued. Questions presented on tiger survey. Format: Y/N – Yes or No, MC – multiple choice, Scale 1-5 – Rate answer on a fixed scale, FR – free response.

Question	Format
<p>On average, how frequently do you visit zoos, aquariums, nature centers, circuses, sanctuaries, or other venues that have live animals on display to the public?</p> <ul style="list-style-type: none"> ○ 0 times per year ○ 1-3 times per year ○ 4-6 times per year ○ More than 6 times per year 	MC

involving comparisons of proportions (choice questions) were analyzed either with Chi-Square tests or Binomial tests.

Because background had minimal effects (see Results), I performed post-hoc analyses examining the data without including background as a variable. In some cases, I compared responses to individual questions for tigers versus cheetah surveys or responses for adult tigers versus cubs using ANOVAs. To further filter out “noise” in the analyses of Likert-scale scores, I deleted “neutral” response (3 on the Likert scale) and combined remaining scores into “low” (1 and 2) and “high” (4 and 5) categories and compared proportions of individuals with low versus high scores.

This study was submitted to Missouri State University’s Institutional Review Board and found to be exempt on April 4, 2016 (See Appendix A).

Table 2. Questions presented on cheetah survey. Format: Y/N – Yes or No, MC – multiple choice, Scale 1-5 – Rate answer on a fixed scale, Select All That Apply – more than one choice may be selected.

Question	Format
How happy is the cheetah in the photograph?	Scale 1-5
Do you think it should be illegal/legal for people to keep a big cat, such as a cheetah or tiger, as a pet?	Y/N
How do you think it impacts a cheetah to have physical contact with the general public? <ul style="list-style-type: none"> ○ Harmful/Stressful ○ Beneficial/Enjoyable ○ No Impact 	MC
How safe is it for the average adult to have physical contact with a captive cheetah under the following conditions? <ul style="list-style-type: none"> (1) unrestrained adult cheetah (2) unrestrained cheetah cub 	Scale 1-5
How appropriate is it to have a cheetah as a pet?	Scale 1-5
You attend a presentation about cheetahs at a zoo. A keeper brings a cheetah out of its exhibit on a leash, but no public physical contact with the cheetah is allowed. Bringing a cheetah out of its exhibit would be justified if people who saw the presentation: <ul style="list-style-type: none"> <input type="checkbox"/> are more likely to donate money to cheetah conservation <input type="checkbox"/> learn and retain more information about cheetahs <input type="checkbox"/> rate their zoo visits as more satisfactory <input type="checkbox"/> develop a stronger emotional connection to cheetahs <input type="checkbox"/> none of these outcomes justify bringing a cheetah out of its exhibit on a leash for a presentation 	Select All That Apply
How likely are you to donate money to cheetah conservation?	Scale 1-5
How likely are you to watch a documentary about cheetahs?	Scale 1-5
On a scale of 1 to 5, how would you characterize the current conservation status of cheetah populations in the wild?	Scale 1-5
On average, how frequently do you visit zoos, aquariums, nature centers, circuses, sanctuaries, or other venues that have live animals on display to the public? <ul style="list-style-type: none"> ○ 0 times per year ○ 1-3 times per year ○ 4-6 times per year ○ More than 6 times per year 	MC

RESULTS

Demographic information on age range, gender, geographic location, and household income was obtained for each respondent. Although the characteristics of the responders in our study were not systematically balanced, a diverse audience was included for age, gender, region, and income. SurveyMonkey divided demographic responses into equal-sized categories for each variable. For cheetah surveys, the percentage of respondents in the four age categories ranged from 20.0% (18-29 years; youngest age group) to 30.5% (> 60 years; oldest age group). For gender, 47% identified gender as male and 53% as female. SurveyMonkey divided the country into nine geographic regions, with respondents ranging from 5.1% (East South Central) to 19.3% (Pacific) per category. For three income categories, 17.6% respondents were in the highest income category (\$125K and above), 42.6% were categorized as in the middle income (\$50K—100K), and 39.8% were in the lowest income category (\$0—39K); although almost all respondents answered the other demographic questions, 13.6% did not respond to the income question. Demographic characteristics for tiger surveys were similar.

Does Background in Photographs Affect Perceptions

For both the tiger and cheetah surveys, the only question that was significantly affected by the photographs concerned the assessment of the happiness of the tiger or cheetah pictured. The tiger was assessed as least happy in the circus, naturalistic zoo exhibit, and hard-surface exhibit ($F_{7,1233} = 26.34$, $P = < 0.001$; Figure 3). The cheetah was evaluated as least happy when pictured on a leash and zoo background ($F_{5,927} = 13.60$; $P = < 0.001$; Figure 4). None of the other questions were significantly affected by the photographs for the tiger survey (Appendix B) or

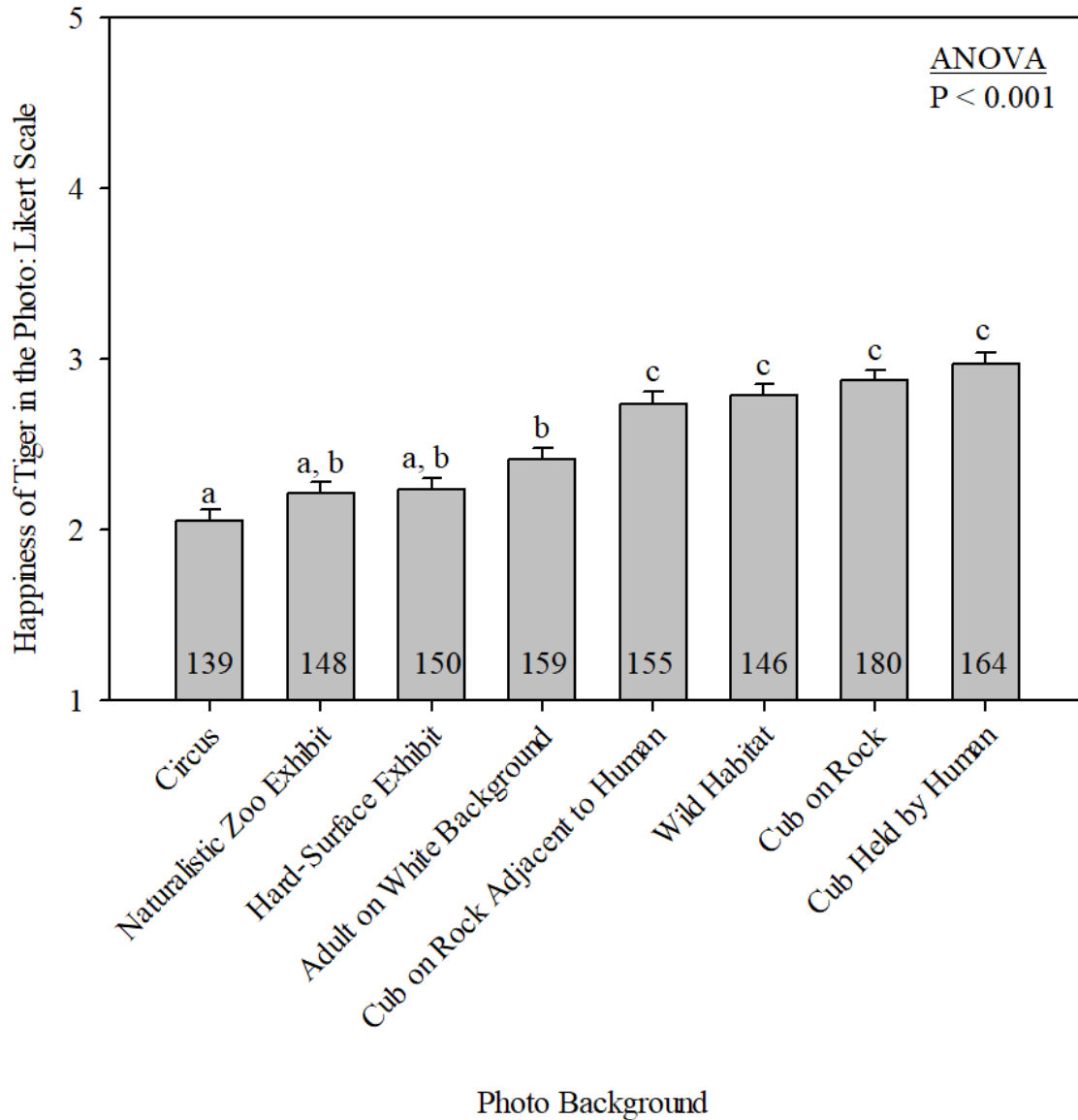


Figure 3. Happiness of the tiger in the photo with 1 being extremely unhappy and 5 being extremely happy. Different letters indicate significant differences.

cheetah survey (Appendix C).

Human Physical Interactions with Tigers and Cheetahs

All scenarios for both tigers and cheetahs were rated as unsafe by >50% of respondents (Table 3, Table 4). The four scenarios on the tiger survey were statistically different ($F_{3,4960} =$

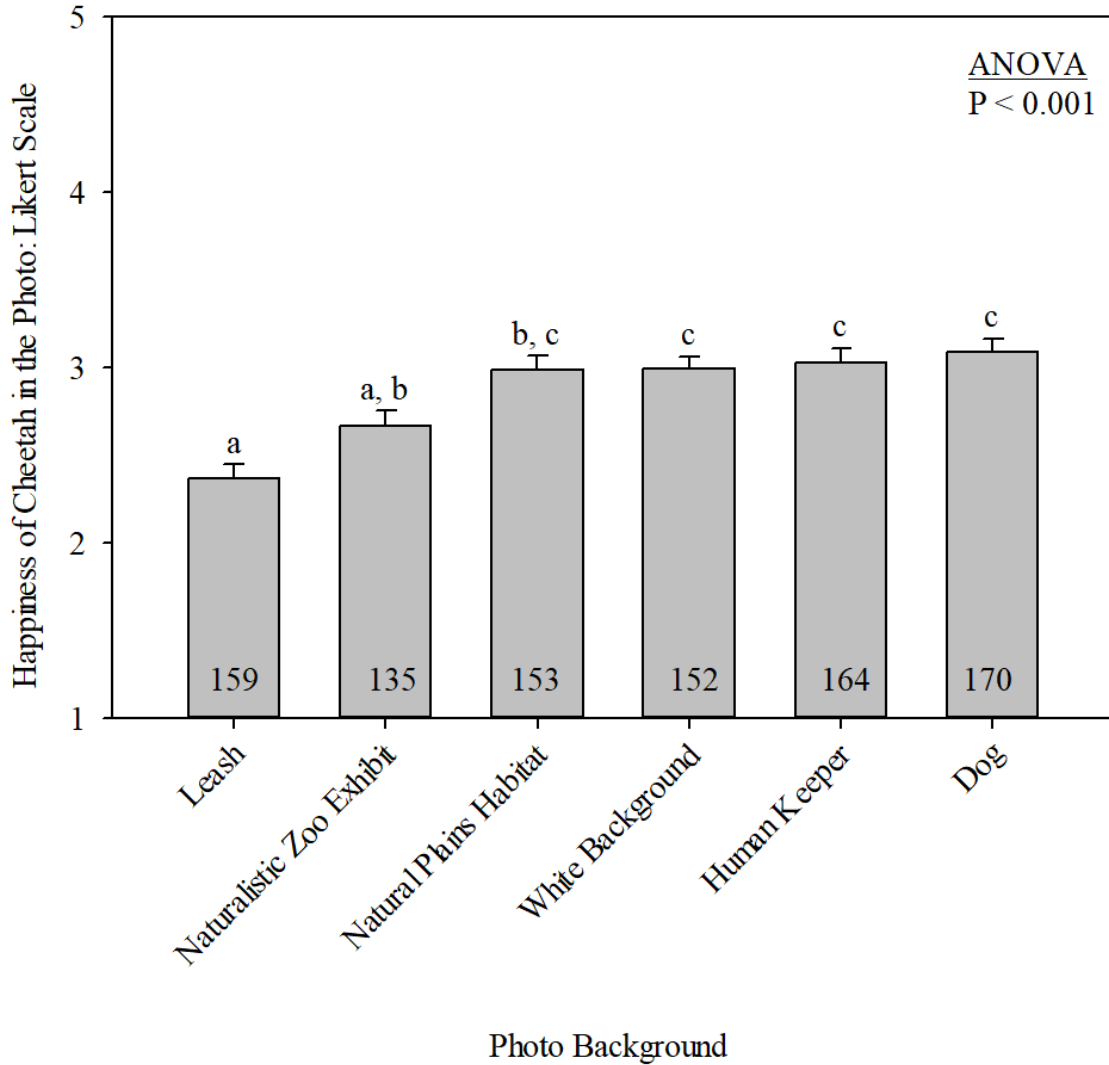


Figure 4. Happiness of the cheetah in the photo with 1 being extremely unhappy and 5 being extremely happy. Different letters indicate significant differences.

222.01, $P < 0.001$; Figure 5). According to Tukey multiple comparison tests, the two tiger cub scenarios were rated as less unsafe than both scenarios with adult tigers, but the means for all scenarios were less than three on a one to five Likert scale. There was no difference between the two scenarios for tiger cubs, but, not surprisingly, unrestrained adult tigers were rated as more dangerous than adult tigers on a chain. All scenarios were statistically different from one another with the exception of two scenarios; interacting with an unstrained tiger cub or swimming with a

Table 3. Number and percent of respondents that rated each interaction with a tiger as unsafe.

	n	Mean	% respondents rated unsafe
Unrestrained adult tiger	1178	1.20	94.92%
Adult tiger on a chain	1046	1.58	84.29%
Swimming with a tiger cub	833	2.00	67.12%
Unrestrained tiger cub	803	2.09	64.71%

Table 4. Number and percent of respondents that rated each interaction with a cheetah as unsafe.

	n	Mean	% respondents rated unsafe
Unrestrained adult cheetah	846	1.38	90.68%
Unrestrained cheetah cub	503	2.42	53.91%

tiger cub were ranked as the least unsafe and were not statistically different from one another.

For the two scenarios on the cheetah survey, interacting with an unrestrained cheetah cub was ranked as significantly safer than interacting with an unrestrained adult cheetah ($F_{1,1864} = 477.86$, $P < 0.001$; Figure 6), although both interactions had mean scores of less than three on a 1-5 Likert scale, indicating both scenarios were perceived as unsafe.

Is keeping tigers or cheetahs as pets appropriate and should it be legal? Relatively few respondents selected a neutral answer when asked to characterize the appropriateness of keeping a tiger or cheetah as a pet (tigers $n = 54$, 4.35%; cheetahs $n = 51$, 5.47%), and these were not considered in the statistical analysis. The vast majority of respondents who made choices characterized tigers (93.6%) and cheetahs (92.28%) as inappropriate pets (Binomial test: tigers $p < 0.001$; cheetahs $p < 0.001$; Table 5). Similarly, respondents on both surveys thought that it

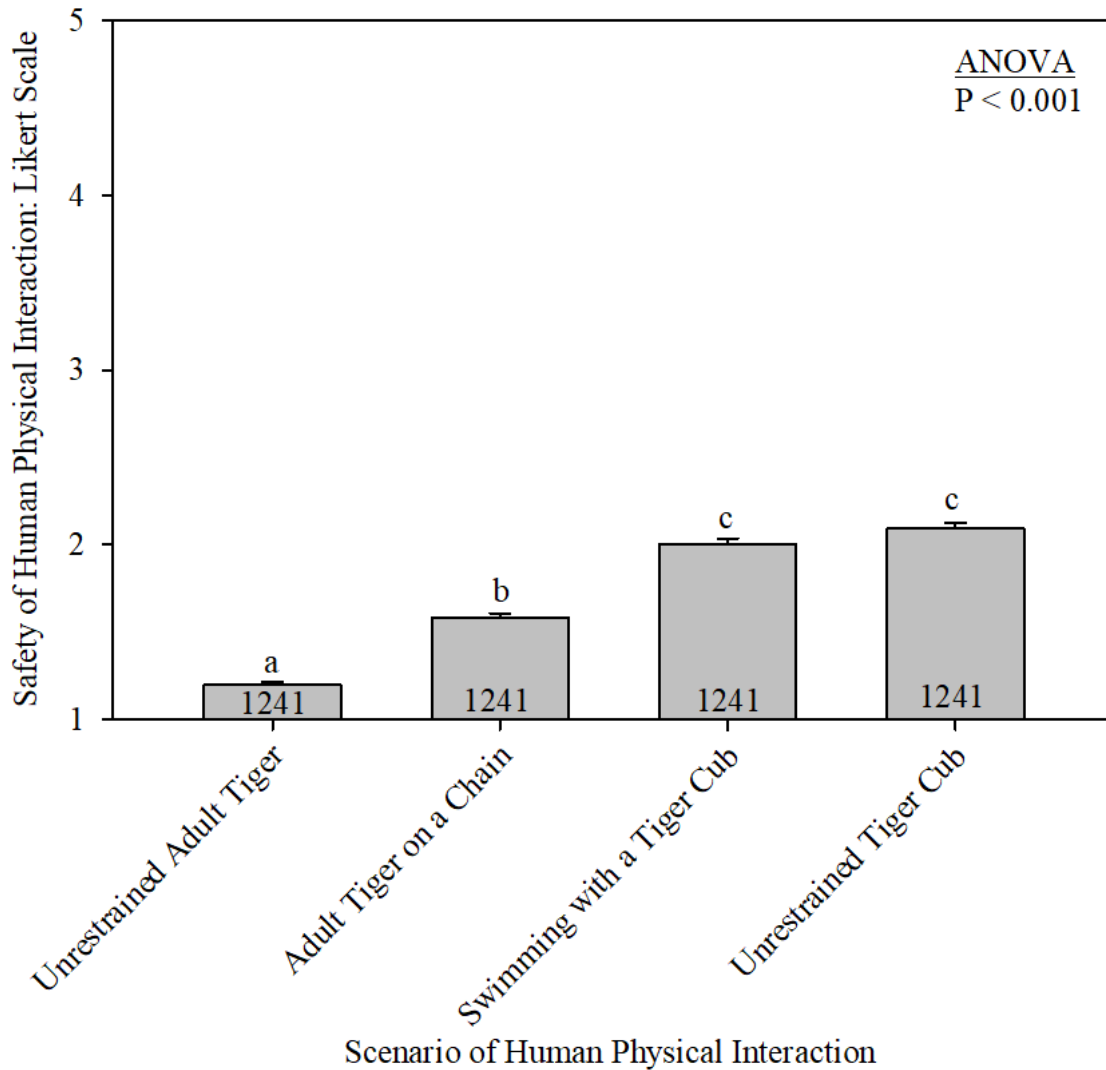
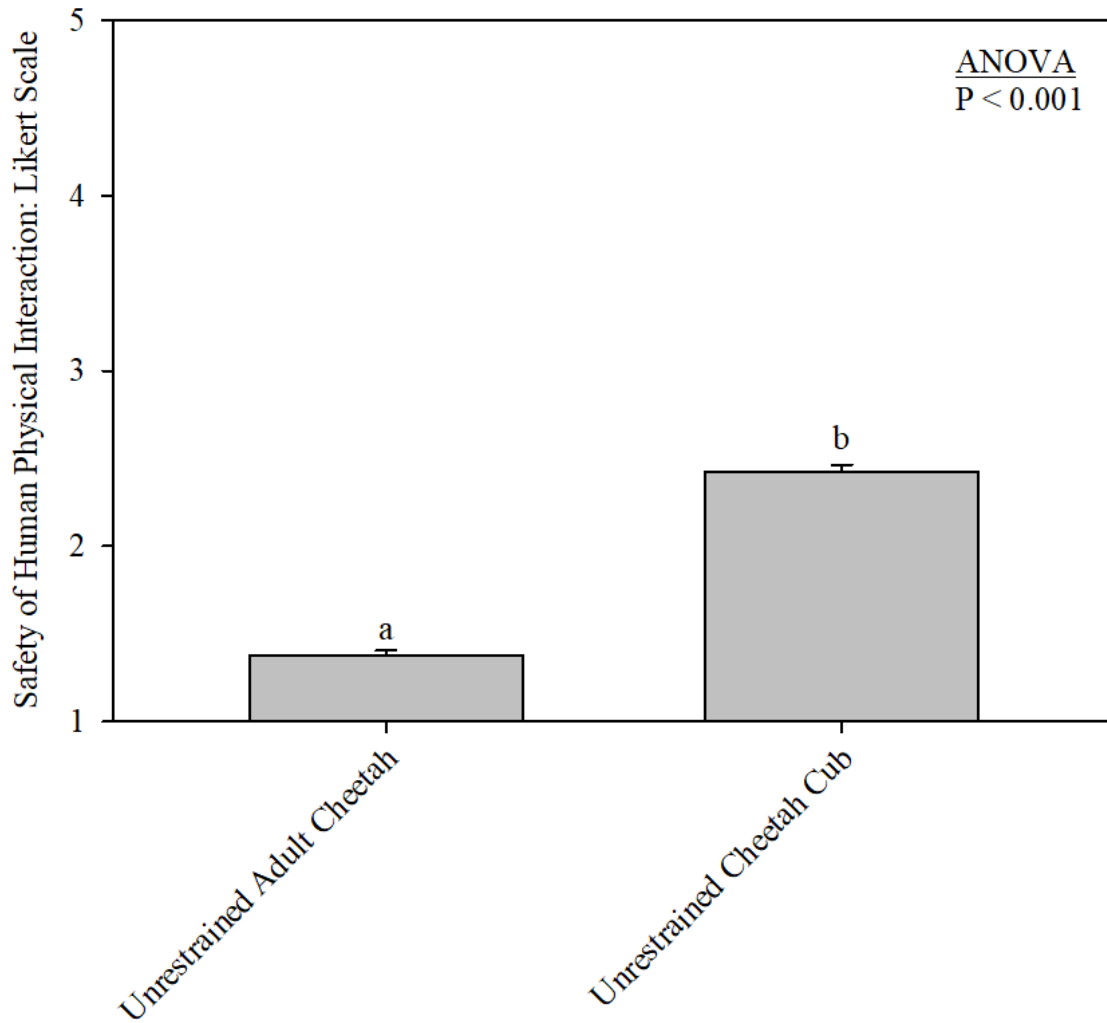


Figure 5. Safety of Human Physical Interaction with a tiger in various backgrounds with 1 being not safe at all and 5 being very safe. Different letters indicate significant differences.

should not be legal to keep a big cat as a pet (tigers 85.50%; cheetahs 85.10%; Table 6).

The next three questions addressed physical interactions between humans and tigers and so were asked only on the tiger survey.

Should the public have physical contact with tiger cubs? The majority of respondents (77.68%) felt that the public should not have opportunities **for physical contact** with tiger cubs (Binomial test, $p < 0.001$). In the follow-up question, the most frequent reason given for



Scenario of Human Physical Interaction

Figure 6. Safety of Human Physical Interaction with a cheetah in various scenarios with 1 being not safe at all and 5 being very safe. Different letters indicate significant differences.

answering “no” was that the contact was unnatural, followed by contact being a risk to humans or animals (Table 7). A fairly large percentage of respondents who answered “yes” (29%) said that contact should be limited to zookeepers or medical staff. The most frequent rationales for “yes” answers were that there was educational value to physical contact followed by human or animal benefit to the contact. Interestingly, about 4% of respondents who answered “yes” listed a reason that indicated they had some negative feelings about human/cub interactions.

Table 5. The proportion of respondents that characterized tigers and cheetahs as pets as inappropriate, neutral, or appropriate.

	Tiger survey	Cheetah survey
Inappropriate	93.55%	92.28%
Neutral	4.35%	5.47%
Appropriate	2.10%	2.25%

Table 6. The proportion of respondents that thought it should be legal to keep a big cat as a pet.

	Tiger survey	Cheetah survey
No	85.50%	85.10%
Yes	14.50%	14.90%

Is contact with the general public harmful/stressful for a tiger? Over 80% of respondents described contact with the general public to be harmful/stressful for a tiger. Only a few indicated that such contact had no impact (9.02%) or was beneficial (7.49%) for the tiger (Table 8).

Zoos and Other Public Exhibits of Tigers and Cheetahs

How frequently do respondents visit zoos or other exhibits of live animals? Over 50% of respondents on both surveys visited zoos or other exhibits of live animals at least once per year, with most visiting 1-3 times per year (Table 9). A few (2.42%, 4.72% on tiger survey and cheetah survey, respectively) visited live animal exhibits more than 6 times per year.

Is it appropriate for a tiger to perform tricks for the public’s entertainment? Most respondents (79.13%) rated this type of exhibit as inappropriate, with only 7.41% describing it as appropriate and 13.46% selecting a neutral answer. Selections of 1 and 2 on the Likert scale were

grouped as responses for inappropriate (n = 982), and responses of 4 and 5 on the Likert scale were grouped as responses for appropriate (n = 92). Respondents that selected a 3 on the Likert

Table 7. Number and percent of respondents that selected yes/no when asked if the public should have opportunities to have physical contact with tiger cubs and the reasons for their responses. As many respondents gave more than one reason, the number of reasons exceeds the number of respondents.

Reason for saying that contact should not be allowed	n	%
Unnatural	340	35.27
No reason	244	25.31
Human risk	145	15.04
Animal risk	123	12.76
Inappropriate acclimation to humans	73	7.57
Unethical	63	6.54
Unnecessary	53	5.50
Total no	964	100
Reason for saying that contact should be allowed		
Education/Connection	92	33.21
With exception	81	29.24
No reason	71	25.63
Human benefit/right	31	11.19
Animal benefit	18	6.50
Small/safe/cute	15	5.42
Human risk	4	1.44
Unnatural	4	1.44
Animal risk	3	1.08
Inappropriate acclimation	2	0.72
Unnecessary	1	0.36
Unethical	1	0.36
Total yes	277	100

Table 8. The number and percent of respondents that characterized contact with the general public as harmful/stressful, having no impact, or beneficial for a tiger.

Reason for saying that contact should not be allowed	n	%
Harmful/stressful	1036	83.48
No impact	112	9.02
Beneficial	93	7.49

Table 9. The proportion of respondents that visited venues with live animals on display 0, 1-3, 4-6, or more than 6 times per year.

	Tiger survey	Cheetah survey
0 times per year	42.14%	35.48%
1-3 times per year	50.68%	54.45%
4-6 times per year	4.75%	5.36%
More than 6 times per year	2.42%	4.72%

scale (n = 167) were not considered in the analysis. A binomial test indicated that the distribution of responses for inappropriate versus appropriate was significantly different from a random distribution of 50:50 ($p < 0.001$; Table 10).

Is it appropriate to bring a cheetah out of its exhibit on a leash for a presentation if no public contact with the cheetah is allowed? Respondents most frequently (46.52%) indicated that it was never appropriate (Table 11). A moderate number felt these types of exposures were justified for educational or conservation-related outcomes (28.51—37.40%). Only 17.47% felt that exhibiting cheetahs outside of their exhibits was justified if the only outcome was a more satisfactory experience for zoo patrons. These data were not analyzed statistically, because

participants could choose more than one answer.

Conservation Issues

How do respondents view the conservation status of tigers and cheetahs? The majority of respondents described populations of both cheetahs (Chi-squared = 599.85, $p < 0.001$) and tigers (Chi-squared = 1099.32, $p < 0.001$) as declining (Table 12).

Are respondents likely to watch a documentary about tigers or cheetahs? The majority of respondents characterized themselves as likely to watch a documentary about tigers (57.21%) or cheetahs (53.16%). The remaining respondents were unlikely to watch a documentary (tigers 20.47%; cheetahs 25.29%) or selected a neutral answer (tigers 22.32%; cheetahs 21.54%). Selections of 4 and 5 on the Likert scale were grouped as responses for likely to watch a documentary (tigers $n = 710$; cheetahs $n = 496$), and responses of 1 and 2 on the Likert scale were grouped as responses for not likely to watch a documentary (tigers $n = 254$; cheetahs $n = 236$). Respondents that selected a 3 on the Likert scale (tigers $n = 277$; cheetahs $n = 201$) were not considered in the analysis. A binomial test indicated that the distribution of responses for likely versus not likely to watch a documentary was significantly different from a random distribution of 50:50 for both tigers and cheetahs (tigers $p < 0.001$; cheetahs $p < 0.001$) (Table

Table 10. The proportion of respondents that characterized tigers performing tricks for the public's entertainment as inappropriate, neutral, or appropriate.

	n	%
Inappropriate	982	79.13%
Neutral	167	13.46%
Appropriate	92	7.41%

13).

How should resources be allocated for tiger conservation efforts? Nearly all (91.78%) respondents believed wild tigers should receive preference over captive tigers in resource allocation, with 50.68% of respondents indicating that programs for both captive and wild tigers are important, but more resources should be used to protect wild tigers and 41.10% of survey participants answering that resources should be used exclusively on programs that support wild tigers (Table 14).

Are respondents likely to donate money to conservation of tigers or cheetahs?

Table 11. The proportion of respondents that believed the provided outcome would justify taking a cheetah out of its exhibit on a leash for a presentation.

Outcome	%
None of these outcomes justify bringing a cheetah out of its exhibit on a leash for a presentation	46.52%
Learn and retain more information about cheetahs	37.40%
Are more likely to donate money to cheetah conservation	34.51%
Develop a stronger emotional connection to cheetahs	28.51%
Rate their zoo visit as more satisfactory	17.47%

Table 12. The proportion of respondents who characterized the wild tiger or cheetah population as declining, stable, or increasing.

	Tiger survey	Cheetah survey
Declining	76.79%	68.92%
Stable	19.34%	26.58%
Increasing	3.87%	4.50%

Table 13. The proportion of respondents that characterized themselves as likely or not likely to watch a documentary about tigers or cheetahs.

	Tiger survey	Cheetah survey
Likely or very likely	57.21%	53.16%
Neutral	22.32%	21.54%
Not likely or not likely at all	20.47%	25.29%

Table 14. The proportion of respondents in favor of allocating resources for tiger conservation to captive versus wild tigers.

Resource allocation preference	%
Both of the above but more resources should be used for wild tiger protection programs	50.68%
Programs that protect wild tigers	41.10%
Both of the above but more resources should be used for captive tiger education programs	6.61%
Programs the use captive tigers to educate the public	1.61%

Respondents that selected a neutral answer (tigers n = 400; cheetahs n = 288) were not considered in the analysis. Selections of 4 and 5 on the Likert scale were grouped as responses for likely to donate money (tigers n = 278; cheetahs n = 173), and responses of 1 and 2 on the Likert scale were grouped as responses for not likely to donate (tigers n = 563; cheetahs n = 472). A binomial test indicated that the distribution of responses for likely versus not likely to donate money was significantly different from a random distribution of 50:50 for both tigers and cheetahs (tigers $p < 0.001$; cheetahs $p < 0.001$) (Table 15).

Table 15. The proportion of respondents that characterized themselves as likely or not likely to donate money to conservation of tigers or cheetahs.

	Tiger survey	Cheetah survey
Likely or very likely	22.40%	18.54%
Neutral	32.23%	30.87%
Not likely or not likely at all	45.37%	50.59%

DISCUSSION

The results of this experiment show very limited support for the hypothesis that background image characteristics influence attitudes about human physical interactions, captivity, or conservation of tigers or cheetahs. Only the question that asked respondents to characterize the happiness of the tiger or cheetah in the photo was significantly influenced by the image provided at the top of the survey. Cheetahs that were viewed on a leash or naturalistic zoo background were perceived to be less happy than cheetahs in other contexts. On the tiger survey, the adult tiger on the natural habitat background was characterized as the happiest. This was consistent with both our hypothesis and the findings by Leighty et al. [9] where primates were described as most happy when pictured in a natural habitat.

Unlike Leighty et al.'s [9] study of primates, the images of tigers and cheetahs in different venues did not affect other responses in our survey. This difference between the two studies might reflect different levels of empathy that humans feel for primates versus big cats. Harrison et al. [11] found that the degree of empathy for animals varied directly with phylogenetic relatedness with humans. For example, on an empathy ("ability to understand the animal's feelings") scale where human-human rated a 9.82, human-monkey rated a 7.46, but human-cheetah rated only a 4.70. Interestingly, human-domestic cats rated a 7.08, indicating that humans view domestic cats and wild cats differently with respect to empathy/anthropomorphism. Harrison et al.'s [11] results closely mirror the findings of Eddy et al.'s [12] study in which humans rated the "cognitive abilities" of different species.

It is well documented that captive big cats are dangerous and can cause life-threatening or fatal injuries to humans [2, 13]. Most respondents recognized the dangers of humans having

physical interactions with big cats, particularly if the animal is an adult. A large majority (84-95% of people surveyed) characterized interactions with adult tigers or cheetahs as unsafe, and fewer respondents (53-67%) described interactions with cubs as unsafe. Although adult tigers are clearly more dangerous than cubs, cubs can also cause serious injuries to humans, including bites that resulted in stitches, plastic surgery, and, in one case, a severed finger [13]. The low danger rating for interactions with cubs suggests that more education is needed to communicate the risk of big cats that are not full grown. Although certified professionals from organizations, such as the AZA and Big Cat Sanctuary Alliance, do not support opportunities for the public to have physical contact with big cats, there are still many roadside zoos and privately-owned tourist attractions that offer these opportunities despite safety concerns [14, 15, 16].

In addition to human safety, survey participants also exhibited concern for the welfare of the animal when being handled by the public. Over 80% of respondents described contact with the general public to be harmful/stressful for a tiger. Wildlife experts have long asserted that there are a variety of animal welfare issues with allowing contact between the public and exotic animals, including but not limited to, premature mother-infant separation, excessive handling and stress, and abusive training [14]. Although numerous reputable sources [17, 18] have reported on abuses, including killing of tiger cubs after they have grown too big for handling, scientific studies are lacking. Facilities with abusive practices are unlikely to cooperate with researchers conducting legitimate scientific studies. However, even under more benign circumstances without physical contact with strangers, exposure to increased numbers of visitors can influence stereotypy (stress-related pacing) and levels of stress hormones [19, 20] for big cats.

Given that survey participants felt there were risks both to humans and animals, it is not surprising that most people concluded that the public should not have opportunities for contact

with big cats and should not be permitted to keep them as a pet. A large majority of participants characterized adult tigers and cheetahs as inappropriate as pets (94%, 92% respectively), and a slightly smaller majority (86%, 85% respectively) felt that keeping them as pets should be illegal. Respondents were slightly more willing for the public to have opportunities for interactions with cubs, as only 78% rated this activity as inappropriate. There have been many efforts by wildlife organizations, experts, and advocates to enact national laws in the United States to prohibit public contact with and private ownership of dangerous animals, including big cats. One such national effort gaining momentum at the time of this writing, is the Big Cat Public Safety Act, which would prohibit big cats from being kept as pets or used in exhibits that allow direct contact with the public. The bill would still allow the exhibition and care of big cats by licensed professionals, such as AZA zoos and licensed wildlife sanctuaries [21]. Overall, our data offer robust support that Americans believe opportunities for the public to have physical contact with big cats or keep them as pets should be eliminated and prevented in the future.

Our findings also have implications for the exhibition of big cats in the United States in exhibits such as traveling circuses or more long-term events, such as theater performances. Most (79%) people characterized it as inappropriate for a tiger to perform tricks for the public's entertainment. Criticism of performing animals from professionals has occurred on both the international and national landscape [22]. Public criticism of the circus industry has resulted in more than 50 countries enacting nationwide bans or local ordinances that prohibit or restrict the use of wild animals in circuses, including 106 jurisdictions in the United States [23]. Studies on the welfare of circus animals have supported concerns that the species commonly used in performances, such as large felids, do not have their environmental or behavioral needs met, and they encounter significant stressors associated with travel and performing/training [22]. Our data

further highlight the shifting public perceptions about how big cats should or should not be used by humans for entertainment and suggest that the majority of Americans agree with removing tigers from performances.

Similarly, nearly half (47%) of survey participants believed it was not justified for a cheetah to leave its exhibit on a leash for a presentation regardless of the outcome. This finding, coupled with our finding that participants characterized cheetahs pictured on a leash as unhappy, could have implications on educational programming at zoos because some facilities have education or enrichment programs that include taking cheetahs out on a leash. A position statement on the use of programs in the Cheetah Species Survival Plan (outlined in Ziegler-Meeks [24]) is supportive of the use of cheetahs as “program species” under limited circumstances. Zoos may want to reconsider these programs if the public perceives cheetahs do not enjoy being leashed, and it may result in a less desirable opinion of their organizations. Our survey did not ask respondents why they thought it was not justified for a cheetah to be on a leash for a presentation, so it is not possible for us to delineate if they had concerns for the welfare of the animal, safety of the public, or other reasons. It should be considered that the remaining 53% of survey respondents selected one or more reason that *would* justify taking a cheetah out of its exhibit on a leash for a presentation, so there is not a strong consensus across questions in our data. Further research is required to help guide future educational programming in zoological facilities.

The broadest implications of this study concern conservation efforts for tigers and cheetahs. The high percentage of respondents that characterized tiger and cheetah populations as declining (77%, 69% respectively) suggests that education efforts to make the American public aware of the plight of these species has been somewhat successful. With 130 nature series airing

on television in 2019 [25], nature documentaries are experiencing high levels of popularity among US viewers. Even so, a surprisingly high percentage of respondents described themselves as likely to watch a documentary about tigers or cheetahs (57%, 53% respectively). A smaller percentage rated themselves as likely to donate to conservation efforts (22%, 19% respectively). These data suggest that there is substantial interest in conservation efforts, which should be taken advantage of by conservationists and other wildlife professionals. Approximately half (51%) of respondents thought more resources for tiger conservation should be focused on wild tigers instead of captive tigers, and 41% thought 100% of resources should be focused on wild tigers. Conservation professionals may have more success in their efforts to educate and fundraise if their resource allocation mirrors the priorities of the American public.

Survey data are susceptible to a number of well-known biases that can affect the reliability and generalizability of the data. For example, SurveyMonkey (<https://www.surveymonkey.com/mp/how-to-avoid-common-types-survey-bias/>) describes several common potential sources of bias. Sampling bias occurs when certain people are more likely to be sampled than others; for example, in this study, people with easy access to computers and high-quality internet may be more likely to be sampled than those without this access. We attempted to reduce sampling bias by having a robust (n approaching 1000 respondents) and diverse sample; however, some viewpoints are undoubtedly over- or under-represented in our sample in comparison to the entire US population. Response bias occurs when respondents provide answers different to how they actually feel, often due to a desire to appear socially/morally “correct”, to “help” the researchers by providing answers that they think are desired, or just because questions are confusing. In this study, for example, respondents may have exaggerated their negative feelings about big cats performing “tricks” for entertainment

purposes because they felt this view was no longer socially acceptable. We attempted to mitigate this source of bias by presenting questions as neutrally as possible with respect to implications of the “purpose” of the survey or placing judgement values on the positive or negative answers. Question Order bias occurs when the order of questions or choices influences the answers; a common example is that respondents are more likely to choose the first answer in a multiple-choice question. We controlled for order bias by randomizing both the order of questions and the order of choices except when doing so would be confusing.

It’s important for conservationists and wildlife professionals to understand the attitudes of the American public to guide activities involving animals, including, but not limited to educational programming, resource allocation, portrayal of animal species in media, and wildlife regulations. Assessment and consideration of the public’s views can enable professionals to engage in efforts that best meet their education and conservation goals. Overall, these findings highlight a growing awareness among the public regarding conservation and welfare issues for big cats but also present areas where additional conservation efforts may be focused.

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APPENDICES

Appendix A. Notice of IRB Exemption

From: IRB [mailto:irb_no_reply@cayuse.com]
Sent: Monday, April 04, 2016 8:55 AM
To: Greene, Janice S
Cc: Knudsen, Abbie
Subject: IRB Notice

To: Janice Greene
Biology
Kings 201 901 S National Ave Springfield MO 65897-0027

From: MSU IRB

Date: 4/04/2016

RE: Notice of IRB Exemption
Exemption Category: 2.Survey, interview, public observation
Study #: 16-0375

Study Title: Image Characteristics Influence Attitudes About Tiger Conversation and Tiger-Human Interecations

This submission has been reviewed by the Missouri State University IRB and was determined to be exempt from further review according to the regulatory category cited above under 45 CFR 46.101(b).

Investigator's Responsibilities:

If your study protocol changes in such a way that exempt status would no longer apply, you should contact the above IRB before making the changes.

CC:
Abbie Knudsen, Biology

Appendix B. Effect of Image Background on Responses to Tiger Survey

Question	p-value	F or Chi-Square	DF
How happy is the tiger in the photograph?	0.001	F = 26.34	7
Do you think it should be illegal/legal for people to keep a big cat, such as a tiger or cheetah, as a pet?	0.443	Chi-Square = 6.87	7
How do you think it impacts a tiger to have physical contact with the general public? <ul style="list-style-type: none"> ○ Harmful/Stressful ○ Beneficial/Enjoyable ○ No Impact 	0.215	Chi-Square = 17.82	14
How safe is it for the average adult to have physical contact with a captive tiger under the following conditions? (1) unrestrained adult tiger (2) unrestrained tiger cub (3) swimming with a tiger cub (4) adult tiger on a chain	0.195 0.884 0.392 0.777	F = 1.41 F = 0.43 F = 1.05 F = 0.57	7 7 7 7
How appropriate is it to have a tiger as a pet?	0.125	F = 1.62	7
Resources for tiger conservation should be used on: <ul style="list-style-type: none"> ○ Programs that protect wild tigers ○ Programs that use captive tigers to educate the public ○ Both of the above but more resources should be used for wild tiger protection programs ○ Both of the above but more resources should be used for captive tiger education programs 	0.751	Chi-Square = 16.33	21
Should the public have opportunities to have physical contact with tiger cubs?	0.475	Chi-Square = 6.56	7
How likely are you to donate money to tiger conservation?	0.839	F = 0.49	7
How likely are you to watch a documentary about tigers?	0.158	F = 1.52	7
Would it be appropriate for a tiger to perform tricks, such as jumping through a hoop, in a performance for the public's entertainment?	0.459	F = 0.96	7

Appendix B Continued. Effect of Image Background on Responses to Tiger Survey

On a scale of 1 to 5, how would you characterize the current conservation status of tiger populations in the wild?	0.936	F = 0.34	7
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Appendix C. Effect of Image Background on Responses to Cheetah Survey

Question	p-value	F or Chi-Square	DF
How happy is the cheetah in the photograph?	0.001	F = 7.398	5
Do you think it should be illegal/legal for people to keep a big cat, such as a cheetah or tiger, as a pet?	0.977	Chi-Square = 0.796	5
How do you think it impacts a cheetah to have physical contact with the general public? <ul style="list-style-type: none"> ○ Harmful/Stressful ○ Beneficial/Enjoyable ○ No Impact 	0.796	Chi-Square = 6.221	10
How safe is it for the average adult to have physical contact with a captive cheetah under the following conditions?			
(1) unrestrained adult cheetah	0.734	F = 0.556	5
(2) unrestrained cheetah cub	0.431	F = 0.976	5
How appropriate is it to have a cheetah as a pet?	0.906	F = 0.312	5
How likely are you to donate money to cheetah conservation?	0.827	F = 0.431	5
How likely are you to watch a documentary about cheetahs?	0.537	F = 0.818	5
On a scale of 1 to 5, how would you characterize the current conservation status of cheetah populations in the wild?	0.869	F = 0.371	5