



RESEARCH ARTICLE

The impact of in-person and video-recorded animal experiences on zoo visitors' cognition, affect, empathic concern, and conservation intent

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Abstract

Currently there are mixed results regarding the ability for media or more specifically video to increase a person's interest in conservation. However, there is a growing amount of evidence that in-person experiences at a zoo or aquarium can increase a person's interest in conservation. The goal of the current study was to examine the difference between an in-person experience viewing a polar bear training session and watching a video of the same experience on cognition, emotion, empathic concern, and conservation intent. A total of 124 Brookfield Zoo members were randomly assigned to one of three conditions. Condition 1 was an in-person 10 min (Live Animal) experience viewing a training session with a polar bear. Condition 2 participants (Video Animal) watched a video of the same experience from Condition 1 and Condition 3 (Control) listened to the audio from Condition 1 but only viewed an image of one of our animal care specialists. Results suggest that the live condition is associated with higher probability of answering questions correctly, having a positive emotional experience, having greater empathic concern for wild bears, and wanting to get involved in conservation when compared to the control. These impacts were not observed for the video condition suggesting that for this study, watching a video of a training session was not an effective tool for getting people involved in conservation. Future research is needed to better understand this important topic, but we now have further evidence of the importance of in-person zoo experiences.

KEYWORDS

conservation, emotion, knowledge, live animals, Polar bears

1 | INTRODUCTION

With the current rate of biodiversity loss around the world (Dirzo et al., 2014; Pimm et al., 2014), it is increasingly important to identify effective strategies to motivate people to engage in and advocate for conservation. People tend to adopt conservation behaviors more successfully when the behaviors are easily integrated into their daily lives and produce immediately visible benefits (Vining &

Ebreo, 2002). Unfortunately, the behaviors that have the greatest environmental impact often have benefits that are distant in both space and time. Creating connections between issues and actions, such as between specific animals impacted by habitat loss and the actions that can mediate this loss, can provide people with a tangible motivation for action (Clayton & Brook, 2005).

People enjoy watching animals (Barash, 2014). This affinity for animals is one of the primary reasons why people visit zoos and

aquariums (Klenosky & Saunders, 2007). In the United States, more than 200 million visitors each year pass through the gates of over 230 zoos and aquariums accredited by the Association of Zoos and Aquariums—AZA (2019). The ability of animals to engage people's interest and the volume of people that visit zoos and aquariums each year, make these institutions ideal locations for communicating messages about animals and habitats and forging connections to conservation action. People also enjoy watching animals on screens, specifically in movies, television, and computer screens. Regardless of age, ability, or income, these types of media provide people with opportunities to see and learn about animals and nature, and studies have shown these experiences can generate understanding, interest, and emotional reactions (Skibins & Sharp, 2019; Smith & Broad, 2008).

There is a complex interplay of factors that influence whether people adopt and sustain conservation actions. Factors specific to an individual include motivation, environmental knowledge, values, attitudes, environmental awareness, emotional involvement, locus of control, responsibility, and priorities (Kollmuss & Agyeman, 2002). Research has shown that zoos and aquariums, with their live animal experiences and diverse education offerings, are effective settings to address many of these factors. In terms of knowledge, several studies have demonstrated that a visit to a zoo or aquarium can increase an individual's conservation-related knowledge (Falk et al., 2007; Khalil & Ardoin, 2011; Moss, Jensen, & Gusset, 2017). One of these studies, a worldwide survey with more than 6,000 participants, concluded that a zoo visit results in a better understanding of biodiversity as well as knowledge of the actions that could be taken to protect wildlife (Moss et al., 2017). Zoos also have been shown to elicit positive emotional experiences that connect people with wildlife and interest in getting involved in conservation (e.g., Luebke, Watters, Packer, Miller, & Powell, 2016; Myers, Saunders, & Birjulin, 2004; Powell & Bullock, 2014). For example, Miller, Luebke, and Matiassek (2018) found that having an up-close experience viewing elephants engaged in a variety of species-appropriate behaviors correlated with having a positive emotional experience. The positive emotional experience and the visitor's conservation-related predispositions correlated with a greater interest in getting involved in conservation. Furthermore, visitors' positive emotions and feelings of connectedness with nature have been found to be highly related to empathic concern for wild animals (e.g., Howell, McLeod, & Coleman, 2019; Luebke, 2018). Empathic concern is understood to be an affective dimension of empathy regarding an emotional reaction of caring and concern for someone else undergoing undesirable experiences (Davis, 1983). In particular, empathic concern is seen as an internal motivator in fostering an individual's willingness to take conservation action (Young, Khalil, & Wharton, 2018).

Even with an extensive and growing list of studies, there are still many outstanding questions about how zoo experiences impact visitors and can serve as a foundation for inspiring conservation action. Detractors of zoos advocate that zoos are not effective educational settings and that other forms of education, including movies and television, are better avenues for imparting knowledge and motivating action (Margodt, 2000). With regard to the

effectiveness of influencing conservation behaviors, there has been a growing amount of research examining the impact of media on conservation education. Videos, social media, and documentaries have all shown the potential for increasing knowledge, building connection to animals, and motivating action, at least in the short term, other studies have been unsuccessful in demonstrating this impact. For example, a study examining the impact of visual media to increase knowledge, attitudes, and conservation behaviors toward orangutans was successful at least in the short term (Pearson, Dorrian, & Litchfield, 2011). Similarly, a conservation documentary about Australian marine environments demonstrated an increase in knowledge, attitudes, and behavioral intentions, and even remained at those levels or slightly decreased levels for individuals who received follow-up information following the documentary (Hofman & Hughes, 2018). In comparing the impact of viewing live bears at Katmai National Park to viewing webcam footage of the same bears, Skibins and Sharp (2019) found that both in person and online experiences increased observer interest and generated strong emotional connections to bears. However, in another study exposure to nature documentaries only had an impact if participants were predisposed to have a strong connection to nature (Arendt & Matthes, 2016).

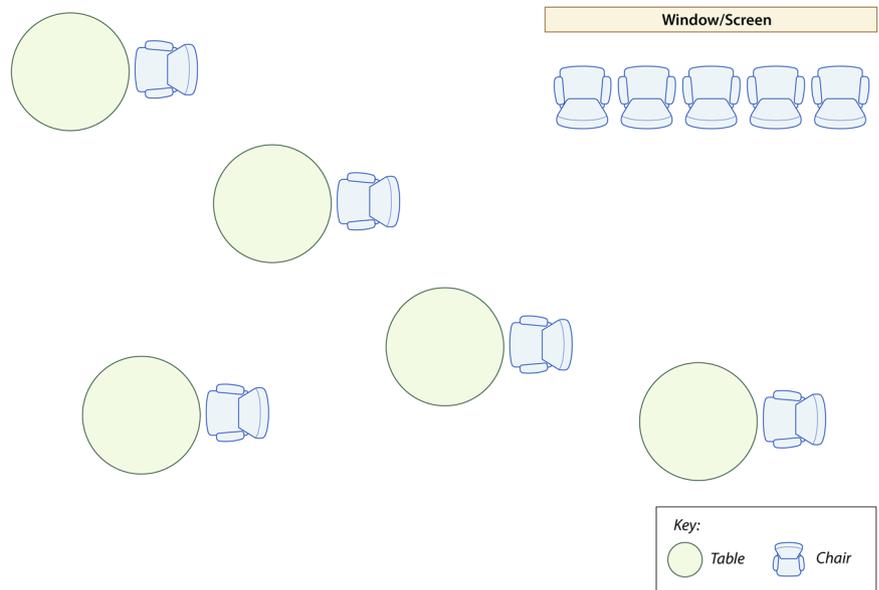
People learn in different ways and we need as many avenues as possible to engage people in conservation action. By exploring the strengths and weaknesses of live, video, and audio presentation of animal and conservation information, we can capitalize on the strengths of each to maximize impact. The goal of the current study was to examine whether media or video would be as impactful as having a real-life experience viewing an up-close polar bear. Specifically, zoo members were randomly assigned to one of three viewing conditions to examine the impact on their knowledge retention, affective experience, empathic concern toward wild polar bears, and their interest in getting involved in the conservation of polar bears.

2 | MATERIALS AND METHODS

2.1 | Data collection

All data were collected between April 23, 2018 and August 19, 2018 at the Brookfield Zoo (Brookfield, IL). The study was conducted in the Great Bear Wilderness Classroom, which is adjacent to one of three animal habitats encompassing the Great Bear Wilderness exhibit. The classroom contains a full-length viewing window where animal training could take place (Figure 1). Data collection occurred on most Sundays and Mondays with the exception of days when the classroom was booked for other zoo business. Participants for the study were recruited from the Chicago Zoological Society's membership database (over 100,000 household memberships). An initial email was sent to a random sample of 6,000 adult zoo members asking if they would be interested in participating in a research study at the zoo. Those who responded were invited to complete a questionnaire regarding availability throughout the study period. The first

FIGURE 1 Great Bear Wilderness classroom set up for the study [Color figure can be viewed at wileyonlinelibrary.com]



300 participants who were available to fill time slots were sent a final email providing instructions to participate in the study, a brief description of the project letting them know they would be randomly assigned to one of three zoo experiences, and their date for participation. It is important to note that due to the possibility of “no-shows,” the research staff invited a total of 10 people for each study date. However, the goal was to only collect data from five individuals at a time to ensure an identical experience across conditions.

During the study period, a staff member met participants at the South Gate entrance to the Brookfield Zoo. The staff member then escorted the participants behind the scenes to the classroom avoiding all but one animal exhibit (Andean Condor, *Vultur gryphus*). Once inside the classroom, if there were more than five participants, five were randomly selected to participate in the study, and the remaining visitors were sent home. All visitors who arrived to participate received an incentive of a free 3-month extension to their zoo membership.

Each day, participants were randomly assigned to one of three conditions. However, due to the study design, Condition 1 was selected for the first three study days to ensure there was a video for subsequent study days. Condition 1 (Live Animal) had participants view a 10-min training session with a polar bear (*Ursus maritimus*). During Condition 1, training sessions were recorded to be used one time each in Conditions 2 and 3. Condition 2 (Video Animal) had participants view a video recording of the 10-min training session. The video was shown on a screen that covered the training window that was used in Condition 1. Condition 3 (Control) had participants listen to an audio recording of the 10-min training session. While the audio recording played, participants viewed an image of an animal care specialist on a screen that covered the training window that was used in Condition 1. An outlined script was created before starting the study that included information regarding the natural history of polar bears, animal care, enrichment, training, conservation threats,

and examples of how people can get involved in polar bear conservation. While the presentation was not exactly identical every day, this was controlled for by only using each Condition 1 video once during Conditions 2 and 3.

During the study, participants each started at individual tables (Figure 1) and began by filling out survey one. Table 1 details the eight questions included in survey one about predispositions regarding their knowledge, interests, and concern for wildlife, nature, and the environment used in previous studies (Luebke et al., 2016). After completing survey one, participants moved to the corner of the classroom to experience one of three conditions (Figure 1). Following the 10-minute experience, participants then returned to their table and filled out surveys two and three (Table 1). Survey two included 11 questions regarding knowledge of polar bear care and conservation that could have been retained from the presentation. The survey also included 10 adjectives to rate their emotional response during the experience, two questions related to empathic concern toward polar bears in the wild, and four questions regarding their interest in getting involved in polar bear conservation used or modified from previous studies (Luebke et al., 2016; Miller et al., 2018). Survey three contained demographic information including sex, ethnicity, and level of education obtained. All three surveys had additional questions that will not be reported on for the current study.

2.2 | Data analysis

Visitor predisposition, emotional affect, empathic concern, and conservation intent questions were all turned into composite scores by averaging the responses across questions (Table 1). Correct responses to knowledge-based questions were totaled and divided by the total number of questions to obtain the correct percent. Demographic variables were examined for differences across treatments

TABLE 1 Questions utilized during the study for surveys one, two, and three

Composite score name	Original questions scale	Original questions
Visitor Predisposition Score	Rate how well each statement describes you. 0 (Does not describe at all) to 4 (Describes me perfectly)	(a) I am ordinarily interested in animals, (b) I often feel a sense of connection with nature, (c) I have a good understanding of wildlife conservation issues, (d) I pay attention to news about environmental issues, (e) I usually try to help protect and preserve local wildlife habitats, (f) I tend to support conservation organizations (volunteer my time, make a donation, sign a petition, etc.), (g) I typically engage in conservation efforts during my daily activities (recycling, reducing energy usage, buying earth-friendly products), (h) I spend as much time as I can in natural settings such as woods, prairies, mountains, or lakes
Emotion Composite Score	Please rate the appropriateness of the following words for describing your emotions during the experience. 0 (Not appropriate at all) to 4 (Very appropriate)	(a) Awe, (b) Contentment, (c) and (d) Excitement, (e) Fear (reverse coded), (f) Joy, (g) Love, (h) Pride, (i) Amusement, (j) Sadness (reverse coded), (k) Surprise
Knowledge Percent Correct	Multiple choice	(a) What year was Hudson born, (b) The reason for training Hudson is for..., (c) Hudson is trained---,(d) A toot of the whistle is to let Hudson know..., (e) How many species of bears are found around the world, (f) Polar bears are classified as..., (g) Which of the following exhibit features is designed to increase the amount of time Hudson spends digging, (h) What color is polar bear skin, (i) In the wild, what is a polar bear's favorite food, (j) What is the number one threat to polar bears in the wild, (k) The polar bear is considered a(n)
Empathic Concern Composite Score	What was your overall reactions to the experience? 1 (Not at all) to 7 (Very much so)	(a) I have a greater sense of my connection with nature because of this experience, (b) This experience has made me more concerned about the well-being of these animals in the wild
Behavioral Intentions Composite Score	Thinking about your overall reactions to the experience, how much do you agree with the following statements? 1 (Strongly disagree) to 7 (Strongly agree)	(a) I want to spend more time learning about bears (reading books, searching the Internet, etc.), (b) I am going to have discussions with others about bears (discuss conservation issues, what they can do to help, etc.), (c) I now have a better understanding of what actions I can take that will help protect and preserve bears and their habitats, (d) As a result of this experience, I want to donate money to a bear conservation organization

utilizing χ^2 test. Impact of the different conditions was analyzed using generalized estimating equations (GEE), which allow for the individual to be used as the unit of analysis while accounting for the survey groups as well as controlling for the zoo predisposition composite scores. Previous research has demonstrated that zoo predispositions are an important factor on the impact of a zoo experience (Luebke et al., 2016; Miller et al., 2018). For all statistical tests, alpha level was set at $p < .05$.

3 | RESULTS

In total, there were 124 subjects with 45 in Condition 1, 44 in Condition 2, and 35 in Condition 3. There were no significant differences between conditions for gender ($\chi^2 = 0.856$; $p = .652$), ethnicity ($\chi^2 = 14.476$; $p = .152$), or level of education ($\chi^2 = 6.045$;

$p = .811$). Overall, the majority of the sample was female (71.0%), white (87.1%), and had achieved a bachelor's degree or higher (72.6%). Table 2 has a full breakdown of the descriptive statistics for participants in the study by the condition.

Table 3 summarizes the results of the GEE examining differences in knowledge, emotional affect, empathic concern, and conservation intent while controlling for survey group day and predisposition scores. Overall, with significance values all below .05, the live condition is associated with a higher probability of answering the questions correctly, having a positive emotional experience, having greater empathic concern for wild bears, and wanting to get involved in conservation. These differences did not exist across any variables for the video condition. Participant's average scores across the conditions can be seen for knowledge (Figure 2), emotional affect (Figure 3), empathic concern (Figure 4), and conservation intent (Figure 5).

TABLE 2 Demographic information for participants across three conditions of the study

Characteristic	Condition		
	Live	Video	Control
Gender			
Male	26.7	34.1	25.7
Female	73.3	65.9	74.3
Ethnicity			
Black/African American	0.0	4.5	0.0
Asian/Pacific Islander	2.2	0.0	0.0
White (non-Hispanic)	82.2	90.9	88.6
Hispanic/Latino	11.1	4.5	2.9
Native American	2.2	0.0	0.0
Multi-Ethnic Heritage	2.2	0.0	8.6
Level of Education			
High School Graduate	8.9	2.3	5.7
Some College or Trade/Business School	11.1	15.9	11.4
2-Year Associate's Degree	8.9	11.4	5.7
4-Year Bachelor's Degree	33.3	25.0	37.1
Some Graduate School	2.2	4.5	8.6
Graduate Degree	35.6	40.9	31.4

4 | DISCUSSION

Overall, the results suggest that having an actual up-close zoological experience could not be replicated through video in the current study. Participants in the live condition retained more knowledge, had a more positive emotional experience, reported greater empathic concern toward wild polar bears, and had a greater interest in getting involved in conservation. These impacts were not observed for the participants in the video condition, demonstrating an important role of live up-close experiences in zoos. With more than 700 million people visiting zoos and aquariums around the world (Gusset & Dick, 2011), that could have a significant impact on conservation.

Participants in the current study retained more knowledge in the live condition compared with the control. Similarly, previous research has shown that visitors are more knowledgeable about conservation-related issues than the general public (Adelman, Falk, & James, 2000; Dierking et al., 2004). Even though some visitors to zoos and aquariums are there for an entertaining experience as opposed to an educational experience (Birney & Matamoros, 1995; Serrell & Aquarium, 1977), research has shown that other visitors seek out educational experiences to further their knowledge about nature and specific animals (Dunlap & Kellert, 1989; Hayward, 1995; Holzer & Scott, 1997). Based on previous research, the current study controlled for visitor predispositions to ensure differences between individuals did not impact the results.

In the current study, participants in the live condition also rated having a more positive emotional experience. Similarly, previous research has demonstrated that viewing animals in a zoo exhibit can lead to a positive emotional experience (Myers et al., 2004). However, this

TABLE 3 Results of the generalized estimating equations comparing live animal and video conditions to the control

Condition	Live	Video
Percent Correct on Questions		
β^c	11.653	-5.236
95% CI	5.163 to 18.142	-13.457 to 2.985
<i>p</i> value	.000 ^b	.212
Emotional Affect Composite Score		
β^c	1.340	0.264
95% CI	0.905 to 1.774	-0.213 to 0.741
<i>p</i> value	.000 ^b	.278
Empathic Concern Composite Score		
β^c	1.085	0.253
95% CI	0.385 to 1.784	-0.477 to 0.983
<i>p</i> value	.002 ^b	.497
Conservation Intent Composite Score		
β^c	0.578	0.113
95% CI	0.052 to 1.103	-0.429 to 0.655
<i>p</i> value	.031 ^a	.684

Note: All *p* values from generalized estimating equation models correctly accounting for survey group day and zoo predisposition scores.

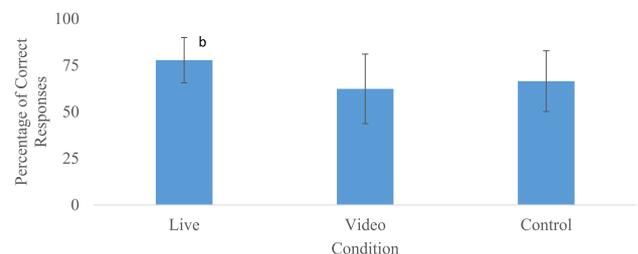
^aSignificant differences are indicated at $p < .05$.

^bSignificant differences are indicated at $p < .01$.

^cReference group is control (audio with image of animal care staff).

response can be different depending on visitor predispositions, the type of behavior, and the species of animal (Myers et al., 2004). Building on this idea, Luebke et al. (2016) suggested that viewing animals up close also leads to a more positive emotional experience. This study also demonstrated that visitor predispositions was a significant predictor of positive affect. The ability to view live animals up-close and engaged in a variety of species-appropriate behaviors can create a positive experience that was not seen for the participants in the video condition.

While there are many outcomes from this study, most importantly, visitors in the live condition reported having greater empathic concern toward wild polar bears and reported a greater interest in getting involved in conservation when compared with the control. Again, this difference was not observed for the participants in the video condition. Ballantyne, Packer, and Sutherland (2011)

**FIGURE 2** Knowledge retention scores across the three conditions of the study. Note. Significant differences are indicated at $p < .05$ and $p < .01$ ^b [Color figure can be viewed at wileyonlinelibrary.com]

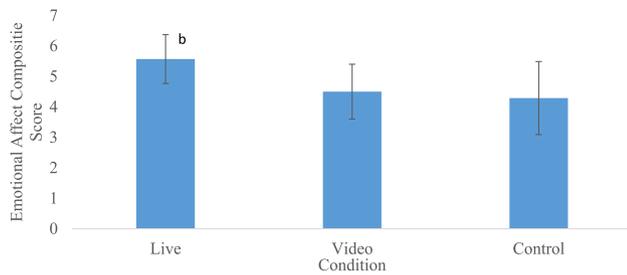


FIGURE 3 Emotional response scores across the three conditions of the study. Note. Significant differences are indicated at $p < .05$ and $p < .01^b$ [Color figure can be viewed at wileyonlinelibrary.com]

suggest that the process moves from what visitors view and hear to creating an empathic connection with the animals and finally, a change in behavior. Specifically, they suggest this involves having an experience, reflecting on that experience, and then thinking about the experience before creating actionable change. With the mission of most modern-day zoos and aquariums to get people involved in conservation, the current results support that these types of up-close activities can be impactful. Previous research has shown that having up-close experiences seeing animals engaged in a variety of species-appropriate behaviors leads to a more positive emotional connection and a greater interest in getting involved in conservation (Luebke et al., 2016; Miller et al., 2018). With recent efforts of the current study and highlighted above, there is a growing body of evidence that up-close experiences at zoos and aquariums are having an impact.

A review of the literature produces mixed results on video or media as a tool to get people involved in conservation. While some studies have been successful in demonstrating media can increase knowledge, attitudes, and behavior change, at least in the short term, other studies have been unsuccessful in demonstrating this impact. In the current study, participants in the live condition demonstrated an increased ability to retain knowledge and reported a more positive experience. Importantly, they also reported greater empathic concern toward wild polar bears and were more interested in getting involved in conservation. These positive results were not observed for participants in the video condition, suggesting at least for the current study, the video was not a successful tool in getting people inspired to help conserve wildlife. This helps to demonstrate the importance of zoological experiences with additional

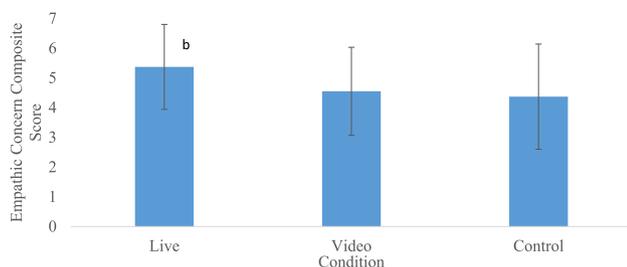


FIGURE 4 Empathic concern scores across the three conditions of the study. Note. Significant differences are indicated at $p < .05$ and $p < .01^b$ [Color figure can be viewed at wileyonlinelibrary.com]

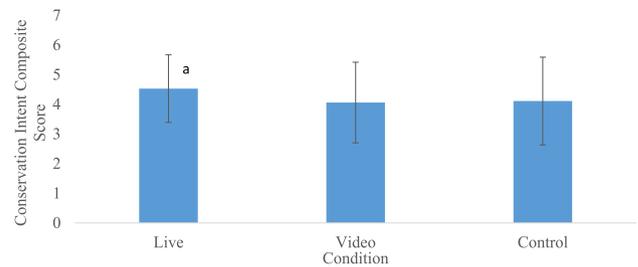


FIGURE 5 Conservation intent scores across the three conditions of the study. Note. Significant differences are indicated at $p < .05^a$ and $p < .01$ [Color figure can be viewed at wileyonlinelibrary.com]

research needed to continue to understand the value of zoos and aquariums. However, the current study did not examine the long-term impact of these experiences and would be an important area of future research.

In the future, it would be critical to examine different species to see if results would be consistent. In the current study, the ability to see a polar bear up close had a significant impact. Research using non-charismatic megafauna would be interesting to see if the same impact would be observed as in the current study. The current experiences were also 10-min in duration and future research, determining how different timing of experiences could be useful. Finally, the quality of the video used in the current study was not in high definition, like many of the nature documentaries made over the last decade. A limitation of the study was only comparing to the same experience on video, as opposed to a nature video of a polar bear in the wild. Future research on the quality of the video, such as high definition nature documentaries using an identical script would also be important to examine the impact. As previously noted, it would also be important to examine the long-term impacts of all of these types of experiences on visitor's conservation-related knowledge, empathic concern, and conservation behavior.

5 | CONCLUSIONS

1. Viewing a live training session of a polar bear resulted in higher probability of answering questions correctly, having a positive emotional experience, having greater empathic concern toward wild polar bears, and a greater interest in getting involved in conservation when compared with a control.
2. The same results were not observed for the video condition when compared with the control suggesting that for this study, video of a training session was not a tool to get people interested in conservation.
3. This study provides additional evidence of the benefits of an in-person zoo experience, but future research is still necessary to understand this important topic.

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REFERENCES

- Adelman, L. M., Falk, J. H., & James, S. (2000). Impact of National Aquarium in Baltimore on visitors' conservation attitudes, behavior, and knowledge. *Curator: The Museum Journal*, 43(1), 33–61.
- Arendt, F., & Matthes, J. (2016). Nature documentaries, connectedness to nature, and pro-environmental behavior. *Environmental Communication*, 10(4), 453–472.
- Association of Zoos and Aquariums. (2019, October 25). About us. Retrieved from <https://www.aza.org/about-us>
- Ballantyne, R., Packer, J., & Sutherland, L. A. (2011). Visitors' memories of wildlife tourism: Implications for the design of powerful interpretive experiences. *Tourism Management*, 32(4), 770–779.
- Barash, D.P. (2014). Animal magnetism. Retrieved from <https://aeon.co/essays/why-did-humans-evolve-to-be-so-fascinated-with-other-animals>
- Birney, B., & Matamoros, Y. (1995). A baseline study of visitors' perceptions of zoo animals, national parks, and management issues: Simon Bolivar Zoo. In *Annual Conference Proceedings of the American Association of Zoological Parks and Aquariums* (pp. 44–49).
- Clayton, S., & Brook, A. (2005). Can psychology help save the world? A model for conservation psychology. *Analyses of Social Issues and Public Policy (ASAP)*, 5(1), 87–102.
- Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology*, 44(1), 113–126.
- Dierking, L. D., Adelman, L. M., Ogden, J., Lehnhardt, K., Miller, L., & Mellen, J. D. (2004). Using a behavior change model to document the impact of visits to Disney's Animal Kingdom: A study investigating intended conservation action. *Curator: The Museum Journal*, 47(3), 322–343.
- Dirzo, R., Young, H. S., Galetti, M., Ceballos, G., Isaac, N. J., & Collen, B. (2014). Defaunation in the Anthropocene. *Science*, 345(6195), 401–406.
- Dunlap, J., & Kellert, S. R. (1989). Informal learning at the zoo: A study of attitude and knowledge impacts. *Report to the Zoological Society of Philadelphia*.
- Falk, J. H., Reinhard, E. M., Vernon, C., Bronnenkant, K., Heimlich, J. E., & Deans, N. L. (2007). *Why zoos & aquariums matter: Assessing the impact of a visit to a zoo or aquarium* (p. 24). Silver Spring, MD: Association of Zoos & Aquariums.
- Gusset, M., & Dick, G. (2011). The global reach of zoos and aquariums in visitor numbers and conservation expenditures. *Zoo Biology*, 30(5), 566–569.
- Hayward, S. A. (1995). Comment on "Failure of standard conservation laws at a classical change of signature". *Physical Review D*, 52(12), 7331–7332.
- Hofman, K., & Hughes, K. (2018). Protecting the Great Barrier Reef: Analysing the impact of a conservation documentary and post-viewing strategies on long-term conservation behaviour. *Environmental Education Research*, 24(4), 521–536.
- Holzer, D., & Scott, D. (1997). The long-lasting effects of early zoo visits. *Curator: The Museum Journal*, 40(4), 255–257.
- Howell, T., McLeod, E. M., & Coleman, G. (2019). When zoo visitors "connect" with a zoo animal, what does that mean? *Zoo Biology*, 38(6), 461–470.
- Khalil, K., & Ardoin, N. (2011). Programmatic evaluation in association of zoos and aquariums-accredited zoos and aquariums: A literature review. *Applied Environmental Education & Communication*, 10(3), 168–177.
- Klenosky, D. B., & Saunders, C. D. (2007). Put me in the zoo! A laddering study of zoo visitor motives. *Tourism Review International*, 11, 317–327.
- Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, 8(3), 239–260.
- Luebke, J. F. (2018). Zoo exhibit experiences and visitors' affective reactions: A preliminary study. *Curator: The Museum Journal*, 61(2), 345–352.
- Luebke, J. F., Watters, J. V., Packer, J., Miller, L. J., & Powell, D. M. (2016). Zoo visitors' affective responses to observing animal behaviors. *Visitor Studies*, 19, 60–76.
- Margodt, K. (2000). *The welfare ark: Suggestions for a renewed policy in zoos*. Brussels, Belgium: VUB University Press.
- Miller, L. J., Luebke, J. F., & Matiasek, J. (2018). Impact of viewing African and Asian elephants at accredited zoological institutions: Conservation intent and perceptions of animal welfare. *Zoo Biology*, 37(6), 466–477.
- Moss, A., Jensen, E., & Gusset, M. (2017). Probing the link between biodiversity-related knowledge and self-reported proconservation behavior in a global survey of zoo visitors. *Conservation Letters*, 10(1), 33–40.
- Myers, O. E. Jr., Saunders, C. D., & Birjulin, A. A. (2004). Emotional dimensions of watching zoo animals: An experience sampling study building on insights from psychology. *Curator: The Museum Journal*, 47(3), 299–321.
- Pearson, E., Dorrian, J., & Litchfield, C. (2011). Harnessing visual media in environmental education: Increasing knowledge of orangutan conservation issues and facilitating sustainable behaviour through video presentations. *Environmental Education Research*, 17(6), 751–767.
- Pimm, S. L., Jenkins, C. N., Abell, R., Brooks, T. M., Gittleman, J. L., Joppa, L. N., ... Sexton, J. O. (2014). The biodiversity of species and their rates of extinction, distribution, and protection. *Science*, 344(6187), 1246–1252.
- Powell, D. M., & Bullock, E. V. W. (2014). Evaluation of factors affecting emotional responses in zoo visitors and the impact of emotion on conservation mindedness. *Anthrozoös*, 27(3), 389–405.
- Serrell, B., & Aquarium, J. G. S. (1977). Survey of visitor attitude and awareness at an aquarium. *Curator: The Museum Journal*, 20(1), 48–52.
- Skibins, J. C., & Sharp, R. L. (2019). Binge watching bears: Efficacy of real vs. virtual flagship exposure. *Journal of Ecotourism*, 18(2), 152–164.
- Smith, L., & Broad, S. (2008). Comparing zoos and the media as conservation educators. *Visitor Studies*, 11(1), 16–25.
- Vining, J., & Ebreo, A. (2002). Emerging theoretical and methodological perspectives on conservation behavior. In R. Bechtel & A. Churchman (Eds.), *New handbook of environmental psychology* (pp. 541–558). New York: Wiley.
- Young, A., Khalil, K. A., & Wharton, J. (2018). Empathy for animals: A review of the existing literature. *Curator: The Museum Journal*, 61(2), 327–343.

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