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Note

Visual-based social norms, distance-related human–wildlife interactions, and viewing devices in parks and protected areas

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Abstract: Distance-related human–wildlife conflict presents a serious challenge in parks and protected areas across the world. Finding ways to alleviate distance-related human–wildlife conflict is hampered by both the difficulty of studying human–wildlife interactions in the field as well as the dearth of existing methodological tools. The purpose of this study is to investigate factors of group size, distance from bison (*Bison bison*), and use of wildlife viewing equipment on visitor proximity preferences in Yellowstone National Park (Wyoming, Montana, and Idaho, USA). Researchers collected data via intercept-surveys during summer 2015. The data were analyzed with repeated measures ANOVA to explore how these factors influenced acceptability ratings of distances between people and bison. Results indicate that people who always used a smartphone camera felt it was more acceptable to stand closer to bison than people who never used a smartphone camera. The discussion offers several practical applications for reducing human–bison conflicts as well as directions for future research.

Key words: *Bison bison*, human–wildlife conflict, national parks, parks and protected areas, proximity, technology, wildlife viewing, Yellowstone

In the United States, wildlife viewing is a popular nature-based recreational pursuit, and many parks and protected areas provide people with opportunities to view free-roaming, charismatic megafauna. Almost a third of U.S. residents participated in wildlife viewing in 2016 (U.S. Fish and Wildlife Service 2016). Wildlife viewing remains one of the primary reasons why people visit U.S. national parks (Manfredo 2008).

Wildlife viewing contributes to high quality visitor experiences in parks and protected areas (Hammitt et al. 1993, Lemelin and Smale 2006, Anderson et al. 2010). Furthermore, viewing, photographing, and identifying wildlife are some of the fastest-growing nature-based activities in the United States, and these increases may be catalyzed by technological advances in digital cameras, smartphone cameras, and other types of viewing equipment (Cordell 2008, Cordell et al. 2008). The relationship between technology, outdoor recreation, and protected areas is a complex one, as technology has the potential to both facilitate people's outdoor recreation experiences and also change the way they pursue them (Shultis 2001, Miller et al. 2019).

Viewing technology can influence the wildlife viewing proximity preferences of visitors (Hammitt et al. 1993, Schänzel and McIntosh 2000, Verbos et al. 2018). Proximity is often regarded as a seminal factor affecting the quality of the wildlife viewing experience (Pearce and Wilson 1995). A number of studies have revealed that when viewing wildlife, visitor satisfaction is closely tied to people's desires to see animals more clearly (Hammitt et al. 1993, Pearce and Wilson 1995) as well as to achieve higher quality photographs (Hammitt et al. 1993, Schänzel and McIntosh 2000, Verbos et al. 2018). Furthermore, a disconnect exists between visitors and managers related to

Figure 1. Map of Yellowstone National Park, USA.

viewing technology.

Visitors indicate that viewing technology reduces their need for close proximity while wildlife viewing; however, park managers identify handheld devices, especially cameras and mobile phones, as the culprits behind visitors' desires to take photographs of wildlife at dangerously close distances (Verbos et al. 2018). This poses a significant challenge, as previous research conducted on the role of mobile technology in outdoor recreation revealed that almost half of recreationists indicated their primary reason for bringing their phone with them during their trip was to take photographs (Lindell 2014). Little is known about how the type of viewing device and how often the device is used relates to park visitors' wildlife viewing-related proximity preferences.

Previous research conducted in Yellowstone National Park (Wyoming, Montana, and Idaho, USA; YNP) used photographs to study social norms around distance-related human–bison (*Bison bison*) interactions. By presenting participants with simulated pictures of people standing in various group sizes (small and large) at various distances (5 yards [4.57 m], 25 yards [22.86 m], and 50 yards [45.72 m]) from bison, researchers found that factors such as nationality (Miller et al. 2018*a*), group size, and viewing distance (Miller and Freimund 2018) influenced perceptions of safe distances from which to view bison. Although most visitors began to find it unacceptable to be closer than 36 yards [32.92 m] from bison, there was less agreement of norms for the two group sizes positioned at farther distances, perhaps because as group sizes get larger, social pressure increases, and norms become stronger (Miller and Freimund 2018). More research is needed on the factors that affect bison viewers' proximity preferences.

Anthropogenic disturbances (i.e., improper roadside viewing etiquette, improper food storage, noise pollution) in national parks have the potential to affect wildlife behavior and increase conflict with humans (i.e., displacement from food sources, increased wildlife mortality, altered mate pairing and reproduction; Brown et al. 2012, Gunther et al. 2018). Furthermore, many human–wildlife incidents can be attributed to inappropriate human behavior (Penteriani et al. 2016), such as approaching wildlife at distances that provoke dangerous reactions and threaten visitor safety. Although it is suggested that viewing devices can influence visitor behaviors around wildlife (Hammitt et al. 1993, Schänzel and McIntosh 2000, Verbos et al. 2018), there is little empirical research that explores this. For instance, empirical evidence that relates viewing devices such as DSLR (digital single-lens reflex) cameras, binoculars, and smartphones to the acceptability of wildlife proximity is lacking. Building upon previous research, the purpose of this study was to investigate factors of group size (small or large), distance from bison (5 yards [4.57 m], 25 yards [22.86 m], and 50 yards [45.72 m]), and use of wildlife viewing equipment (binoculars, smartphone camera, or DSLR camera) on visitor proximity preferences in YNP. Therefore, our primary research question was: how do group size, distance, and viewing equipment influence visitor acceptability of distances between people and bison?

Study area

This research was conducted in YNP, one of the most highly visited national parks in the United States (National Park Service [NPS] 2017*b*; Figure 1). The Greater Yellowstone Ecosystem is one of the largest, mostly intact temperate-zone ecosystems on Earth, and it is comprised of a diversity of hydrothermal features, vegetation, and wildlife (NPS 2019*a*). Average temperatures range from approximately 28°F (-2°C) to 53°F (12°C), and average precipitation is about 16 inches (40 cm; NPS 2019b). The YNP forests are primarily made up of lodgepole pine and alpine meadows, while the lower-elevation ranges are comprised of sagebrush steppe and grasslands, which provide important forage for wildlife (NPS 2019*a*). Undesirable interactions between people and wildlife are prominent in the Greater Yellowstone Ecosystem, which hosts a suite of large mammals such as elk (*Cervus canadensis*), bison, and bears (*Ursus* spp.) in addition to millions of visitors each year (Oliff and Caslick 2003). Many people fear encounters with large carnivores in parks and protected areas; however, bison are involved in more dangerous interactions than any other YNP species, resulting in an average of 4 incidents per year (Oliff and Caslick 2003). Most of these incidents occur when people approach bison at proximities less than the YNP regulation of 25 yards (22.86 m; NPS 2017*a*). Distance-related conflicts, especially between park visitors and bison, present a challenge for YNP managers.

Sampling

Research technicians collected data from July to August 2015 at 2 YNP locations: Old Faithful and Hayden Valley (Miller and Freimund 2018). Following YNP management recommendations, these sites were selected due to the high number and diversity of visitors. Survey administration in Hayden Valley was constrained by weather, wildlife distribution (i.e., bison were not present during data collection and low survey response from visitors), and safety concerns (i.e., high bear activity, bison movement). Data collection occurred across all 7 days of the week from July to August 2015.

Researchers distributed surveys during daylight hours, splitting data collection equally between 2 sampling shifts: 0800 to 1600 hours and 1000 to 1800 hours. Researchers employed a sampling technique designed so that surveys were continuously administered throughout each shift. Researchers intercepted visitors and asked if they would be willing to participate in a 10-minute survey. While collecting data at Hayden Valley, researchers intercepted visitors at roadside turnouts. Once the survey was complete, the next arriving vehicle was intercepted.

At Old Faithful, research assistants walked through the crowd and intercepted visitors along the way. Regardless of location, when groups were intercepted, the person with the most recent birthday was selected to participate. Large tour groups were also included in the sample.

Data instrument

Finding ways to alleviate distance-related human–wildlife conflict is hampered by both the difficulty of studying human–wildlife interactions in the field as well as the dearth of existing methodological tools. To complete the study, researchers used visual representation methods in the survey because they offer realistic and accurate portrayals of park and outdoor recreation settings that allow researchers to simulate conditions and better understand human behavior (Freimund et al. 2002, Manning 2011, Benfield et al. 2018).

Visual-based methods can be used in a variety of formats, including videos, photographs, and virtual reality. They can enhance our understanding of visitors' distance thresholds during wildlife viewing. Researchers presented survey respondents with 6 composite images, which were taken in YNP with a digital camera and a calibrated app-based range finder (Distance Calculator: Range Finder Fee; Miller and Freimund 2018). Using the range finder, researchers calculated a distance of 50 yards (45.72 m) from a real bison in the field. One researcher stood at the 50-yard (45.72-m) distance while another researcher took a picture on the digital camera. Once the bison moved a safe distance away, people were placed at various distances from where the bison stood, calculated with the range finder, and photographs were captured. The images were then edited with Photoshop, and a set of images were created with 2 groups of people (a small group and a large group) standing at 3 distances (5 yards [4.57 m], 25 yards [22.86 m], and 50 yards [45.72 m]). This resulted in 6 total images (a small group at 5 yards [4.57 m], a large group at 5 yards [4.57 m], a small group at 25 yards [22.86 m], a large

Figure 2. Photograph presentation to visitors in Yellowstone National Park, USA, during summer 2015.

group at 25 yards [22.86 m], a small group at 50 yards [45.72 m], and a large group at 50 yards [45.72 m]; Figure 2).

During survey administration, researchers presented each of the 6 images, 1 image at a time in a random order, to survey participants (Miller and Freimund 2018). Respondents were asked to rate the acceptability of the distance between the visitors in the people and the bison in the images on a 7-point Likert-type scale (1 = highly unacceptable, 7 = highly acceptable). Additionally, participants were asked how often they used various viewing devices, including binoculars, a smartphone camera, a point-and-shoot camera, a DSLR camera, a spotting scope, and an iPad or tablet device. Participants were asked to rate how often they used each of these devices on a 5-point Likert-type scale (1 = Never, 5 = Always). Additionally, demographic questions were also asked as part of the survey to describe the sample. Researchers received IRB approval through the University of Montana (Protocol #148-15).

Table 1. Interactions from repeated measures ANOVA for group size, distance from bison (*Bison bison*), and type of viewing device used in Yellowstone National Park, USA, during summer 2015.

Test	F	df_1	df_2	P-value
Group size x Distance x Smartphone camera	2.29	1.56	1360.43	0.12
Group size x Distance x Binoculars	1.65	1.56	1360.43	0.20
Group size x Distance x DSLR camera	1.07	1.56	1360.43	0.33
Group size x Smartphone camera	0.42	1	875	0.65
Group x Binoculars	2.46	1	875	0.12
Group x DSLR camera	0.31	1	875	0.58
Distance x Smartphone camera	8.60	1.73	1513.18	<0.001
Distance x Binoculars	1.62	1.73	1513.18	0.20
Distance x DSLR camera	0.15	1.73	1513.18	0.83

Table 2. Post hoc tests for simple effects for Distance x Smartphone camera in Yellowstone National Park, USA, during summer 2015.

	Never		Rarely		Sometimes		Often		Always	
Distance	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Distance 1*	1.45^{A}	0.12	1.67	0.20	1.49	0.12	1.66	0.01	1.80^{B}	0.09
Distance 2	3.03	0.15	2.96	0.26	3.01	0.16	3.01	0.13	3.15	0.12
Distance 3	4.55	0.15	4.44	0.26	4.45	0.15	4.38	0.13	4.37	0.12

*$P < 0.05$, Different superscripts indicate means that are significantly different from one another.

Data analysis

We used a factorial repeated measures analysis of variance (ANOVA) to test if there were differences in acceptability ratings based on the group size, distance from bison, and viewing device used. The within-subjects factors were group size (2 levels: small and large) and distance (3 levels: 5 yards [4.57 m], 25 yards [22.86 m], and 50 yards [45.72 m]), and the between-subjects factor was the viewing device used (smartphone camera, DSLR camera, and binoculars). The outcome variable was acceptability ratings of distance. All statistical analyses were conducted in IBM SPSS Statistics for Windows, Version 25 (Armonk, New York, USA).

Results

Researchers intercepted 1,091 visitors, and the 6% of survey respondents who did not speak English were excluded. Of the remaining 1,026 respondents, 87% agreed to participate, resulting in a total sample of 890 respondents. Following data cleaning, the final sample size was $n = 870$ participants with a final response rate of 85%.

We first checked the assumption of normality with skewness and kurtosis, which were violated at some levels. The Shapiro-Wilk test also failed. However, visual assessments of Q-Q plots appeared mostly normal. Because the F statistic is robust to normality violations, and factorial ANOVAs are robust to non-normality with large sample sizes, we proceeded with our analyses. We checked the assumption of sphericity with Mauchly's test, which indicated that the assumption of sphericity had been violated ($\chi^2_2 = 294.87$, $P < 0.001$). Therefore, we used the Greenhouse-Geisser correction, which is a procedure used to estimate epsilon so as to correct the degrees of freedom of the F-distribution when sphericity is violated.

The highest level of significant interaction was between distance and viewing device (Table 1). The repeated measures ANOVA for distance and smartphone cameras was statistically significant ($F_{1.73,1513.18} = 8.96$, $P <$ 0.001; Table 1). No other type of viewing device was a significant predictor of acceptability. We conducted post-hoc tests of simple effects to assess where differences between the levels

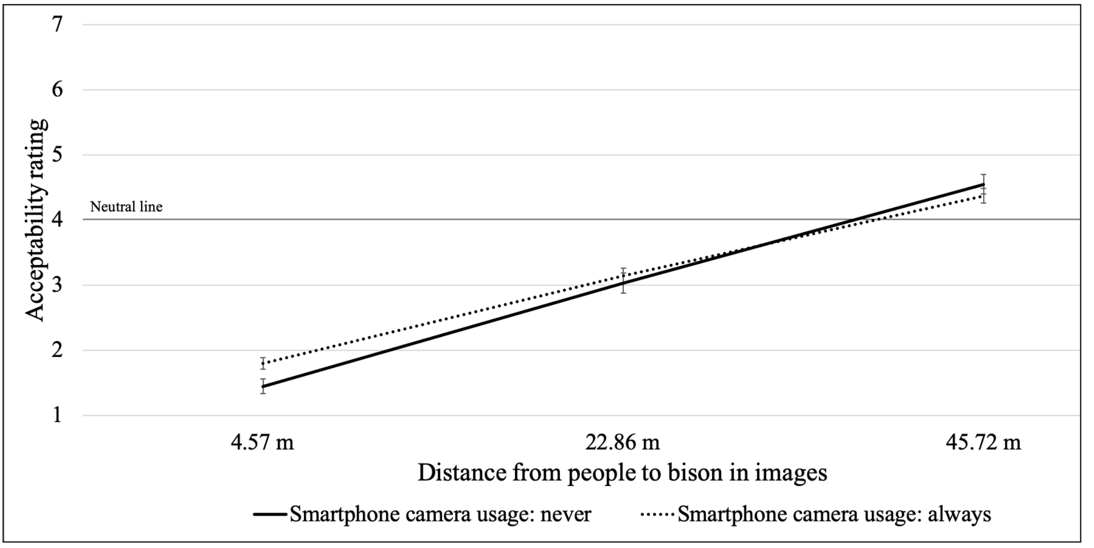

Figure 3. Post-hoc tests of simple effects: acceptability of distance from people to bison (*Bison bison*) in Yellowstone National Park, USA, during summer 2015.

of distance and how often people used a smartphone camera occurred (Table 2). There was a difference between acceptability ratings for photos that included the closest distance (5 yards [4.57 m]; Figure 3).

At the closest distance, respondents who said they never use a smartphone camera ($\bar{x}$ = 1.14, SE = 0.12) rated this distance as less acceptable than those who said they always use a smartphone camera ($\bar{x}$ = 1.80, SE = 0.09). In other words, people who always used a smartphone camera felt it was more appropriate to stand closer to bison than people who never used a smartphone camera. We then calculated a threshold score via interpolation for both groups to determine at what distance respondents' acceptability scores dipped below the neutral point on the scale (3.99). Acceptability scores crossed the neutral point 41.9 yards [38.31 m] for respondents who reported they never used their smartphone cameras and 43.3 yards [39.59 m] for respondents who reported they always used their smartphone camera.

Discussion

The highest level of interaction in our analyses only included the type of viewing device used and the distance from bison represented in the photographs, excluding group size as a significant factor. In other words, group size had no effect when accounting for smartphone camera use. This is an interesting finding, as previous research on visual-based, distance-related social norms for wildlife viewing found group size to influence people's acceptability ratings (Miller and Freimund 2018). More specifically, Miller and Freimund (2018) found higher levels of crystallization (agreement) on acceptability scores at the 5-yard [4.57-m] distance than at the 25-yard [22.86-m] or 50-yard [45.72-m] mark; at 5 yards [4.57 m], there were high levels of agreement that people standing in both small and large groups were located at an unacceptable distance from the bison. Given the degree of crystallization around this distance, factors associated with group size such as crowding or social pressure do not explain why some individuals might engage in risk-enhancing behaviors in exceedingly close proximity to dangerous animals. The types of viewing devices and how often visitors use them paint a more nuanced picture.

In our study, respondents began to find it unacceptable to be closer than 41.9 yards [38.31 m] from bison, which is more conservative than the 25-yard [22.84-m] regulation established by YNP. This is a positive finding and supports previous research that has identified significant relationships between YNP communication strategies and park visitors' bison safety perceptions (Miller et al. 2018*a*). Although very few visitors would approve of approaching bison at the 5-yard [4.57-m] mark, we did find a significant interaction at this distance between those who never used smartphone cameras and those who always used smartphone cameras.

Our findings may be explained by the quality of the view provided by these distinct types of equipment. Devices that allow for higher definition views from farther away may provide sufficient wildlife viewing or photography opportunities independent of the viewer's proximity, specifically when the person is positioned at 50 yards [45.72 meters] or less from an animal. On the other hand, smartphone camera lenses are limited in their zooming capabilities, and poorer views may motivate depreciative (i.e., too close) behavior.

The results of this study may provide park and protected area managers with the opportunity to improve distance-related communication programs. Park visitors exhibit a range of knowledge on available viewing technology (Verbos et al. 2018), leading many novice wildlife viewers or first-time visitors to arrive without equipment that might provide a quality wildlife encounter from farther away. Furthermore, many visitors might not be aware of or own different types of viewing technologies that could facilitate their experience, reduce their desire for proximity, and prevent stress to wildlife and human injuries.

Managers should consider attempting to reach visitors at the planning phase of their experience so they can best prepare for viewing and photographing wildlife. Managers could also engage onsite visitors by providing tips for capturing photos of wildlife in YNP coupled with informational materials on safe and appropriate behaviors to engage in around free-roaming animals in the park. At areas where human–wildlife interactions are common, managers may consider providing access to binoculars or spotting scopes as interpretive tools (Verbos et al. 2018).

Furthermore, persuasive communication strategies may be more effective if managers provide examples regarding how close encounters can harm wildlife, given that many viewers struggle with their desire to both be in close proximity to wildlife and also protect wildlife and natural habitats from anthropogenic disturbance (Pearce and Wilson 1995, Schänzel and McIntosh 2000). Wildlife Value Orientations (WVOs) could be implemented to frame such messages, as communications that are crafted with an audience's WVOs in mind have the potential to increase thoughtful processing, which in turn impacts actual behaviors (Miller et al. 2018*b*).

The following limitations should be taken into consideration. These findings may not generalize to other wildlife species beyond bison or other parks beyond YNP. Future research should incorporate the use of alternative species (i.e., carnivores, other ungulate species) in visual-based methods approaches. It will be important to continue this type of inquiry as technology continues to develop, which may influence visitor behaviors differently. Pairing this type of research with questions regarding frequency of social media use, specifically posting behaviors, may also be additive to understanding visitor motivations and behaviors (Miller et al. 2019). This type of study could also be tested in a controlled laboratory setting with visual-based methods other than photographs that might provide more realistic portrayals of outdoor recreation settings. For instance, these conditions could be simulated in a virtual reality environment that may provide a better understanding of park visitor perceptions.

Management implications

Despite these limitations, the results of this study have direct implications for park managers who are faced with mediating human–wildlife conflict. This study provides novel information on how viewing devices such as smartphone cameras might affect viewing behavior, which can be implemented to create more effective targeted communication strategies, educational materials, and intervention programs for ensuring the safety of both park visitors and wildlife in YNP.

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