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Integrating Emotional Affect into Bear Viewing Management and Bear Safety Education

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INTEGRATING EMOTIONAL AFFECT INTO BEAR VIEWING MANAGEMENT AND BEAR SAFETY EDUCATION

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ABSTRACT

The popularity of viewing wildlife, specifically brown bears (*Ursus arctos*), is increasing rapidly throughout North America, from Yellowstone National Park (NP) to Denali National Park. In addition, population distributions of both humans and brown bears are expanding, creating larger areas of overlap and an increased possibility of human-bear interactions. In order to prevent negative encounters and injury to either species, park managers must continue to work to encourage appropriate behavior among local residents as well as park visitors. Human behavior, however, is a result of many complex factors, including emotion and cognition. Despite this, the effects of emotions on human-wildlife conflict remain unstudied and therefore may limit success of any mitigation efforts. This thesis employs a quantitative self-assessment questionnaire within a sequential exploratory design to understand the relationship between emotion and behavior within the context of human encounters with bears. Results demonstrate significant variation in negative affect across bear encounter scenarios and highlight several areas of uncertainty among respondents. These results are used to develop a set of meaningful recommendations to improve the efficacy of current bear management and safety education.

TABLE OF CONTENTS

Page

Table of Contents (Continued)

Page

LIST OF TABLES

List of Tables (Continued)

Table Page

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

Introduction

At the end of the year 2019, nearly 7.8 billion humans inhabited the earth (UN, 2020). This number is expected to approach 10 billion within the next 30 years as population growth begins to slow (Cohen, 2003) Protected areas across the globe attract human settlement and economic development to rural areas (Wittemyer, Elsen, Bean, Burton, & Brashares, 2008). Increasing human presence and development along with increasing appreciation for nature-based recreation among Americans (Cordell, Betz, & Green, 2008) poses a significant threat to the wild lands originally intended for conservation. Outdoor recreation and higher levels of human use can result in stress, fleeing, and population decline for many wildlife species, including desert bighorn sheep (Papouchis, Singer, & Sloan, 2001), North American wood turtles (Garber & Burger, 1995), and brown bears (Nevin and Gilbert 2005). However, the impact of these changes depends on more than just the amount of use. Human behavior largely decides our ability to coexist with the environment and cope with new ecological challenges that arise (Goujon, 2018).

Human behavior though, is subject to influence from many complex factors. In 1994, neurologist Antonio Damasio outlined the significant role of emotions and feelings in human reason. Not only are current actions influenced by these psychological underpinnings, the ability to predict future events and plan appropriate actions may be as well (Damasio, 1994). Despite similar connotations, emotion, mood, and affect all

represent different phenomena. Affect, the simplest of the three, represents a primitive reaction or response to a stimulus and can occur alone or as a component of mood or emotion. Emotion is the complex interaction between sub-events regarding a specific object. These sub-events include core affect, overt behavior, directed attention, cognitive appraisal of a stimulus, connection of emotion to a stimulus, experience of the emotion, and neural and endocrine changes. Unlike affect and mood, emotion requires cognitive awareness and thought. Lastly, mood is similar to emotion but often persists much longer and is more abstract, lacking a specific or immediate cause (Ekkekakis, 2014). Each of these three phenomena, through their impact on planning and decision making, possess the ability to significantly alter the behavior of an individual.

Problem, Purpose, and Question

Within human-wildlife interactions, emotional responses to wildlife are key determinants of decision making. Despite emotion's pivotal role in human behavior, little knowledge exists regarding emotion's impact on human behavior regarding wildlife. As a result, management strategies might be less effective, potentially limiting success to preventative education efforts. Thus, conflict management can improve only if human emotions are assessed in developing future education strategies that target visitors' subconscious and conscious reactions to wildlife.

This study seeks to explore human reactions to specific wildlife conflict scenarios and their potential implications, focusing on responses to bear-viewing among the general American public. Overall, this study addresses the question of how immediate humans' affective responses impact behavioral choices during human-wildlife encounter scenarios.

Research Approach

To address the research question, I employed two quasi-experimental designs within a quantitative exploratory sequential structure. The first phase of my research involved informal in-situ interviews with bear-viewers at Katmai and Lake Clark National Parks and Preserves in Alaska and video capture. The second phase involved developing an online survey instrument to investigate affective responses to various bear encounter scenarios using two quasi-experimental designs; one to assess responses to nine different combinations of the focal bear's sex, age class, and setting, and the other to assess responses to three different bear behaviors. For the third phase, I administered the survey instrument to a representative sample of the general American public using a cross-sectional representative sample through Qualtrics. The fourth and final phase consisted of the statistical analysis of survey results to address the research question.

Emotion and Behavior

Two judgmental heuristics – practical approaches to decision-making, often separated from logic or rationale – may help understand human behavior through understanding mental predictions. The first, representativeness, involves an individual predicting the outcome best represented by the evidence. These intuitive predictions often ignore reliability of the evidence and lead individuals to predict rare events if they happen to be representative (Kahneman & Tversky, 1973). Second is availability, or the process of decision-making by the ease at which relevant solutions come to mind. This leads to systematic biases represented through frequencies of word classes, combinatorial

outcomes, and repeated events (Tversky & Kahneman, 1973). The use of these heuristics can be detrimental when presented with previously unknown situations, such as instances of human-wildlife conflict. The decision, and resulting action, may not be the logical or reasonable solution, but simply the most representative or first available.

Traditional research in judgement and decision making focused on cognitive processes as the basis for uncertain decisions, in both microeconomics and philosophy. However, starting in the 1990's, research began to incorporate emotional processes within decision making. Rather than the previous dichotomy between emotional and cognitive function, the two may be indistinguishable. Emotions not only encode heuristic evaluations, but the precise parameters of cognitive ones as well (Slovic, Peters, Finucane, & MacGregor, 2005). These evaluations are often referred to as the experiential and analytic systems respectively. The experiential system provides fast, nearly automatic, decisions, while the analytic system provides slow, effortful, and conscious decisions. Previously the experiential system received less credit than the analytic system but current wisdom states both are required in rational decision making. Therefore, when informing others about risks, both systems must be addressed (Quartz, 2009).

Furthermore, emotions may be capable of biasing reasoned judgement. Despite the presence of sound logic or knowledge, emotional processes can alter decisions through both perceptual emotional mechanisms and feeling states. For example, individuals make trustworthy decisions based on the friendliness of nearby faces or expect different outcomes based on subconscious understanding of subtle differences in

body state or environment (Dolan, 2002). Similar to a feedback loop, emotion provides an indirect influence on decisions based off of prior experiences, resulting in decisions informed by previous conscious emotional states. Rapid, affective responses perform a similar function regarding current behavior and provide connections between current events and past emotional outcomes (Baumeister, Vohs, Nathan DeWall, & Zhang, 2007). In order to reach rational, successful decisions, both cognitive and emotional aspects must be addressed. Emotion not only informs heuristic decision-making processes, but cognitive processes as well, and effective conflict management requires implementation of both to better inform future actions and reasoned decision making.

Human-wildlife conflict is becoming an urgent issue due to increasing urban expansion, rapid population growth, and increased visitation to popular wildlife areas. The situational factors surrounding these conflict scenarios contribute significantly to behavior and understanding them is required to create effective management strategies (Hayman, Harvey, Mazzotti, Israel, & Woodward, 2014). Furthermore, human behavioral reactions and decision making often determine the outcome of such scenarios. Understanding human behavior, which emotion heavily influences, can greatly impact management efforts to mitigate human-wildlife conflicts (Wieczorek Hudenko, 2012). However, studies seldom address emotional responses to wildlife conflict scenarios, which limits success of conflict management strategies. In order to improve upon current methods, managers should take human emotion into account.

Despite being responsible for only 24 deaths in North America between 2000 and 2015 (Bombieri et al., 2018), brown bears earn a great deal of negative publicity and have

warranted significant safety education. However, bears are also easily anthropomorphized and develop large online followings (Skibins & Sharp, 2018). When in novel or dangerous wildlife encounters where decisions are made immediately, individuals must weigh negative and positive affect with their knowledge of appropriate behavior. Emotion is heavily responsible for decision-making, yet ignored during instructions for safe behavior.

Thesis Structure and Format

The following chapters further address this discrepancy through survey research on emotions and behavior of the general American public when viewing wild brown bears. This thesis consists of four chapters. Chapter 1 provides a brief introduction to the topic and research focus. Chapters 2 and 3 are formatted as scientific journal articles and detail the results of my research. Chapter 4 provides a discussion of the results, including limitations, implications, and possibilities for future research.

Chapter 2 is intended for submission to the journal, *Ecology and Society*, and focuses on understanding immediate emotional reactions, or affective responses, upon viewing bears and the role that this plays in an individual's ability to behave appropriately. A significant portion of bear management requires cooperation from local residents as well as park visitors, but many factors contribute to human behavior. This may be especially true in exciting and novel experiences like bear encounters. Psychologists have developed many theories regarding these factors, particularly the judgmental heuristics of representativeness and availability and the balance between emotional and cognitive processes. Specific research questions for this chapter include 1)

how do affective responses to the setting and a bear's sex or age class impact decision-making among bear viewers, 2) how do affective responses among bear viewers differ as a result of the bear's behavior, and 3) what factors contribute to the decision-making process during a bear encounter. To test this, I conducted a national online self-assessment survey using short videos to depict twelve potential bear encounter scenarios.

Chapter 3 is intended for the journal, *Ursus*, and focuses on understanding the current level of bear safety knowledge among the general American public. With expanding populations of both humans and grizzly bears, interactions between species are bound to occur. These interactions however, often result in trapping, relocating, or euthanizing the bear. Unfortunately, while many of these incidents are easily preventable through proper human behavior, even one mistake could produce multiple generations of problem bears. Not only are residents within bear habitat responsible for behaving properly, but large numbers of tourists and park visitors must as well. To address this area of concern, I conducted an online self-assessment survey to evaluate the bear safety knowledge of the general American public when presented with several bear encounter scenarios. Specific research questions for this chapter were 1) what locations have resulted in the most brown bear sightings among respondents, 2) how accurate are respondents at identifying brown bears, 3) how do respondents view their level of bear safety knowledge, and 4) what factors contribute to a respondent's perceived appropriateness of listed actions.

From the survey results I developed 10 recommendations to improve the efficacy of bear safety education, including provide reasoning and logic behind policies, release

public service announcements, and provide experiential education using photographs, videos, and virtual reality experiences.

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CHAPTER TWO

INTEGRATING AFFECT INTO BEAR VIEWING MANAGEMENT AND BEAR SAFETY EDUCATION

Introduction

Bear viewing and its management

Already one of the most popular forms of ecotourism, bear-viewing continues to grow in popularity (Aumiller and Matt 1994, Haroldson and Gunther 2013). The creation of Yellowstone National Park (NP) in 1872 inspired the first recreational bear-viewers and participation in wildlife-related recreation continues to increase (Aumiller and Matt 1994). As interest increases, destinations such as McNeil River State Game Sanctuary in Alaska develop into highly demanded tourist attractions. This site, specifically, provides a guiding example of successful bear-viewing management. After the establishment of their management plan, the sanctuary touts no human injuries or bears requiring removal (lethal or otherwise), despite bear use of the area more than doubling (Aumiller and Matt 1994). Managers at McNeil River claim this is largely a result of their ability to encourage appropriate behavior among visitors.

Previous bear attacks

Unfortunately, when park visitors and local citizens behave inappropriately, both bears and humans can be harmed. While injurious encounters with bears are relatively rare, the result can prove fatal. Canadian biologist, Stephen Herrero (2018) found that from 1900 to 1980, 126 injuries were definitely or very probably inflicted by grizzly bears in North American parks. Of these, 56 occurred in Yellowstone National Park and

24 occurred in Glacier National Park. However, two parks with much larger bear populations, Katmai and Denali National Parks in Alaska, account for only 10 injuries, all of which were in Denali (Herrero 2018). Between 1970 and 1973, Yellowstone reported the highest ratio of visitors per grizzly-inflicted injury at 1,745,142:1, or approximately 0.00006% of the visiting population (Herrero 1976).

In this same time period, sows with cubs were responsible for 8 major injuries and 9 minor injuries, while solitary females were responsible for 1 major injury and adult males were responsible for 1 major and 1 minor injury (Herrero 1976). Among fifty aggressive encounters not resulting in injury, 28 involved a sow with cubs, 2 involved an adult male (5 additional accounts attributed to an adult bear of unknown sex), and 5 involved a subadult (Herrero 1976). Overall, these data suggest interior parks with high visitation and relatively small bear populations produce the highest risk of bear-inflicted injury which, if occurred, would most likely be attributed to a sow with cubs. Despite this potential for danger, visitors often hope for the special experience of being near animals or seeing dependent young (Farber and Hall 2007).

Emotion and behavior

During novel encounters with wildlife, emotional responses are key determinants of decision making, yet are seldom studied. Despite emotion's pivotal role in human behavior, little knowledge exists regarding its impact on human-wildlife conflict management strategies. As a result, management strategies might be less effective, potentially limiting success of preventative education efforts. Thus, human-wildlife conflict management can improve only if human emotions are assessed in developing

future education strategies that target visitors' subconscious and conscious reactions to wildlife. This study seeks to explore human reactions to specific wildlife encounter scenarios and their potential implications, focusing on responses to bear-viewing among the general American public. Many visitors and residents of bear-inhabited regions never receive formal safety education and as populations of both bears and humans expand, negative encounters are likely to continue. Collecting a representative sample of the general American public allows for an unbiased estimate of national awareness regarding safe behavior around bears and potential suggestions for improvement.

The objectives of this paper include to 1) Understand immediate emotional reactions upon viewing bears in different scenarios, including various sexes, age classes, behaviors, and habitat types, and 2) understand the role of emotional reactions in individuals' ability to behave appropriately. Research questions include:

1) How do affective responses to the setting and a bear's sex or age class impact decision-making among bear-viewers?
    a. How do affective responses vary across treatments?
    b. How does the likelihood of performing listed actions vary across treatments?
    c. How does the reported appropriateness of performing listed actions vary across treatments?
    d. For which behaviors are there discrepancies between likelihood and reported appropriateness?

2) How do affective responses to a bear's behavior impact decision-making among bear-viewers?
    a. How do affective responses vary across treatments?
    b. How does the likelihood of performing listed actions vary across treatments?
    c. How does the reported appropriateness of performing listed actions vary across treatments?
    d. For which behaviors are there discrepancies between likelihood and reported appropriateness?
3) What factors contribute to the decision-making process during a bear encounter?

Background

Underpinning these research questions is a body of knowledge about emotion, mood, and affect, which despite similar connotations, all represent different phenomena. Affect, the simplest of the three, represents a primitive reaction or response to a stimulus and can occur alone or as a component of mood or emotion. Emotion is the complex interaction between sub-events regarding a specific object. These sub-events include core affect, overt behavior, directed attention, cognitive appraisal of a stimulus, connection of emotion to a stimulus, experience of the emotion, and neural and endocrine changes. Unlike affect and mood, emotion requires cognitive awareness and thought. Lastly, mood is similar to emotion but often persists much longer and is more abstract, lacking a specific or immediate cause (Ekkekakis 2012).

Two judgmental heuristics – practical approaches to decision-making, often separated from logic or rationale – may help understand human behavior through understanding mental predictions. The first, representativeness, involves an individual predicting the outcome best represented by the evidence. These intuitive predictions often ignore reliability of the evidence and lead individuals to predict rare events if they happen to be representative (Kahneman and Tversky 1973). Second is availability, or the process of decision-making by the ease at which relevant solutions come to mind. This leads to systematic biases represented through frequencies of word classes, combinatorial outcomes, and repeated events (Tversky and Kahneman 1973). The use of these heuristics can be detrimental when presented with previously unknown situations, such as instances of human-wildlife encounters. The decision, and resulting action, may not be the logical or reasonable solution, but simply the most representative or first available (Kahneman and Tversky 1973, Tversky and Kahneman 1973).

Traditional research in judgement and decision making focused on cognitive processes as the basis for uncertain decisions, in both microeconomics and philosophy (Quartz 2009). However, starting in the 1990's, research began to incorporate emotional processes within decision making. Rather than the previous dichotomy between emotional and cognitive function, the two may be indistinguishable. Emotions not only encode heuristic evaluations, but the precise parameters of cognitive ones as well (Slovic et al. 2005). These evaluations are often referred to as the experiential and analytic systems respectively. The experiential system provides fast, nearly automatic decisions, while the analytic system provides slow, effortful, and conscious decisions. Previously

the experiential system received less credit than the analytic system but current wisdom states both are required in rational decision making. Therefore, when informing others about risks, both systems must be addressed (Quartz 2009).

In order to reach rational, successful decisions, both cognitive and emotional aspects must be addressed. Emotion not only informs heuristic decision-making processes, but cognitive processes as well, and effective conflict management requires implementation of both to better inform future actions and reasoned decision making. Integrating such complexity in management efforts requires a multi-disciplinary approach. Items impacting decision-making during an encounter include cognition and emotions, barriers and benefits to specific behavior choices, and social thresholds (Jochum et al. 2014). These dimensions each play a role in determining behavior; however, some may lack effectiveness due to individuals' reliance on affect-based shortcuts.

Wilson (2008) proposed three approaches to alter affect-based shortcuts to improve conservation efforts. Value-focused approaches aim to incorporate an individual's conservation objectives into decisions. Trade-off techniques encourage justification for conservation actions over affective impressions or other values. Lastly, identifying shared values and increasing procedural fairness work to foster trust in decision-making authorities and the decision process (Wilson 2008). Through incorporation of these techniques, managers develop the capacity to edit individuals' affective responses to wildlife encounters, quickly and drastically altering the effectiveness of mitigation efforts.

Methods

Overall design

To best determine how the American public responds emotionally to various bear-encounter scenarios, I used an exploratory sequential design (Cabrera 2011). The first phase of my research involved informal in-situ interviews with bear-viewers at Katmai and Lake Clark National Parks and Preserves in Alaska and video capture. The second phase involved developing an online survey instrument to quantitatively capture affective responses to various bear encounter scenarios using two quasi-experimental designs. In the third phase, I administered the survey instrument to a representative sample of the general American public using a Qualtrics cross-sectional representative sample. The fourth and final phase consisted of the statistical analysis of survey results to address the research question.

This study employed two independent samples designs: a 3x3 design as well as an additional 3x1 design. Each treatment represented a different 15-second video. The first design (3x3), setting treatments, compared visitor responses across three different settings and three different age and sex classes. Settings included a salmon stream, a meadow, and a viewing platform while age and sex classes included solitary boar, sow with cubs, and sub-adults. Study design 2 (3x1), behavior treatments, acted as a qualifier, testing responses across bear behavior, holding other variables constant. The three studied behaviors were feeding, curious, and aggressive, but respondents were not provided with an interpretation or description. Behavior was held constant across the entire 3x3 design

but was tested here to alleviate the threat to external validity resulting from the lack of independence between bear behavior and an individual's response. This second design also served as an additional test of current education efforts and an individual's ability to behave appropriately in such situations.

Phase 1: Informal interviews

Informal interviews

Brief qualitative interviews occurred directly after or during a bear-viewing experience, following approaches recommended by Seidman (2012). These interviews were informal, recorded only through field notes, and looked to capture the current emotions of visitors (Halcomb and Davidson 2006). Questions were open ended to allow the respondent to verbalize their reactions independent of outside influence. Interviews were conducted with as many visitor groups as possible and at multiple locations across Katmai and Lake Clark National Parks to reach data saturation (Seidman 2012). These locations support abundant brown bear populations while providing high quality viewing experiences in all three of the intended settings.

Video capture

To best simulate the nine setting treatments, I captured high quality video clips that effectively demonstrated the intended scenario while minimizing any nuisance variables due to unintended differences across videos, such as lighting, weather, microhabitat, size and positioning of the bear, and video quality. For the three behavior treatments, I elicited videos from online bear-viewing communities, online video sharing sites, and public access documentaries. Videos were selected that displayed only the focal

bear and clearly illustrated the intended behavior while minimizing differences due to microhabitat, lighting, weather, age or sex of the bear, and video quality. All final videos are available online (http://tinyurl.com/Affect-Videos).

Researchers in park and visitor use management often use visual methods, in the form of computer-altered photographs, to help identify outdoor recreationists' ideal conditions (Laven and Krymkowski 2005, Manning, Valliere, and Wang 1999). Photographs depicting varying levels of resource or experiential impact can be used as suggestive surrogates for true conditions (Newman, Marion, and Cahill 2001) and are much more effective than traditional narrative descriptions (Manning and Freimund 2004). While less studied, videos have also been used successfully to determine park visitors' preferred conditions (Bateson and Hui 1992, Freimund et al. 2002). This study would have ideally been conducted in person, but field research would not have allowed the questions to be addressed. Not only would this method be time consuming and expensive, it would be difficult to maintain consistency across scenarios and ensure all types of encounters were represented. As a result, videos were used to best depict first-hand experience of bear behavior and viewing locations, allowing me to design the experiment appropriately while keeping both bears and humans safe and avoiding distractions during onsite experiences. Further research could test the potential of virtual reality in more accurately depicting encounter scenarios or could use an in person qualitative approach to assess emotional reactions on a deeper level immediately following an encounter. This research could occur at several different parks and protected areas to assess reactions to various types of bear viewing using participant observation.

Phase 2: Survey development

For the second phase of the design, I developed an online self-assessment survey of emotional affect towards brown bears (*Ursus arctos)* among the general American public. Surveys used the Positive and Negative Affect Schedule (PANAS scale) to quantify affective reactions of survey respondents. Developed by Watson, Clark, and Tellegen (1988), the PANAS scale is one of the most widely used tools for measuring affect (e.g., Crawford and Henry 2004, Crocker 1997, Jacobs, Fehres, and Campbell 2012, Schmuckle et al. 2002, Thompson 2007). This scale uses a list of twenty adjectives describing various feelings and emotions, ten of which relate to positive affect, and ten to negative affect. Respondents are asked to rate the intensity of each affective item on a five-point scale, with one being "very slightly or not at all" and five being "extremely." This scale exhibits high scale, item, and external validity, is reliable across a range of time instructions from the present moment to general, and provides precise measures of positive and negative affect (Watson et al. 1988).

I included photographs of viewing scenarios and explicit instructions in the survey to encourage respondents to immerse themselves in the video and respond based only on immediate reactions to each video. Figure 2.1 displays the photographs for each setting category (i.e., meadow, stream, and platform). This figure also includes the generic bear viewing photo displayed prior to all three behavior treatments used to further illustrate the viewing scenario.

I developed the survey through an online survey platform, Qualtrics, using best practices for online survey construction as described by Dillman (2011) and Vaske (2008). Surveys showed each respondent a randomly selected video from the first design, a 3x3 design with three settings and three categories of sex or age class, followed by a question prompting them to rate their level of agreement with all listed adjectives, using the PANAS scale to measure positive and negative affect. Next, surveys showed each respondent a randomly selected video from the second design, a 3x1 design with three bear behavioral categories, followed by the same PANAS scale. Despite efforts to maximize the applicability of videos and the PANAS scale, their use may have hampered the ability to measure true affective responses. This study, then, offers a foundation for future research which could use in depth, onsite, qualitative interviews to better understand the complexities within affective responses.

Figure 2.1. Images shown to respondents prior to viewing the respective setting and behavior treatment videos.

For each video, respondents were asked how they plan to react and the perceived appropriateness of potential actions. Both questions provided a list of fifteen potential actions and a seven-point Likert scale for respondents to rate their level of agreement with each choice. These potential actions were chosen based on historical accounts of reactions listed by Gunther and Hoekstra (1998) and personal accounts from working in bear safety education. The final list was chosen to provide a range of appropriateness and

was listed in alphabetical order. For appropriateness, respondents were given the additional option to select "I don't know" for each action. Lastly, the respondents rated, on a ten-point Likert scale (1 = not at all, 10 = a great deal), the potential impact of bear safety education, current emotion, and previous experience on their in-the-moment decisions. These questions helped to determine the strength and accuracy of judgmental heuristics (i.e., representativeness and availability) in respondents' decision-making process.

Phase 3: Sampling

After developing the final survey instrument, I purchased a cross-sectional representative sample study from Qualtrics to collect a representative sample of the general American public. Unless bear safety training is mandatory and standardized, many visitors and residents may encounter a bear without having knowledge of proper behavior. I chose the general American public as the study population to best understand how such individuals will behave in bear encounter scenarios, with or without previous training. Purchasing a cross-sectional representative sample allowed for efficient data collection given the broad sampling population. Qualtrics sampling used six demographic questions and standard U.S. Census Bureau categories as qualifiers to ensure a representative sample. These included age, education level, gender, income, race, and zip code of primary residence.

Phase 4: Analysis

All statistical analyses were conducted using IBM's Statistics Package for the Social Sciences (SPSS) version 24.0 (2018).

Confirmatory Factor Analysis

To determine fit indices, measurement variance, and item independence for the shortened PANAS scale, I conducted a confirmatory factor analysis (CFA) with robust estimation methods using EQS 6.3. Ultimately, the CFA helps evaluate the psychometric measurement properties of the scale and provides an assessment of scale validation.

Research Question 1: Responses to setting and sex or age class

Research questions 1a, 1b, and 1c asked how the setting of a bear encounter and a bear's sex or age class impact a viewer's intensity of affective responses (question 1a), likelihood of performing listed actions (question 1b), and perceived appropriateness of listed actions (question 1c). To assess differences in responses, I used three multivariate analyses of variance (MANOVAs). This statistical test compares values for multiple continuous or scale dependent variables (i.e., affect items, listed actions) across a categorical independent variable (i.e., video treatments). Assumptions include an independent random sample, independence of dependent variables, multivariate normality, and similar variance across groups. When a difference across video treatments was statistically significant ($p < 0.05$), I used Bonferroni post-hoc tests to assess pair-wise comparisons while minimizing the impact of testing multiple hypotheses on statistical results. For perceived appropriateness, I did not include responses of "I don't know," so results were easily comparable between perceived appropriateness and likelihood.

Research question 1d asked how the difference between likelihood and perceived appropriateness of listed actions differed across setting and a bear's sex or age class. To

assess differences between an individual's responses, I used a paired-samples t-test for each listed action, excluding responses of "I don't know" for perceived appropriateness. This statistical test compares values across two sets of observations. The area of interest is not the difference in group means of likelihood and perceived appropriateness, but how discrepancies in these values differ among individuals. Assumptions include independent observations and normally distributed data with no outliers. In terms of the mean difference, a negative value represents an action that is more likely than appropriate, while a positive value represents an action that is more appropriate than likely.

Research Question 2: Responses to bear behavior

Research questions 2a, 2b, and 2c asked how a bear's behavior impacts a viewer's intensity of affective responses (question 2a), likelihood of performing listed actions (question 2b), and perceived appropriateness of listed actions (question 2c). Since the scales used in these survey questions were also used in questions regarding setting and a bear's sex or age class, an individual's response to the first use of the scale needed to be accounted for in this phase of analysis. To do so in assessing differences among responses, I used three multivariate analyses of covariance (MANCOVAs), with an individual's previous response as a covariate to account for the dependency between the repeated measure. This statistical test compares values of multiple continuous dependent variables (i.e., affect items, listed actions) across a categorical independent variable (i.e., video treatments) while accounting for values of a third variable (i.e., previous response to same scale). Assumptions for a MANCOVA are the same as for a MANOVA; an independent random sample, independence of dependent variables, multivariate

normality, and similar variance across groups. When a difference across video treatments was statistically significant ($p < 0.05$), I used Bonferroni post-hoc tests to assess pair-wise comparisons while minimizing the impact of testing multiple hypotheses on statistical results. For perceived appropriateness, I did not include responses of "I don't know," so results were easily comparable between perceived appropriateness and likelihood.

Research question 2d asked how the difference between likelihood and perceived appropriateness of listed actions differed across bear behavior. To assess differences between an individual's responses, I used a paired-samples t-test for each listed action, excluding responses of "I don't know" for perceived appropriateness. I did not include previous responses as a covariate in this analysis because each individual was only shown one combination of video treatments and the impact of a previous scale response is likely similar for an individual across questions, limiting the impact of previous scale completion on the difference between an individual's responses to these two questions. In terms of the mean difference, a negative value represents an action that is more likely than appropriate, while a positive value represents an action that is more appropriate than likely.

For all analyses using covariates, I calculated the two-tailed Pearson correlation coefficient, r, to confirm the need for their inclusion. This value represents the level of covariation between the variable of interest for the setting and sex or age class treatment and that for the behavior treatment. Values of r between 0.7 and 1.0 or -0.7 and -1.0 represent strong positive or negative linear relationships, respectively.

Research Question 3: Factors in decision-making

Research question 3 asked which factors most contribute to an individual's in-the-moment decision. The tested factors included knowledge of bear safety, current emotional state, and previous experience. To assess the impact of these factors, I conducted a univariate general linear model (GLM) to determine variables associated with each factor. This statistical analysis assesses the accuracy of predictions for a continuous independent variable based on one or more dependent variables. Assumptions include a linear relationship between variables, normally distributed data with limited collinearity, and independent residuals that are relatively constant across the range of the data.

I included demographics, experience use history, and affective responses in the global model, removing variables to maximize the adjusted R^2 value. This value emphasizes the principle of parsimony by providing a measure of the proportion of variation present in the data that is explained by the model (i.e., R^2) while penalizing for each additional independent variable included. For all three final models, I included video treatment, regardless of statistical significance to illustrate its impact, or lack thereof, on decisions.

Results

I received a total of 511 complete responses with approximately 57 responses (*SD* = 4.39) for each of nine setting treatments and 170 responses (*SD* = 7.76) for each of three behavior treatments. For all sample-wide analyses, this produced an overall confidence interval of 4.34% at the 95% confidence level, suggesting a high-quality

sample. To confirm that the sample produced enough statistical power to detect differences in means, I calculated the minimum sample size per cell needed to maintain a power of 0.8. Since statistical power decreases with further segmentation, I determined the minimum sample size required for each of 9 cells within design 1 (i.e., setting treatments). If the true effect size was 0.2, each cell would require a sample size of 43 to produce a power of 0.8 at a significance level of 0.05. If the true effect size was 0.15, each cell would require a sample size of 75. Based on the average observed sample size per cell (n = 57), an effect size of 0.15, and a significance level of 0.05, the resulting statistical power was 0.66. As a result, I am confident in the sample's ability to detect even minor differences in means.

The sample accurately represented the general American public, as estimated by the U.S. Census Bureau (USCB, 2020), with 66.5% identifying as white, 16.6% as Hispanic or Latino/Latina, 18.4% earning less the $24,999 per year, 17.8% earning between $50,000 and $74,999, 14.9% earning between $25,000 and $49,999, 24.1% reporting high school graduate as their highest level of education, 24.1% reporting a four-year college degree as their highest level of education, and 45% identifying as female. Of these responses, 55% reported never seeing a wild brown bear, while 11.2% reported seeing a wild bear but were unsure of the species. In addition, 47.2% reported being taught any form of bear safety. However, it is unlikely that 33% of the sample truly saw a wild brown bear. While it does not impact the validity of results, it does suggest that visitors may respond to black and brown bears in the same manner.

Informal Interviews

As discussed above, the survey used an adjusted version of the PANAS scale, one of the most widely used and tested measures of affect. To minimize burden on the respondent and eliminate items not relevant to a bear viewing experience, I included only adjectives described in the qualitative interviews while maintaining balance between the positive and negative sides. This process resulted in use of 10 of the 20 PANAS items. The five chosen items within positive affect were attentive, alert, enthusiastic, excited, and interested. The five chosen items within negative affect were distressed, hostile, jittery, nervous, and scared.

Confirmatory Factor Analysis

Results of the original CFA demonstrated low factor loadings and cross loadings for two positive affect items: alert and attentive (initial model fit indices: $SB\chi^2 = 1158$, $p < 0.01$, CFI = 0.82, NNFI = 0.82, RMSEA = 0.18, SRMR = 0.181). I then ran an additional CFA, excluding alert and attentive. This model resulted in relatively high factor loadings, with 6 of the 7 above 0.76 and one at 0.54 (modified model fit indices: $SB\chi^2 = 122.7$, $p < 0.01$, CFI = 0.98, NNFI = 0.97, RMSEA = 0.07, SRMR = 0.042). Intuitively, alert and attentive are not limited to positive responses, which might have influenced the cross loadings and low factor loadings. However, alert and attentive are considered by researchers (e.g., Watson et al. 1988) to be positive affect items.

While this second model met the customary levels of fit as described by Byrne (2008) and Kline (2011), these authors advise researchers to interpret fit indices holistically, maintaining theoretical and conceptual validity. Since results for each item

were foundational to this study, I chose to include alert and attentive in all analyses except for those at the factor level. Ultimately, the CFA results suggest that most PANAS items appropriately reflected the intended latent variables or factors of positive affect and negative affect.

Research Question 1: Responses to setting and sex or age class

Question 1a: Affective responses

Among the Positive Affect (PA) items, alert, $F(8, 502) = 1.61$, $p = 0.12$, and excited, $F(8, 502) = 1.67$, $p = 0.10$, varied the most across setting treatments but none were statistically different at the $p > 0.05$ level. Among the Negative Affect (NA) items, distressed, jittery, nervous, and scared were all statistically different, $F(8, 502) > 1.96$, $p < 0.05$, across setting treatments (see Table 1.1). Overall, viewing a sow and cubs in a meadow resulted in a statistically stronger negative reaction than viewing a boar in a meadow, $t(107) = 3.76$, $p < 0.001$, a boar from a platform, $t(113) = 4.56$, $p < 0.001$, or a subadult from a platform, $t(101) = 2.12$, $p = 0.04$.

Table 2.1. *Mean intensity of affective response to the nine setting treatments.*

	Boar	Sow and Cubs	Subadult	Boar	Sow and Cubs	Subadult	Boar	Sow and Cubs	Subadult	
	MEADOW			**STREAM**			**PLATFORM**			***F*(8, 502)**
	Mean (SD)									
Positive Affect										
Alert	3.89 (1.2)	3.73 (1.2)	3.95 (1.1)	3.91 (1.2)	3.69 (1.4)	3.69 (1.3)	3.35 (1.1)	3.49 (1.3)	3.50 (1.4)	1.61
Attentive	3.93 (1.1)	3.80 (1.1)	4.22 (0.9)	3.93 (1.2)	3.72 (1.3)	3.86 (1.3)	3.68 (1.1)	3.84 (1.2)	3.75 (1.3)	1.16
Enthusiastic	3.04 (1.2)	3.31 (1.4)	3.42 (1.3)	3.16 (1.3)	3.24 (1.3)	2.98 (1.4)	3.40 (1.2)	3.41 (1.4)	3.40 (1.2)	0.94
Excited	3.37 (1.2)	3.53 (1.1)	3.78 (1.1)	3.25 (1.2)	3.36 (1.4)	3.30 (1.4)	3.75 (1.2)	3.52 (1.3)	3.79 (1.1)	1.67
Interested	3.80 (1.2)	3.95 (1.1)	3.92 (1.2)	3.82 (1.0)	3.74 (1.4)	3.54 (1.4)	3.88 (1.1)	3.89 (1.2)	3.90 (1.4)	0.60
Total PA	10.20 (3.0)	10.78 (3.2)	11.13 (3.1)	10.24 (3.3)	10.34 (3.6)	9.82 (3.8)	11.03 (2.9)	10.82 (3.4)	11.08 (3.2)	1.13
Negative Affect										
Distressed	1.8 (1.0)	2.42 (1.3)^{2}	2.02 (1.1)	2.15 (14)	1.97 (1.1)	2.29 (1.4)	1.70 (1.1)	1.67 (1.2)^{1}	2.02 (1.1)	2.53**
Hostile	1.69 (1.8)	2.13 (1.4)	1.73 (1.2)	1.64 (1.1)	1.52 (1.0)	1.88 (1.3)	1.55 (1.0)	1.62 (1.2)	1.98 (1.3)	1.65
Jittery	1.94 (1.1)^{1}	2.76 (1.2)^{2}	2.42 (1.2)	2.25 (1.4)	2.22 (1.3)	2.43 (1.3)	1.97 (1.2)^{1}	1.80 (1.4)^{1}	2.15 (1.3)	3.10**
Nervous	2.22 (1.1)^{1}	3.13 (1.3)^{2}	2.61 (1.3)	2.49 (1.4)	2.43 (1.3)	2.43 (1.4)	1.87 (1.1)^{1}	1.92 (1.3)^{1}	2.35 (1.4)	4.93**
Scared	2.22 (1.2)	2.96 (1.4)^{2}	2.72 (1.2)	2.44 (1.4)	2.16 (1.1)^{1}	2.64 (1.4)	2.00 (1.2)^{1}	1.92 (1.3)^{1}	2.56 (1.5)	4.34**
Total NA	9.87 (4.3)^{1}	13.40 (5.4)^{2}	11.50 (5.1)	10.96 (5.9)	10.29 (4.8)	11.66 (6.3)	9.08 (5.7)^{1}	8.93 (5.7)^{1}	11.06 (5.8)	3.91**

Note. Intensity was ranked by respondents on a five-point scale with one representing “very slightly or not at all” and five representing “extremely.” Superscripts represent significant differences across rows at the $p < 0.05$ level. Total PA does not include alert or attentive.

*$p < 0.05$ **$p < 0.01$

Questions 1b and 1c: Likelihood and appropriateness of performing listed actions

When asked to rate the likelihood of performing each of several potential actions on a scale from one to seven (1 = extremely unlikely, 7 = extremely likely), the most likely actions were back away slowly ($M = 5.37$, $SD = 1.8$), group together ($M = 4.16$, $SD = 2.0$), stand still and wait for the bear to leave ($M = 4.73$, $SD = 1.8$), and walk around the bear ($M = 4.51$, $SD = 2.2$). However, the actions perceived as most appropriate, on a scale of one to seven (1 = extremely inappropriate, 7 = extremely appropriate), were back away slowly ($M = 5.57$, $SD = 1.6$), group together ($M = 4.33$, $SD = 2.0$), stand still and wait for the bear to leave ($M = 4.77$, $SD = 1.8$), try to hide ($M = 4.09$, $SD = 2.0$), and walk around the bear ($M = 4.64$, $SD = 2.1$).

Question 1d: Discrepancies between likelihood and perceived appropriateness

Of the 135 combinations of setting videos and potential actions, fifteen showed statistical differences between likelihood and perceived appropriateness (see Table 2.2), meaning respondents may be aware of correct behavior but are either unable to resist participating in inappropriate behavior (i.e., more likely than appropriate; negative value) or unwilling to participate in appropriate behavior (i.e., more appropriate than likely; positive value). Across all setting treatments, backing away slowly, $t(498) = 2.95$, $p = 0.003$, climbing a tree, $t(481) = 3.82$, $p < 0.001$, grouping together to appear larger, $t(482) = 2.40$, $p = 0.017$, playing dead, $t(486) = 4.49$, $p < 0.001$, and walking around the bear, $t(476) = 2.41$, $p = 0.017$, were generally seen as more appropriate than likely.

Table 2.2. *Mean difference between perceived appropriateness and likelihood of performing several potential actions after viewing one of nine setting treatments.*

	Boar	Sow and Cubs	Subadult	Boar	Sow and Cubs	Subadult	Boar	Sow and Cubs	Subadult	
Action	**MEADOW**			**STREAM**			**PLATFORM**			**MEAN (SD)**
	Mean Difference (SD)									
Approach the bear	-0.06 (1.4)	-0.07 (0.9)	-0.11 (1.3)	-0.04 (1.1)	-0.09 (1.5)	-0.16 (1.5)	0.03 (1.2)	-0.05 (1.5)	0.13 (1.6)	-0.05 (1.3)
Back away slowly	-0.02 (1.6)	0.39 (1.6)	0.19 (1.5)	0.24 (1.9)	0.61 (1.4)**	-0.35 (1.6)	0.54 (2.0)*	0.37 (1.4)*	-0.02 (2.4)	0.23 (1.7)**
Climb a tree	0.00 (1.3)	0.54 (1.4)**	0.44 (1.6)*	-0.06 (1.7)	0.32 (1.7)	0.25 (2.0)	0.39 (1.6)	0.33 (1.7)	0.33 (2.0)	0.29 (1.6)**
Kick or punch the bear	0.06 (1.4)	0.41 (1.8)	0.00 (1.7)	-0.19 (0.8)	-0.11 (1.2)	-0.15 (2.2)	0.14 (1.5)	0.27 (1.4)	-0.35 (1.5)	0.02 (1.5)
Group together	0.14 (1.8)	0.28 (1.4)	0.24 (1.6)	0.25 (1.1)	0.35 (1.5)	0.04 (1.6)	0.05 (1.5)	0.24 (1.5)	-0.07 (2.2)	0.17 (1.6)*
Play dead	0.33 (1.6)	0.30 (1.5)	0.33 (1.7)	0.40 (1.3)*	1.09 (2.0)**	0.21 (2.0)	0.29 (1.4)	0.26 (1.8)	-0.09 (2.1)	0.35 (1.7)**
Run away	-0.51 (1.6)*	-0.09 (1.4)	-0.15 (.7)	-0.09 (1.3)	-0.11 (1.5)	0.02 (2.1)	0.07 (1.4)	-0.17 (1.9)	-0.17 (1.8)	-0.13 (1.7)
Shout or make noise	0.00 (1.5)	-0.04 (1.6)	-0.05 (1.6)	0.02 (1.8)	0.55 (1.3)**	-0.15 (1.9)	-0.07 (1.4)	-0.10 (1.6)	0.02 (1.9)	0.02 (1.6)
Shoot the bear	-0.32 (1.7)	0.11 (1.3)	0.31 (1.2)*	0.04 (0.8)	-0.24 (1.0)	0.02 (1.7)	-0.02 (1.5)	-0.10 (1.3)	0.22 (1.9)	0.00 (1.4)
Spray with bear spray	-0.16 (1.8)	0.04 (1.3)	0.00 (1.1)	-0.13 (1.8)	-0.07 (1.2)	0.02 (1.6)	-0.07 (1.3)	-0.15 (1.5)	0.05 (1.9)	-0.05 (1.5)
Stand still and wait	0.27 (1.7)	0.39 (1.5)	0.03 (1.9)	0.38 (1.5)	-0.18 (1.3)	-0.12 (1.9)	-0.22 (1.6)	0.10 (1.5)	-0.02 (1.9)	0.06 (1.6)
Throw food into woods	-0.21 (1.6)	-0.04 (1.5)	-0.16 (1.8)	0.12 (1.4)	0.47 (1.5)*	-0.17 (1.9)	0.39 (1.6)	-0.38 (1.3)*	0.16 (1.9)	0.01 (1.6)
Throw things at the bear	-0.24 (1.6)	-0.11 (1.4)	-0.37 (1.3)*	-0.15 (1.0)	0.16 (1.3)	-0.11 (1.4)	-0.15 (1.1)	-0.13 (1.5)	0.36 (1.9)	-0.10 (1.4)
Try to hide	-0.15 (1.9)	0.31 (1.5)	0.33 (2.0)	0.17 (1.5)	0.26 (1.6)	-0.02 (1.6)	0.05 (1.4)	0.28 (1.3)	-0.11 (2.0)	0.13 (1.7)
Walk around the bear	0.02 (1.6)	0.15 (1.2)	-0.20 (1.9)	0.43 (1.4)*	0.59 (1.8)*	0.31 (1.8)	0.20 (1.8)	0.27 (1.5)	-0.11 (2.0)	0.18 (1.7)*

Note. Likelihood and appropriateness were each ranked on a seven-point scale with one representing "extremely unlikely" or "extremely inappropriate" and seven representing "extremely likely" or "extremely appropriate." Negative values represent actions that are more likely than appropriate.

For results of the paired samples *t*-tests: *$p < 0.05$, **$p < 0.01$

Research Question 2: Responses to bear behavior

Question 2a: Affective responses

Across all positive and negative affect items, intensity differed significantly, $F(2, 507) > 3.014$, $p < 0.05$, across behavior treatments. For three positive items, enthusiastic, $F(2, 507) = 12.61$, $p < 0.001$, excited, $F(2, 507) > 3.81$, $p < 0.02$, and interested, $F(2, 507) = 23.40$, $p < 0.001$, the intensity of affective responses decreased statistically with more aggressive behaviors. However, for the other two positive items, alert, $F(2, 507) = 11.56$, $p < 0.001$, and attentive, $F(2, 507) = 8.84$, $p < 0.001$, affective responses to the feeding video were statistically less intense compared to both the curious and aggressive videos. For all items within negative affect, intensity increased statistically with more aggressive behaviors (Distressed: $F(2, 507) = 71.72$, $p < 0.001$, Hostile: $F(2, 507) = 26.48$, $p < 0.001$, Jittery: $F(2, 507) = 55.58$, $p < 0.001$, Nervous: $F(2, 507) = 41.41$, $p < 0.001$, Scared: $F(2, 507) = 43.48$, $p < 0.001$). See Table 2.3.

Questions 2b and 2c: Likelihood and appropriateness of performing listed actions

The most likely actions among respondents were back away slowly (*EMM* = 5.40, *SE* = 0.1), group together (*EMM* = 4.27, 0.1), stand still and wait for the bear to leave (*EMM* = 4.65, *SE* = 0.1), and walk around the bear (*EMM* = 4.41, *SE* = 0.1). The actions viewed as most appropriate were largely the same, including back away slowly (*EMM* = 5.39, *SE* = 0.1), group together (*EMM* = 4.46, *SE* = 0.1), stand still and wait for the bear to leave (*EMM* = 4.74, *SE* = 0.1), try to hide (*EMM* = 4.07, *SE* = 0.1), and walk around the bear (*EMM* = 4.64, *SE* = 0.1).

Table 2.3. *Estimated marginal mean for intensity of affective responses to the three behavior treatments.*

	Feeding	Curious	Aggressive	$F(2, 507)$	r
	Estimated Marginal Mean (SE)				
Positive Affect					
Alert	3.90 (0.1)[1]	4.30 (0.1)[2]	4.38 (0.1)[2]	11.56**	0.47**
Attentive	3.92 (0.1)[1]	4.19 (0.1)[2]	4.36 (0.1)[2]	8.84**	0.51**
Enthusiastic	3.13 (0.1)[2]	2.74 (0.1)[1]	2.53 (0.1)[1]	12.61**	0.47**
Excited	3.36 (0.1)[2]	3.07 (0.1)	3.04 (0.1)[1]	3.81*	0.46**
Interested	3.71 (0.1)[2]	3.44 (0.1)[2]	2.86 (0.1)[1]	23.40**	0.42**
Total PA	10.20 (0.2)[3]	9.23 (0.2)[2]	8.45 (0.2)[1]	16.83**	0.55**
Negative Affect					
Distressed	2.22 (0.1)[1]	3.09 (0.1)[2]	3.67 (0.1)[3]	71.72**	0.42**
Hostile	1.81 (0.1)[1]	2.13 (0.1)[2]	2.62 (0.1)[3]	26.48**	0.60**
Jittery	2.38 (0.1)[1]	3.27 (0.1)[2]	3.66 (0.1)[3]	55.58**	0.36**
Nervous	2.72 (0.1)[1]	3.51 (0.1)[2]	3.86 (0.1)[3]	41.41**	0.36**
Scared	2.71 (0.1)[1]	3.48 (0.1)[2]	3.91 (0.1)[3]	43.50**	0.40**
Total NA	11.85 (0.3)[1]	15.47 (0.4)[2]	17.71 (0.3)[3]	75.45**	0.48**

Note. Intensity was ranked by respondents on a five-point scale with one representing "very slightly or not at all" and five representing "extremely." Superscripts represent significant differences across rows at the $p < 0.05$ level. The two-tailed Pearson correlation coefficient, r, represents the strength of the correlation between intensity of response for the behavior and setting videos. Total PA does not include alert or attentive.

*$p < 0.05$ **$p < 0.01$

Question 2d: Discrepancies between likelihood and perceived appropriateness

Of the 45 combinations of behavior video and potential actions provided, seven showed statistical differences between likelihood and perceived appropriateness (see Table 2.4). Across all behavior treatments, climbing a tree, $t(484) = 3.01$, $p = 0.003$, grouping together to appear larger, $t(477) = 2.47$ $p = 0.014$, playing dead, $t(482) = 3.86$, $p < 0.001$, trying to hide, $t(481) = 2.59$, $p = 0.010$, and walking around the bear, $t(477) = 3.77$, $p < 0.001$, were generally seen as more appropriate than likely.

Table 2.4. *Mean difference between appropriateness and likelihood of performing several potential actions after viewing one of three behavior treatments.*

Action	Feeding	Curious	Aggressive	Mean (SD)	r
	Mean Difference (SD)				
Approach the bear	-0.01 (1.1)	0.02 (1.0)	0.04 (1.3)	0.02 (1.1)	0.15**
Back away slowly	0.05 (1.7)	-0.06 (1.4)	-0.05 (1.8)	-0.02 (1.7)	0.27**
Climb a tree	0.18 (1.8)	0.22 (1.3)*	0.26 (1.6)*	0.22 (1.6)**	0.22**
Kick or punch the bear	0.02 (1.3)	0.02 (1.1)	-0.16 (1.5)	-0.04 (1.3)	0.18**
Group together	0.14 (1.5)	0.19 (1.5)	0.20 (1.7)	0.18 (1.6)*	0.25**
Play dead	0.32 (1.5)**	0.38 (1.5)**	0.08 (1.4)	0.26 (1.5)**	0.18**
Run away	0.14 (1.7)	-0.03 (1.2)	-0.15 (1.7)	-0.01 (1.5)	0.17**
Shout or make noise	-0.05 (1.5)	0.06 (1.3)	0.18 (1.8)	0.06 (1.6)	0.10*
Shoot the bear	-0.01 (1.3)	-0.07 (1.3)	0.16 (1.5)	0.03 (1.4)	0.24**
Spray with bear spray	-0.06 (1.2)	-0.04 (1.3)	0.02 (1.6)	-0.02 (1.4)	0.16**
Stand still and wait	0.12 (1.7)	0.07 (1.4)	0.15 (1.6)	0.12 (1.6)	0.22**
Throw food into woods	0.17 (1.5)	0.08 (1.6)	0.10 (1.9)	0.12 (1.7)	0.16**
Throw things at the bear	0.00 (1.3)	0.19 (1.2)	-0.13 (1.3)	0.02 (1.3)	0.20**
Try to hide	0.14 (1.8)	0.29 (1.3)**	0.14 (1.5)	0.19 (1.6)**	0.17**
Walk around the bear	0.14 (1.6)	0.27 (1.4)*	0.45 (1.9)**	0.29 (1.7)**	0.25**

Note. Likelihood and appropriateness were each ranked on a seven-point scale with one representing "extremely unlikely" or "extremely inappropriate" and seven representing "extremely likely" or "extremely appropriate." A negative value represents an action more likely than appropriate. Superscripts represent significant differences across rows at the $p < 0.05$ level. The two-tailed Pearson correlation coefficient, r, represents the strength of the correlation between intensity of response for the behavior and setting videos.

For results of the paired samples *t*-tests: *$p < 0.05$, **$p < 0.01$

Research Question 3: Factors in decision-making

Bear safety education

For the impact of bear safety knowledge on a respondent's in-the-moment decision, seven independent variables were statistically significant, $F(19, 1002) = 12.75$, $p < 0.001$, adjusted $R^2 = 0.179$ (see Table 2.5). These were previous bear safety instruction, general feelings towards bears, respondent age, and the affective items of alert, attentive, interested, and hostile. The adjusted R^2 value of 0.179 suggests the model explains approximately 18% of the variation in the anticipated impact of previous bear safety education on an in-the-moment decision. The impact of bear safety education was

greater among respondents who had participated in a bear safety training, $F(2, 1002) = 7.96$, B = 1.17, $SE = 0.42$, $p < 0.001$. Additionally, increased positive feelings towards bears, $F(1, 1002) = 23.79$, B = 0.231, $SE = 0.05$, $p < 0.001$, respondent age, $F(1, 1002) = 19.26$, B = 0.02, $SE = 0.01$, $p < 0.001$, alertness, $F(1, 1002) = 13.86$, B = 0.333, $SE = 0.09$, $p < 0.001$, attentiveness, $F(1, 1002) = 10.66$, B = 0.311, $SE = 0.05$, $p = 0.001$, and interest, $F(1, 1002) = 12.17$, B = 0.219, $SE = 0.06$, $p = 0.001$, all resulted in an increased impact of bear safety education on decision-making. However, increased feelings of hostility decreased the impact of safety education, $F(1, 1002) = 9.74$, B = -0.189, $SE = 0.06$, $p = 0.002$.

Table 2.5. *Univariate general linear model for the impact of previous bear safety education on an individual's in-the-moment decision for both video treatments.*

Action	df	F	B (SE)	Adjusted R^2
Corrected model	19	12.8**		0.18
Intercept	1	46.5**	3.47 (0.6)	
Video treatment	11	1.0		
Taught bear safety-Yes	2	8.0*	1.17 (0.4)	
Feelings towards bears	1	23.8**	0.23 (0.0)	
Age	1	19.3**	0.02 (0.0)	
Alert	1	13.9**	0.33 (0.1)	
Attentive	1	10.7**	0.31 (0.1)	
Interested	1	12.2**	0.22 (0.1)	
Hostile	1	9.7**	-0.19 (0.1)	

Note. *$p < 0.05$ **$p < 0.01$

Current emotion

For the impact of emotion on a respondent's in-the-moment decision, four independent variables were significant, $F(15, 1002) = 6.34$, $p < 0.001$, adjusted $R^2 = 0.086$ (see Table 2.6). These were the affective items of attentive, interested, hostile, and scared. The adjusted R^2 value of 0.07 suggests the model explains approximately 7% of the variation in the anticipated impact of current emotion on an in-the-moment decision and as a result, does little to predict this impact. However, for all four significant independent variables, an increase in the intensity of the affective response resulted in an increased impact of emotion on decision-making (Attentive: $F(1, 1002) = 8.99$, B = 0.023, $SE = 0.08$, $p = 0.003$, Interested: $F(1, 1002) = 7.25$, B = 0.184, $SE = 0.07$, $p = 0.007$, Hostile: $F(1, 1002) = 16.35$, B = 0.288, $SE = 0.07$, $p < 0.001$, Scared: $F(1, 1002) = 13.34$, B = 0.262, $SE = 0.07$, $p < 0.001$).

Table 2.6. *Univariate general linear model for the impact of current emotion on an individual's in-the-moment decision for both video treatments.*

Action	df	F	B (SE)	Adjusted R^2
Corrected model	15	6.3**		0.07
Intercept	1	82.7**	2.89 (0.4)	
Video treatment	11	0.8		
Attentive	1	9.0**	0.23 (0.1)	
Interested	1	7.2**	0.18 (0.1)	
Hostile	1	16.3**	0.29 (0.1)	
Scared	1	13.3**	0.26 (0.1)	

Note. *$p < 0.05$ **$p < 0.01$

Previous experience

Lastly, for the impact of previous experience on a respondent's in-the-moment decision, six independent variables were significant, $F(17, 1002) = 8.00$, $p < 0.001$, adjusted $R^2 = 0.104$ (see Table 2.7). These were having seen a bear, general feelings towards bears, self-reported grade in bear safety, and the affective items of attentive, enthusiastic, and scared. The adjusted R^2 value of 0.104 suggests the model explains approximately 10% of the variation in the anticipated impact of previous experience on an in-the-moment decision. Respondents who had not previously seen a bear of any species reported a lower impact of previous experience, $F(1, 1002) = 12.11$, B = -0.659, $SE = 0.20$, $p = 0.001$. More positive feelings towards bears, $F(1, 1002) = 9.74$, B = 0.223, $SE = 0.06$, $p = 0.001$, higher bear safety grades, $F(1, 1002) = 8.66$, B = 0.086, $SE = 0.03$, $p = 0.003$, and increasing levels of attentiveness, $F(1, 1002) = 10.56$, B = 0.284, $SE = 0.09$, $p = 0.001$, enthusiasm, $F(1, 1002) = 8.06$, B = 0.222, $SE = 0.08$, $p = 0.005$, and fear, $F(1, 1002) = 21.03$, B = 0.351, $SE = 0.08$, $p < 0.001$ all resulted in an increased impact of previous experience on decision-making.

Table 2.7. *Univariate general linear model for the impact of previous experiences on an individual's in-the-moment decision for both video treatments.*

Action	df	F	B (SE)	Adjusted R^2
Corrected model	17	8.0**		0.10
Intercept	1	5.3*	0.43 (0.6)	
Video treatment	11	1.7		
Ever seen a bear-No	1	10.4**	-0.66 (0.2)	
Feelings towards bears	1	12.1**	0.22 (0.1)	
Reported bear safety grade	1	8.7**	0.09 (0.0)	
Attentive	1	10.6**	0.28 (0.1)	
Enthusiastic	1	8.1**	0.22 (0.1)	
Scared	1	21.0**	0.35 (0.1)	

Note. *$p < 0.05$ **$p < 0.01$

Strategies to encourage safe behavior

Additionally, I asked respondents to rank the importance of three strategies to encourage safe behavior. Using the approaches to overcoming affective shortcuts detailed by Wilson (2008), I included 1) being told why instructions or policies are what they are, 2) relating with the goals of park managers, and 3) using your own personal values to justify safe behavior. Of 508 complete responses, 66.3% selected strategy one as the most important, 53.0% selected strategy two as the second most important, and 61.8% selected strategy three as the least important.

Discussion

I used a quantitative, exploratory sequential design, to understand both the immediate emotional reactions upon viewing bears in different scenarios and the role of emotional reactions in individuals' ability to behave appropriately. Survey results suggest respondents are generally aware of appropriate behavior around brown bears, but affective responses may hamper their ability to behave accordingly.

Encouraging appropriate behavior

With increasing interest in outdoor recreation, rising visitation levels to parks and protected areas, and expanding brown bear populations, the frequency of human-bear interactions may likely continue to increase. Unfortunately, many individuals will not know how to behave and could cause injury to themselves or a bear. It is the responsibility of park managers and staff to encourage appropriate behavior among park visitors. Individuals must not only be familiar with bear safety, but comfortable enough to

act appropriately when forced to make in-the-moment decisions in the presence of large, novel, and potentially dangerous wildlife.

As suggested by the linear model analysis, different encounter scenarios may result in different behavioral strategies. Scenarios that result in feelings of attentiveness, hostility, and fear may decrease the impact of safety education on behavioral choices while increasing the impact of previous experiences and current emotion. However, among setting treatments, a subadult in a meadow produced the highest level of attentiveness and levels of hostility and fear were both highest in response to a sow and cubs in a meadow. While these affective responses are highly appropriate for the given scenario, they unfortunately increase the impact of current emotion on decision making and could encourage inappropriate behavior.

Similarly, among behavior treatments, the level of attentiveness was higher for curious and aggressive behaviors than feeding behavior and levels of hostility and fear both increased as the behavior treatment increased in aggressiveness. So, as the scenarios become more dangerous and require careful decisions, the more impact emotion has on behavior. In order to continue improving the current effectiveness of bear safety and education efforts, the impact of affective responses must be overcome. Respondents' ranking of potential education strategies stress the potential benefits of explaining to park visitors why instructions and policies were put in place and how they work.

Affective responses

Encouragingly, respondents viewing a sow and cubs in a meadow reported the highest levels of negative affect, followed by a subadult in a stream. These two

treatments represent the setting with the highest potential for danger and the setting with the most erratic behavior (Herrero 1976, 2018). Interestingly, those viewing a sow and cubs from a platform reported the lowest levels of negative affect. This suggests that despite high levels of positive affect, respondents recognized the potential for danger when viewing a sow and cubs while exposed in a meadow. When viewing from a platform, a significant portion of this concern was presumably alleviated, and respondents reported a largely positive experience.

Further, while total levels of negative affect were slightly higher in a stream or meadow than from a platform, total levels of positive affect were slightly lower in a stream than a meadow or from a platform. This lower level of positive affect may have been a result of the focal bears being partially obscured by water, the orientation or movement of bears displayed in the videos, or unfamiliarity among respondents with bears in a stream setting.

As expected, respondents who viewed increasingly aggressive behaviors, reported lower levels of positive affect and higher levels of negative affect. This trend suggests respondents were largely able to correctly identify the behaviors presented. The fact that alertness and attentiveness were higher following aggressive behavior than curious or feeding behavior highlights a limitation of the PANAS scale. While these items are technically listed among positive affect, they may have been operationalized among respondents as more neutral, or even negative. For example, being alert and attentive is an expected human response to aggressive behaviors from bears and could be perceived

negatively. As a result, analysis of the PANAS scale has been primarily conducted at the item level, rather than the factor level.

It is important to note as well, that the total negative affect score for even the feeding behavior was higher than all but one among setting treatments. This could have been a result of seasonal differences between video series or other nuisance variables but could also have been in response to subtle defensive behaviors illustrated by the focal bear, such as burying or guarding the food source.

Behavioral responses

Objective appropriateness

Objective appropriateness for the 15 listed actions were determined using recommendations outlined by Herrero (2018) and Masterson (2016) and incorporated into Table 2.8. Those listed as "Inappropriate" are not recommended in any scenario because they could result in personal injury, could teach the bear bad habits, or would simply not be effective. Those listed as "Appropriate" are recommended across all scenarios. The appropriateness of those listed as "Depends" can depend on several factors, but mainly the bear's behavior and the species of bear.

Kicking or punching the bear is only appropriate when encountering a predatory black bear. If the black bear is attacking, the most appropriate response is to fight back. Playing dead is largely recommended as an appropriate behavior but only when encountering an aggressive brown bear. When being attacked by a black bear or encountering a curious brown bear, playing dead could be highly ineffective or could cause the bear to investigate further. Shouting or making noise is an appropriate and

effective method to avoid surprising a brown or black bear and is the best choice when encountering a black bear. However, when approached or attacked by a brown bear, loud noises could anger or threaten the bear. It is important to talk calmly to a curious or aggressive brown bear and remain silent if it begins to attack. Bear spray is generally recommended when encountering an aggressive animal of any species but must be used correctly. If deployed too early or aimed too high, the spray will dissipate before it hits the bear. It is important to remain calm, wait for the bear to come within thirty feet, and then deploy the spray in short bursts at a 45-degree angle towards the ground.

Standing still and waiting for the bear to move is an acceptable behavior when viewing the bear from a safe distance and in a non-threatening manner. Give the bear plenty of space and time to move out of the way prior to approaching. However, if the bear remains there, it could be guarding a food source or cubs and the best option would be to turn around find a new route. Throwing things at the bear is largely inappropriate, especially for a brown bear, but may occasionally be necessary when hazing a curious black bear. The best method is to remove any potential bear attractants prior to this point, but if a black bear does become overly curious or aggressive, this could discourage the bear from unwanted behaviors. Lastly, walking around the bear is generally an appropriate behavior but it is important to keep an eye on the bear and its behavior. This should only be done if there is plenty of room and visibility to avoid surprising or threatening the bear and getting lost.

Table 2.8. *Perceived and objective appropriateness of listed actions.*

Listed Action	Perceived Appropriateness *Mean (SD)*	Objective Appropriateness
Approach the bear	1.75 (1.6)	Inappropriate
Back away slowly	5.57 (1.6)	Appropriate
Climb a tree	2.99 (1.9)	Inappropriate
Kick or punch the bear	2.36 (1.9)	Depends
Group together	4.33 (2.0)	Appropriate
Play dead	3.89 (2.0)	Depends
Run away	2.87 (2.1)	Inappropriate
Shout or make noise	3.31 (2.2)	Depends
Shoot the bear	2.52 (2.1)	Inappropriate
Spray with bear spray	2.86 (2.1)	Depends
Stand still and wait	4.77 (1.8)	Depends
Throw food into the woods	3.27 (2.0)	Inappropriate
Throw things at the bear	2.18 (1.8)	Depends
Try to hide	4.09 (2.0)	Inappropriate
Walk around the bear	4.64 (2.1)	Depends

Note. Perceived appropriateness is based on average rating across all setting treatments. Ratings were on a 7-point Likert scale (1 = extremely inappropriate, 4 = neither appropriate nor inappropriate, 7 = extremely appropriate). Objective appropriateness was determined based on recommendations outlined by Herrero (2018) and Masterson (2016).

Likelihood and perceived appropriateness

The most directly applicable results of this study came from the difference between likelihood and perceived appropriateness of potential actions. In cases where likelihood exceeded appropriateness, individuals may have known the intended behavior could have resulted in injury, but were unable to overcome their emotional and affective responses to the bear encounter. Such scenarios included running away from a boar in a meadow, throwing things at a subadult in a meadow, and throwing food into the woods to lure a sow and cubs away from a platform. These three behaviors then, are areas of concern within bear safety and management. Public perception regarding these behaviors may prove difficult to overcome. In order to do so, efforts must be made to encourage

further internalization of not only the danger associated with these behaviors, but how to behave appropriately in such scenarios as well. All park visitors and area residents must fully understand the benefits of appropriate actions and the consequences of inappropriate actions.

When likelihood exceeded appropriateness, individuals were likely aware that their actions may not have been appropriate. However, when the opposite was true, individuals believed the behavior to be appropriate but were unable to act accordingly. In such cases, individuals may understand the importance of behaving in such a manner, but current emotional and affective state encourage behaving otherwise. Some of these behaviors were shooting a subadult in a meadow, backing away slowly or playing dead to avoid a sow and cubs in a stream, and backing away slowly when viewing a boar from a platform. Further, all seven significant differences among behavior treatments fall into this category as well. These include playing dead to avoid a feeding bear, climbing a tree, playing dead, waiting for the bear to leave, or walking around the bear to avoid a curious bear, and climbing a tree or walking around the bear to avoid an aggressive bear.

Similar to inappropriate behaviors in the former category, behaviors in this latter category that were appropriate, such as backing away slowly or walking around a sow and cubs in a stream, require management and safety instruction to emphasize the benefits to such behavior and the reasoning behind its effectiveness. Experiential training through photographs, videos, or virtual reality could help park visitors and area residents to imagine such scenarios and practice behaving appropriately, weakening these affective shortcuts. If needed, examples of worst-case scenarios may provide a significant

reminder of potential consequences. Most likely due to the novelty of the experience, viewing a sow and cubs in a stream resulted in the most behaviors in this category and as a result, requires additional attention.

An additional area of concern is the fact that several actions in this latter category could be inappropriate or dangerous (Herrero 2018). Climbing a tree, responding aggressively (i.e., shooting the bear or throwing things at the bear), throwing food to lure the bear away, and running away are all seen among the general American public as appropriate but are rarely so, and could result in injury or death to either party. According to survey results, these actions were more appropriate than likely, making them not yet problematic, as respondents were generally less likely to behave in such a way. In order to prevent these actions from becoming a problem, managers and staff must continue to reinforce the inappropriateness of these actions, explaining the specific factors leading to their inefficacy.

Management implications

From these results and further suggestions provided by respondents, I developed 8 recommendations to improve the overall effectiveness of safety training and education efforts regarding brown bears.

1. All bear safety education should warn of potential affective responses such as fear, hostility, and attentiveness that may occur during an encounter and remind users to remain calm.

2. Education efforts should continue to address the appropriateness of uncertain or popular behaviors, including climbing a tree, running away, trying to hide, grouping together, and walking around the bear.
3. Regions with established brown bear populations, as well as those on the edge of dispersing populations, should release bear safety public service announcements across several forms of media to reach the widest audience possible.
4. Place educational materials (e.g., signs, pamphlets, interactive displays, etc.) at various locations outside of park visitor's centers.
5. Use photographs, videos, and virtual reality experiences to incorporate various scenarios and bear behaviors in preparing users for potential bear encounters
6. Provide logic and reasoning behind policies, regulations, and behavioral instructions, including potential negative results.
7. Pay special attention to overly confident individuals, those with more experience, and those more likely to respond aggressively, particularly younger males.
8. If necessary and feasible, mandatory bear safety training prior to park admission may be an effective solution. If not, consider implementing a mandatory bear safety lesson or video prior to purchasing park passes online.

Limitations

Threats to internal validity

While the PANAS scale has been well tested and items were chosen to best reflect the viewing experience, its use and abbreviation only approximates the range of potential affective responses. A representative sample was collected with adequate sample size, but Qualtrics users and those willing to take the survey may not be entirely representative of the general American public, or those visiting national parks or other protected areas where bear viewing may occur. Although statistically accounted for by appropriate analysis, the repeated use of scales within the survey may have resulted in a testing effect, or dependency between measures.

Threats to external validity

For feasibility, survey respondents were provided with videos representing each scenario as opposed to firsthand experience. As a result, affective responses may have been limited or dulled. The online survey format also allowed respondents to pause and reflect prior to answering and potentially select answers believed to be correct rather than true. Lastly, despite significant effort to minimize nuisance variables among videos, some were unavoidable and may have unintentionally altered affective responses.

Future research

Research on emotional reactions to viewing wildlife, especially carnivores, has been limited in scope. Many previous studies have addressed feelings towards carnivores (e.g., Farber & Hall, 2007; Jacobs, Fehres, & Campbell, 2012; Jacobs, Vaske, & Roemer, 2012; Raadik & Cottrell, 2007) or opinions regarding potential management action (e.g.,

Gilkman, Vaske, Bath, Ciucci, & Boitani, 2012; Hayman, Harvey, Mazzotti, Israel, & Woodward, 2014; Johansson, Sjostrom, Karlsson, & Brannlund, 2012; McFarlane, Stumpf-Allen, & Watson, 2007), but the focus on how these reactions impact behavior is currently understudied. This study begins to address the current knowledge gap, but more importantly, provides a foundation for continued exploration. Future research could use participant observations and onsite qualitative interviews to further understand complex emotional responses beyond what quantitative questionnaires allow. It is also important to test the applicability of virtual reality technology in representing onsite encounters. While still more contrived than firsthand experience, this developing technology could allow park managers and bear safety administrators to accurately represent different scenarios and encourage appropriate behavior despite affective responses. Further research in virtual reality could also be used to advance visual methods within park and visitor management research.

An additional area of interest is the applicability of this research to other settings or wildlife species. Videos and questions included in this survey were targeted at brown bears, but behavioral similarities and misidentification suggest results may be highly transferable to black bears. Future research efforts should assess this degree of transferability to not only black bears, but entirely different contexts as well, such as African safaris, tiger viewing in India, underwater at coral reefs, or even deer hunting. Although it would need to be tested, I anticipate similar results across contexts. Potential hypotheses and predictions to test include:

H_1: Overall levels of positive and negative affect differ across contexts

P_1: More unique or rarer scenarios result in higher levels of overall positive affect

P_2: More dangerous scenarios result in higher levels of overall negative affect

H_2: Levels of positive and negative affect respond differently across scenarios

P_1: All scenarios produce a similar level of positive affect

P_2: More dangerous scenarios produce higher levels of negative affect

Conclusion

Not only do affective responses differ across various bear encounter scenarios, these affective responses can potentially discourage appropriate behavior while encouraging inappropriate behavior. Scenarios that produce intense affective responses are often the most dangerous, but significantly increase the impact of emotion on decision-making. Managers of relevant parks and protected areas must continue to educate visitors on safe behavior around bears while further detailing the reasoning and logic behind policies and encouraged behaviors. While rarely feasible, the ideal solution would be to conduct mandatory training sessions at all relevant parks and protected areas prior to admission, including further emphasis on appropriate behavior. Survey respondents also suggested public service announcements, further online training or information regarding safe behavior, video and virtual reality practice encounters, education on understanding bear behavior, and cautionary tales, as potential methods to encourage appropriate behavior; all of which could provide feasible and effective improvements to bear safety education.

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CHAPTER THREE

A NATIONAL ASSESSMENT OF KNOWLEDGE REGARDING BEAR SAFETY AND APPROPRIATE BEHAVIOR

Introduction

At the end of the year 2019, nearly 7.8 billion humans inhabited the earth (UN 2020). This number is expected to approach 10 billion within the next 30 years as population growth begins to slow (Cohen 2003). Protected areas across the globe attract human settlement and economic development to rural areas (Wittemyer et al. 2008). Increasing human presence and development along with increasing appreciation for nature-based recreation among Americans (Cordell, Betz, and Green 2008, Cordell and Tarrant 2002) poses a significant threat to the wild lands originally intended for preservation. Outdoor recreation and higher levels of human use can result in stress, fleeing, and population decline for many wildlife species, including brown bears (Nevin and Gilbert 2005), desert bighorn sheep (Papouchis, Singer, and Sloan 2001) and North American wood turtles (Garber and Burger 1995). However, the impact of these changes depends on more than just the amount of use. Human behavior largely decides humans' ability to coexist with the environment and cope with new ecological challenges that arise (Goujon 2018).

Despite continued human population growth, populations of grizzly bears (*Ursus arctos*) have begun to recover throughout both the Northern Continental Divide Ecosystem (NCDE) and the Greater Yellowstone Ecosystem (GYE) (Bjornlie et al. 2014, Costello et al. 2016, Eberhardt and Breiwick 2010, Haroldson et al. 2016, Keating 1986,

Kendal et al. 2009, Mace et al. 2012, Schwartz et al. 2006). However, many still worry of the limited genetic and landscape connectivity between these populations, restricting their long term success and resilience (Haroldson et al. 2010, Peck et al. 2017, Proctor et al. 2015, Schwartz, Haroldson, and White 2010, Shafer 2015,). The significant, negative impacts of human-dominated landscapes, such as habitat fragmentation and incidental take, on population recovery and expansion have been well documented (e.g., Proctor et al. 2015, Pyare et al. 2004, Schwartz, Haroldson, and White 2010, Shafer 2015). In order for continued recovery, these threats must be addressed.

With expanding populations of both humans and brown bears, interactions between species are bound to occur. These interactions, however, often result in trapping, relocating, or euthanizing the bear (Wilson, Neudecker, and Jonkel 2014). Unfortunately, while many of these incidents are easily preventable through proper human behavior, even one mistake could produce multiple generations of problem bears (Aumiller and Matt 1994, Masterson 2016, Morehouse et al. 2016). Not only are residents within brown bear habitat responsible for behaving properly, but large numbers of tourists and park visitors must as well. To address this area of concern, I conducted an online self-assessment survey to test the bear safety knowledge of the general American public when presented with several brown bear encounter scenarios. Specific research questions included:

1) What locations have resulted in the most brown bear sightings among respondents?
2) How accurate are respondents at identifying brown bears?

3) How do respondents view their level of bear safety knowledge?
4) What factors contribute to a respondent's perceived appropriateness of potential actions?

Study population

I distributed an online survey to a sample of the general American public through a cross-sectional representative sample study purchased from online survey platform, Qualtrics. Unless bear safety training is mandatory and standardized, many visitors and residents may encounter a brown bear without having knowledge of proper behavior. I chose the general American public as the study population to best understand how such individuals will behave in bear encounter scenarios, with or without previous training. Purchasing a cross-sectional representative sample allowed for efficient data collection given the broad sampling population. Qualtrics sampling procedures used six demographic questions and standard U.S. Census Bureau categories as qualifiers to ensure a representative sample. These included age, education level, gender, income, race, and zip code of primary residence.

Methods

Study design

I developed an online self-assessment survey of bear safety knowledge among the general American public. This study employed two independent samples designs: a 3x3 design as well as an additional 3x1 design. The first design (3x3), setting treatment, compared perceived appropriateness of potential actions across three different settings and three different sex or age classes. Settings included a salmon stream, a meadow, and

a viewing platform while age and sex classes included a solitary boar, a sow with cubs, and a subadult. While brown bear encounters can occur in other settings, the three included here represent the most common viewing scenarios across the United States and two distinctly different feeding behaviors (i.e., fishing and grazing). Study design 2 (3x1), behavior treatment, acted as a qualifier, testing perceived appropriateness of potential actions across bear behavior, holding the setting and sex or age class constant. The three studied behaviors were feeding, curious, and aggressive, but respondents were not provided with an interpretation or description. Behavior was held constant across the entire 3x3 design but was tested here to alleviate the threat to external validity resulting from the lack of independence between bear behavior and an individual's response. This second design also served as an additional test of current education efforts and an individual's ability to behave appropriately in such situations.

Treatment videos

To best simulate the nine setting treatments, I captured high quality video clips at Katmai and Lake Clark National Parks that effectively demonstrated the intended scenario while minimizing any nuisance variables due to unintended differences across videos, such as lighting, weather, microhabitat, size and positioning of the bear, and video quality. These locations support abundant brown bear populations while providing high quality viewing experiences in all three of the intended settings. For the three behavior treatments, I elicited videos from online bear-viewing communities, online video sharing sites, and public access documentaries. Videos were selected that displayed only the focal bear and clearly illustrated intended behavior, while minimizing

differences due to microhabitat, lighting, weather, age or sex of the bear, and video quality. All final videos are available online (http://tinyurl.com/Affect-Videos).

Researchers in visitor use management often use visual methods, in the form of computer-altered photographs, to help identify outdoor recreationists' ideal conditions (Laven and Krymkowski 2005, Manning, Valliere, and Wang 1999). Photographs depicting varying levels of resource or experiential impact can be used as suggestive surrogates for true conditions (Newman, Marion, and Cahill 2001) and are much more effective than traditional narrative descriptions (Manning and Freimund 2004). While less studied, videos have also been used successfully to determine park visitors' preferred conditions (Bateson and Hui 1992, Freimund et al. 2002).

This study would have ideally been conducted in person, but field research would not have allowed the questions to be addressed. Not only would this method be time consuming and expensive, it would be difficult to maintain consistency across scenarios and ensure all types of encounters were represented. As a result, videos were used to best depict first-hand experience of bear behavior and viewing locations, allowing me to design the experiment appropriately while keeping both bears and humans safe and avoiding distractions during onsite experiences. Further research could test the potential of virtual reality in more accurately depicting encounter scenarios or could use an in person qualitative approach to assess emotional reactions on a deeper level immediately following an encounter. This research could occur at several different parks and protected areas to assess reactions to various types of bear viewing scenarios using participant observation.

Quantitative questionnaire

I developed the questionnaire through an online survey platform, Qualtrics, using best practices for online survey construction as described by Dillman (2011) and Vaske (2008). Questionnaires showed each respondent a randomly selected video from each treatment group (i.e., setting and behavior). For each video, respondents were asked to rate the appropriateness of fifteen potential actions on a seven-point Likert scale (1 = extremely inappropriate, 7 = extremely likely or appropriate). For this question, respondents were given the additional option to select "I don't know" for each action. These potential actions were chosen based on historical accounts of reactions discussed by Gunther and Hoekstra (1998) and Herrero (2018) and personal accounts from working in bear safety education. The final list was chosen to provide a range of appropriateness and was listed in alphabetical order.

Prior to each video, I included a photograph of the viewing scenario and explicit instructions to encourage respondents to immerse themselves in the video and respond based only on immediate reactions to each video. Figure 3.1 displays the photographs for each setting category (i.e., meadow, stream, and platform). This figure also includes the generic bear viewing photo displayed prior to all three behavior treatments used to further illustrate the viewing scenario.

Bear identification

At the beginning of the survey, I provided brief descriptions about the differences between brown and black (*Ursus americanus*) bears and the relationship between brown and grizzly bears. This was followed by a range map for the three North American bear

species. Respondents were then asked to select the brown bears out of six bear pictures. Two were black bears, two were brown bears, one was a polar bear (*Ursus maritimus*), and one was a giant panda (*Ailuropoda melanoleuca*).

Figure 3.1. Images shown to respondents prior to viewing the respective setting and behavior treatment videos.

Self-reported knowledge of bear safety.

Regardless of a respondent's previous experience with any bear species or bear safety education, I asked them to grade themselves on their ability to behave safely around bears using a thirteen-point scale with standard letter grades from A+ to F.

Respondents with bear safety experience were also asked the source of their bear safety information (e.g., commercial guide, taught themselves, park or destination staff, etc.)

Analysis

All statistical analyses were conducted using IBM's Statistics Package for the Social Sciences (SPSS) version 24.0 (2018). I used descriptive statistics, measures of central tendency, general linear models, and when necessary, Bonferroni post-hoc tests to analyze results.

To understand the factors that determine the appropriateness of behaviors I ran a univariate general linear model for each potential action with six categorical and four continuous explanatory variables. These ten variables were determined prior to analysis and were included in all models. In all cases, the model was statistically significant ($p < 0.01$) but explained relatively little of the variation in the data. These models were included to highlight potential sources of variation between individuals but are not to be used to make predictions.

Results

I received a total of 511 complete responses with approximately 57 responses ($SD = 4.39$) for each of nine setting treatments and 170 responses ($SD = 7.76$) for each of three behavior treatments. For all sample-wide analyses, this produced an overall confidence interval of 4.34% at the 95% confidence level, suggesting a high-quality sample. To confirm that the sample produced enough statistical power to detect differences in means, I calculated the minimum sample size per cell needed to maintain a power of 0.8. Since statistical power decreases with further segmentation, I determined

the minimum sample size required for each of 12 cells across both study designs (i.e., setting and behavior treatments) If the true effect size was 0.2, each cell would require a sample size of 36 to produce a power of 0.8 at a significance level of 0.05. If the true effect size was 0.15, each cell would require a sample size of 63. Based on the average observed sample size per cell (n = 57), an effect size of 0.15, and a significance level of 0.05, the resulting statistical power was 0.66. As a result, I am confident in the sample's ability to detect even minor differences in means.

The sample accurately represented the general American public, as estimated by the U.S. Census Bureau (USCB, 2020), with 66.5% identifying as white, 16.6% as Hispanic or Latino/Latina, 18.4% earning less the $24,999 per year, 17.8% earning between $50,000 and $74,999, 14.9% earning between $25,000 and $49,999, 24.1% reporting high school graduate as their highest level of education, 24.1% reporting a four-year college degree as their highest level of education, and 45% identifying as female.

Experience viewing brown bears

Of all questionnaire respondents, 55% had never seen a wild brown bear, while 11.2% had seen a wild bear but were unsure of the species (Figure 3.2). When asked to select the region within the lower 48 states in which they had seen a brown (grizzly) bear, many individuals either selected viable regions with no confirmed population (i.e., North Cascades and Bitterroot Regions) or chose to write in additional areas such as Colorado, California, or Tennessee (Table 3.1) that currently have no potential for brown bear sightings.

Figure 3.2. Responses to questions regarding an individual's past experience viewing brown bears.

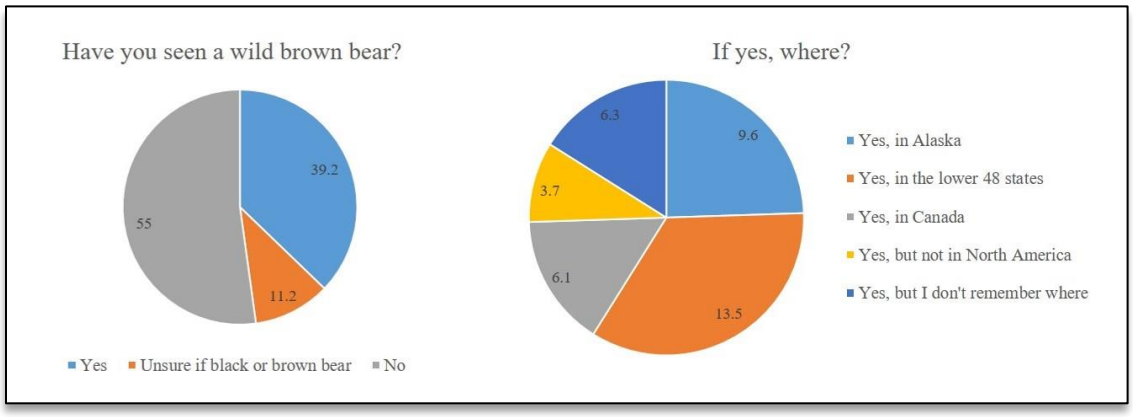

Table 3.1. *Locations in which respondents report viewing a wild brown (grizzly) bear within the lower 48 states.*

Location	Frequency	Percent
Greater Yellowstone Region	28	40.6
North Cascades Region[a]	19	27.5
Northern Continental Divide Region	17	24.6
Bitterroot Region[a]	14	20.3
None of these	9	13.0
Colorado[b]	4	5.8
Selkirk Region	3	4.4
Cabinet-Yaak Region	3	4.4
California[b]	3	4.4
Tennessee[b]	3	4.4
Pennsylvania[b]	2	2.9
Michigan[b]	2	2.9

Note. [a]Within the U.S. Fish and Wildlife Service recovery zone but currently no confirmed population, [b]No populations of brown (grizzly) bears.

Bear identification

After a brief lesson on bear identification, respondents were asked to select the brown (grizzly) bears out of six bear pictures. Two were black bears, two were brown bears, one was a polar bear, and one was a giant panda (Figure 3.3). Only 18.6% of respondents were able to correctly select both photos while 9.1% selected more incorrect

photos than correct photos. A large majority of the sample (93.2%) was able to correctly select one of the brown bear photos, but only 42.5% correctly selected the second of two brown bear photos. While the videos, questionnaire, and analyses were specific to brown bears, this propensity for misidentification suggests visitors may not respond any differently to black bears. This is slightly concerning in that encounters with black and brown bears occasionally require different behavior. Even individuals provided with information on the two species struggled in identification, emphasizing the need for further elaboration in this topic during bear safety instruction.

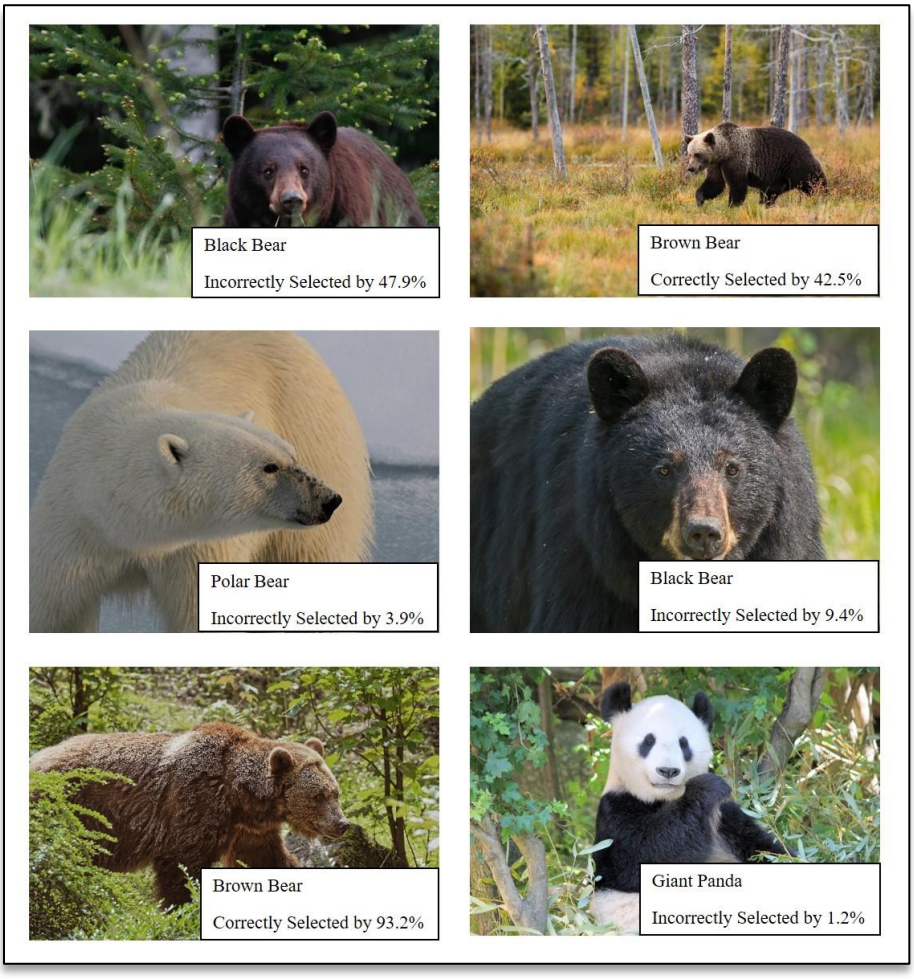

Figure 3.3. Images shown to respondents to assess accuracy in identifying bear species, with the percent of sample selecting each image. Respondents were asked to select all brown bears.

Self-reported knowledge of bear safety

In addition, while 75% had never participated in an official bear safety training, only 47.2% had never received any bear safety instruction (Figure 3.4, Table 3.2). Individuals who taught themselves reported slightly higher grades (M = 9.69; B+, SD = 2.8) than those who learned from other sources, but all were significantly higher ($p < 0.05$) than those who had not been taught (M = 5.82; C, SD = 3.5) (Table 3.3). However, it is important to not that these grades are self-reported, so a slightly higher grade among those who taught themselves does not necessarily mean this group is more knowledgeable, just that they describe themselves as such.

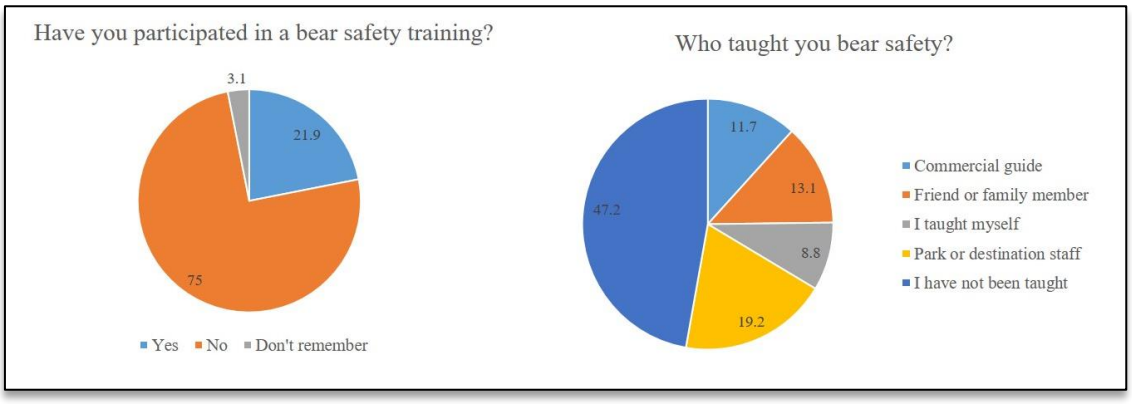

Figure 3.4. Responses to questions regarding an individual's past experience with bear safety education.

Table 3.2. *Respondents' self-reported grades for knowledge of safe behavior around bears.*

Grade	Frequency	Percent
A+	72	14.1
A	26	5.1
A-	18	3.5
B+	51	10.0
B	46	9.0
B-	56	11.0
C+	56	11.0
C	56	11.0
C-	34	6.7
D+	22	4.3
D	14	2.7
D-	12	2.3
F	48	9.4

Table 3.3. *Respondents' self-reported grades for knowledge of safe behavior around bears, split by source of bear safety education.*

Source	Mean	SD	Grade
Commercial guide	9.25A	3.2	B
Friend or family member	9.33A	3.1	B
I taught myself	9.69A	2.8	B+
Park or destination staff	9.17A	2.6	B
I have not been taught	5.82B	3.5	C

Note. Capped Roman letters in Mean column represent statistically significant differences among means ($p < 0.05$). Grade was on a thirteen-point scale using standard letter grades from F to A+.

Objective appropriateness of actions

Objective appropriateness for the 15 listed actions were determined using recommendations outlined by Herrero (2018) and Masterson (2016) and incorporated into Table 3.4. Those listed as “Inappropriate” are not recommended in any scenario because they could result in personal injury, could teach the bear bad habits, or would simply not be effective. Those listed as “Appropriate” are recommended across all scenarios. The appropriateness of those listed as “Depends” can depend on several factors, but mainly the bear’s behavior and the species of bear.

Kicking or punching the bear is only appropriate when encountering a predatory black bear. If the black bear is attacking, the most appropriate response is to fight back. Playing dead is largely recommended as an appropriate behavior but only when encountering an aggressive brown bear. When being attacked by a black bear or encountering a curious brown bear, playing dead could be highly ineffective or could cause the bear to investigate further. Shouting or making noise is an appropriate and effective method to avoid surprising a brown or black bear and is the best choice when encountering a black bear. However, when approached or attacked by a brown bear, loud noises could anger or threaten the bear. It is important to talk calmly to a curious or aggressive brown bear and remain silent if it begins to attack. Bear spray is generally recommended when encountering an aggressive animal of any species but must be used correctly. If deployed too early or aimed too high, the spray will dissipate before it hits the bear. It is important to remain calm, wait for the bear to come within thirty feet, and then deploy the spray in short bursts at a 45-degree angle towards the ground.

Standing still and waiting for the bear to move is an acceptable behavior when viewing the bear from a safe distance and in a non-threatening manner. Give the bear plenty of space and time to move out of the way prior to approaching. However, if the bear remains there, it could be guarding a food source or cubs and the best option would be to turn around find a new route. Throwing things at the bear is largely inappropriate, especially for a brown bear, but may occasionally be necessary when hazing a curious black bear. The best method is to remove any potential bear attractants prior to this point, but if a black bear does become overly curious or aggressive, this could discourage the bear from unwanted behaviors. Lastly, walking around the bear is generally an appropriate behavior but it is important to keep an eye on the bear and its behavior. This should only be done if there is plenty of room and visibility to avoid surprising or threatening the bear and getting lost.

Table 3.4. *Perceived and objective appropriateness of listed actions.*

Listed Action	Perceived Appropriateness *Mean (SD)*	Objective Appropriateness
Approach the bear	1.75 (1.6)	Inappropriate
Back away slowly	5.57 (1.6)	Appropriate
Climb a tree	2.99 (1.9)	Inappropriate
Kick or punch the bear	2.36 (1.9)	Depends
Group together	4.33 (2.0)	Appropriate
Play dead	3.89 (2.0)	Depends
Run away	2.87 (2.1)	Inappropriate
Shout or make noise	3.31 (2.2)	Depends
Shoot the bear	2.52 (2.1)	Inappropriate
Spray with bear spray	2.86 (2.1)	Depends
Stand still and wait	4.77 (1.8)	Depends
Throw food into the woods	3.27 (2.0)	Inappropriate
Throw things at the bear	2.18 (1.8)	Depends
Try to hide	4.09 (2.0)	Inappropriate
Walk around the bear	4.64 (2.1)	Depends

Note. Perceived appropriateness is based on average rating across all setting treatments. Ratings were on a 7-point Likert scale (1 = extremely inappropriate, 4 = neither appropriate nor inappropriate, 7 = extremely appropriate). Objective appropriateness was determined based on recommendations outlined by Herrero (2018) and Masterson (2016).

Factors in perceived appropriateness of actions

Respondent age and who taught bear safety were both significant for eleven of the fifteen potential behaviors while attending a bear safety training and reported bear safety grade were only significant for one and two behaviors, respectively.

Males reported statistically higher levels of appropriateness for fight or flight behaviors, such as kicking or punching the bear, $F(2, 995) = 7.69$, $p < 0.001$, shooting the bear, $F(2, 995) = 15.61$, $p < 0.001$, or running away, $F(2, 995) = 5.67$, $p = 0.004$, than did females (Table 3.5). Additionally, older individuals classified a majority of the listed actions as less appropriate than did younger individuals (Table 3.5), such as climbing a tree, $F(1, 995) = 19.77$, $p < 0.001$, hiding, $F(1, 995) = 19.83$, $p < 0.001$, throwing things at the bear, $F(1, 995) = 30.32$, $p < 0.001$, or approaching the bear, $F(1, 995) = 37.50$, $p < 0.001$.

Further, those who had seen a wild brown bear viewed backing away slowly, $F(1, 995) = 7.20$, $p = 0.009$, or grouping together, $F(1, 995) = 4.15$, $p = 0.042$, as less appropriate and kicking or punching the bear, $F(1, 995) = 4.35$, $p = 0.037$, or throwing things at the bear, $F(1, 995) = 8.95$, $p = 0.003$, as more appropriate than those who had not (Table 3.5). Lastly, individuals reporting higher bear safety grades saw approaching the bear, $F(1, 995) = 459$, $p = 0.032$, and running away, $F(1, 995) = 7.63$, $p = 0.006$, both as more appropriate than did individuals reporting lower bear safety grades (Table 3.5).

For the effect of video treatment in these models, (i.e., which of the twelve potential videos the individual was responding to), shouting or making noise, $F(11, 995) = 2.39$, $p = 0.026$, shooting the bear, $F(11, 995) = 3.62$, $p < 0.001$, and spraying bear

spray, $F(11, 995) = 2.41$, $p = 0.026$, were all significantly more appropriate for an aggressive bear than a feeding bear (Table 3.6). In addition, throwing things at the bear was significantly more appropriate when encountering a curious bear than encountering a boar in a stream, $F(11, 995) = 2.42$, $p = 0.026$ (Table 3.6). Further, those who live in states with black bears only viewed standing still and waiting for the bear to leave as significantly more appropriate than did those who live in states with no bears or both black and brown bears, $F(2, 995) = 11.71$, $p < 0.001$ (Table 3.7).

For the effect of the source of bear safety information in these models, those taught by park or destination staff report the statistically lowest levels of appropriateness for all eleven models in which it was significant, $F(4, 995) > 2.38$, $p < 0.05$. Of these eleven actions, six are categorized as inappropriate, four as depends, and one as appropriate. Individuals taught by a commercial guide or who taught themselves generally reported the highest levels of appropriateness, $F(4, 995) > 2.38$, $p < 0.05$ (Table 3.8). There were also four activities that respondents were largely uncertain about; climbing a tree, grouping together to appear larger, standing still and waiting for the bear to leave, trying to hide, and walking around the bear, with approximately 17.9%, 21.9%, 25.7%, 20.4%, and 26.0%, respectively, unsure of the appropriateness of such behavior (Figure 3.5). These topics are potential areas to address during bear safety education efforts.

Table 3.5. *Resulting F values from univariate general linear models for appropriateness of listed actions.*

	Corrected Model	Intercept	Video treatment	Bears where you live	Ever seen a bear	Feelings towards bears	Attended a safety training	Who taught bear safety	Bear safety grade	Gender	Age	Education	Adjusted R^2
Action	*F*(26, 995)	*F*(1, 995)	*F*(11, 995)	*F*(2, 995)	*F*(1, 995)		*F*(2, 995)	*F*(4, 995)	*F*(1, 995)	*F*(2, 995)	*F*(1, 995)		
Approach the bear	7.2**	46.5**	1.2	0.7	2.9	0.9	0.8	9.3**	4.6*	6.7**	37.5**	0.9	0.14
Back away slowly	2.6**	125.4**	2.5**	4.7**	7.2**	6.2*	0.5	0.5	0.0	0.7	4.6*	2.8	0.04
Climb a tree	3.4**	67.9**	1.3	0.4	0.7	1.7	1.4	4.2**	1.8	0.0	19.8**	1.4	0.06
Kick or punch the bear	5.1**	54.8**	2.0*	0.6	4.3*	0.1	3.6*	5.7**	2.6	7.7**	17.2**	1.7	0.10
Group together	2.1**	89.1**	2.0*	1.0	4.1*	2.1	0.7	2.6*	1.2	0.5	9.4**	0.3	0.03
Play dead	2.0**	112.2**	1.0	0.7	0.0	0.0	0.3	2.0	1.5	2.8	5.1*	2.5	0.02
Run away	4.1**	58.1**	1.4	0.2	3.3	0.2	0.7	3.0*	7.6**	5.7**	33.1**	1.5	0.07
Shout or make noise	3.1**	47.0**	2.4**	2.7	1.0	0.2	1.0	5.8**	1.3	1.8	0.3	0.1	0.05
Shoot the bear	5.3**	84.8**	3.6**	2.4	0.4	4.9*	2.6	4.2**	1.8	15.6**	12.3**	4.8*	0.10
Spray with bear spray	3.5**	63.1**	2.4**	0.9	0.2	0.1	2.0	3.7**	1.3	10.4**	3.3	2.3	0.06
Stand still and wait	1.9**	109.7**	1.0	11.7**	2.0	1.7	1.5	0.3	2.5	2.0	0.8	1.7	0.02
Throw food into woods	2.4**	65.4**	1.4	3.4*	2.2	0.3	0.7	2.6*	0.0	1.8	13.5**	2.7	0.04
Throw things at the bear	6.0**	60.0**	2.4**	0.0	9.0**	0.2	0.9	7.0**	1.8	6.0**	30.3**	0.7	0.11
Try to hide	3.2**	113.6**	1.1	0.0	0.0	0.2	0.5	3.4*	0.4	2.2	19.8**	9.6**	0.05
Walk around the bear	2.1**	66.9**	0.7	3.7*	0.8	4.9*	0.1	1.7	3.7	1.2	0.7	1.5	0.03

Note. *$p < 0.05$, **$p < 0.01$. Appropriateness was rated on a seven-point Likert scale (1 = extremely inappropriate, 7 = extremely appropriate). For binary or continuous independent variables, color of cell reflects the direction of a significant relationship. Negative relationships are colored red and positive relationships are colored green.

Table 3.6. *Marginal mean estimate and difference-of-mean tests for appropriateness of listed actions, split by video treatment.*

	Meadow						Stream						Platform						Behavior					
Action	Boar		Sow and cubs		Subadult		Boar		Sow and cubs		Subadult		Boar		Sow and cubs		Subadult		Feeding		Curious		Aggressive	
	M	SE	M	SE	M	SE	M	SE	M	SE	M	SE	M	SE	M	SE	M	SE	M	SE	M	SE	M	SE
Back away slowly	5.8	0.4	6.4	0.4	6.2	0.4	6.1	0.4	6.5A	0.4	5.8	0.4	5.6	0.4	6.0	0.4	5.3B	0.4	5.8	0.4	5.7	0.4	5.8	0.4
Kick or punch the bear	2.7	0.4	3.0	0.4	3.1	0.4	2.4	0.4	2.6	0.4	3.3	0.4	2.6	0.4	3.0	0.4	2.8	0.4	2.7	0.4	3.1	0.4	3.2	0.4
Group together	4.6	0.5	4.9	0.5	5.4	0.4	5.2	0.5	4.8	0.5	4.8	0.5	4.4	0.5	4.4	0.4	4.4	0.5	4.6	0.4	5.0	0.4	5.1	0.4
Shout or make noise	3.8	0.5	3.8	0.5	3.9	0.5	4.1	0.5	3.9	0.5	4.2	0.5	3.7	0.5	4.1	0.5	4.0	0.5	3.4B	0.5	4.0	0.5	4.5A	0.5
Shoot the bear	3.2	0.5	3.2	0.5	3.6	0.5	3.4	0.5	2.7B	0.5	3.9	0.5	3.1	0.5	3.2	0.5	3.7	0.5	3.0B	0.4	3.5	0.4	4.0A	0.4
Spray with bear spray	3.4	0.5	3.5	0.5	4.0	0.5	3.9	0.5	3.3	0.5	4.2	0.5	3.4	0.5	3.8	0.5	3.8	0.5	3.3B	0.4	3.9	0.4	4.1A	0.4
Throw things at the bear	2.7	0.4	2.7	0.4	2.5	0.4	2.2B	0.4	2.5	0.4	3.2	0.4	2.6	0.4	2.9	0.4	3.2	0.4	2.6	0.4	3.1A	0.4	3.0	0.4

Note. M represents the mean estimate with standard error, SE. Capped Roman letters in M column represent statistically significant differences among means ($p < 0.05$). Only general linear models with significant effects of "Video treatment" (Table 3.5) on appropriateness are included in this table. Appropriateness was rated on a seven-point Likert scale (1 = extremely inappropriate, 7 = extremely appropriate).

Table 3.7. *Mean estimate and difference-of-mean tests for appropriateness of listed actions, split by presence of bears in a respondent's home state.*

Action	No bears where I live		Black bears only		Both black and brown bears	
	M	SE	M	SE	M	SE
Back away slowly	5.6	0.3	5.3	0.2	6.8	0.7
Shout or make noise	3.4	0.3	3.7	0.3	4.7	0.9
Shoot the bear	2.9	0.3	2.8	0.3	4.5	0.9
Stand still and wait	5.3B	0.3	4.8A	0.3	7.2B	0.8

Note. M represents the mean estimate with standard error, SE. Capped Roman letters in M column represent statistically significant differences among means ($p < 0.05$). Only general linear models with significant effects of "Bears where you live" (Table 3.5) on appropriateness are included in this table. Appropriateness was rated on a seven-point Likert scale (1 = extremely inappropriate, 7 = extremely appropriate). Presence of bears was determined based on respondent-reported zip code of primary residence.

Table 3.8. *Mean estimate and difference-of-mean tests for appropriateness of listed actions, split by source of bear safety information.*

Action	Commercial guide		Friend or family member		I taught myself		Park or destination staff		I have not been taught	
	M	SE	M	SE	M	SE	M	SE	M	SE
Approach the bear	2.9B	0.3	2.4B	0.3	2.5B	0.3	1.9A	0.3	2.2A	0.3
Climb a tree	3.8B	0.4	3.3	0.4	3.6	0.4	2.9A	0.4	3.3	0.4
Kick or punch the bear	3.1B	0.4	2.8	0.4	3.3B	0.4	2.3A	0.4	2.7	0.4
Group together	4.8	0.4	4.6	0.4	5.3B	0.4	4.6A	0.4	4.7	0.4
Run away	3.5B	0.5	3.1	0.4	2.7	0.5	2.8A	0.4	3.0	0.4
Shout or make noise	4.2	0.5	3.6A	0.5	4.7B	0.5	3.7A	0.5	3.6A	0.4
Shoot the bear	3.7B	0.4	3.5B	0.4	3.6	0.4	2.9A	0.4	3.3	0.4
Spray with bear spray	3.8	0.5	3.7	0.4	4.3B	0.5	3.3A	0.4	3.5A	0.4
Throw food into the woods	3.5B	0.5	3.1	0.4	3.1	0.5	2.8A	0.4	2.8	0.4
Throw things at the bear	3.1BC	0.4	2.7	0.4	3.2C	0.4	2.2A	0.4	2.6AB	0.4
Try to hide	4.6B	0.4	3.9A	0.4	4.1	0.4	3.9A	0.4	4.1	0.4

Note. M represents the mean estimate with standard error, SE. Capped Roman letters in M column represent statistically significant differences among means ($p < 0.05$). Only general linear models with significant effects of "Who taught bear safety" (Table 3.5) on appropriateness are included in this table. Appropriateness was rated on a seven-point Likert scale (1 = extremely inappropriate, 7 = extremely appropriate).

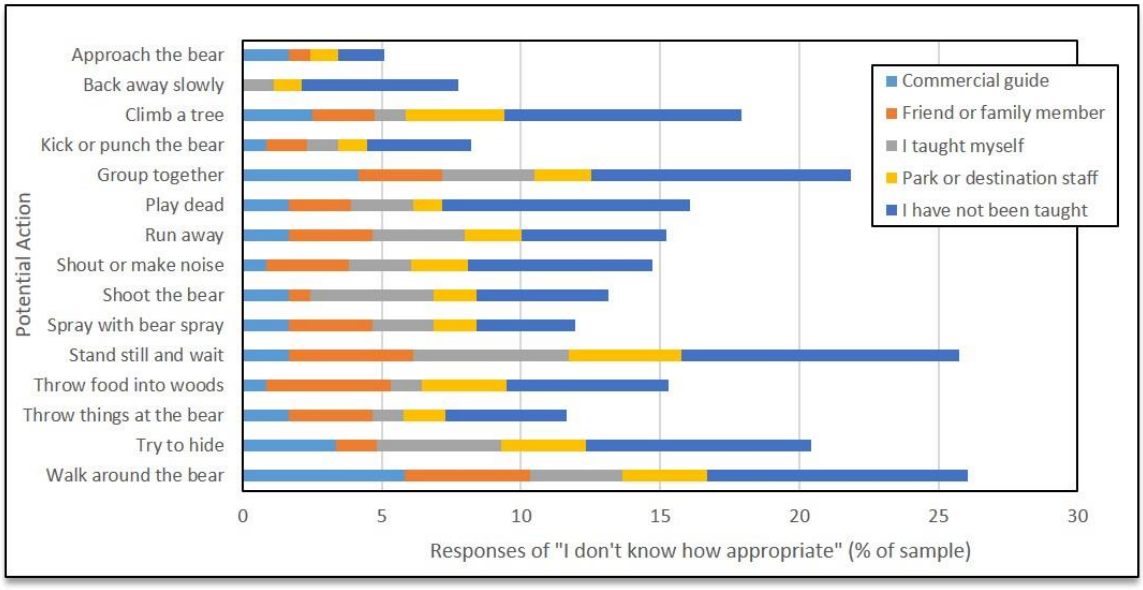

Figure 3.5. Percent of sample unsure of the appropriateness regarding fifteen potential behaviors when encountering a bear.

Management implications

As the popularity of outdoor recreation and the populations of humans and bears all continue to expand, so does the likelihood of a brown bear encounter. Not only are local residents responsible for behaving appropriately around brown bears, but park and area visitors are as well, many of whom never receive any formal safety education. To determine areas of success or potential improvement, I conducted a national online self-assessment survey of bear safety knowledge.

In preparing for increased interactions between brown bears and people, managers must continue to develop skills to best encourage safe practices among residents and park visitors alike. My results demonstrate the high potential for danger among younger and more experienced or confident individuals, who may be more likely to respond aggressively to an encounter. Respondents who had seen a bear or felt confident in their

level of safety knowledge reported higher levels of appropriateness for potentially dangerous actions, such as running away, throwing things at the bear, or kicking or punching the bear, but higher levels of appropriateness for typically correct behaviors, including backing away or grouping together to appear larger. This might have been a result of increased confidence around bears, or feelings that such behavior is unnecessary when one's past experiences have been positive. While positive encounters may help to improve feelings towards bears (Skibins and Sharp 2017, 2018), they may override previous safety instruction (Coleman 2014). To avoid this, the importance of behaving appropriately must be reinforced for all individuals, regardless of past experiences.

Among sources of bear safety information, I found park and destination staff to be the most successful in warning visitors against inappropriate behaviors such as approaching the bear, kicking the bear, running away, and throwing things at the bear, while those who were taught by themselves or a commercial guide generally viewed these actions as more appropriate. However, those taught by park or destination staff reported significantly lower levels of appropriateness for generally appropriate behaviors, such as grouping together, making noise, and spraying the bear with bear spray, than those who taught themselves. These results suggest park bear safety education efforts currently focus more on inappropriate behaviors than appropriate behaviors, leaving visitors unsure of the correct way to respond to encounters with brown bears.

Further, current bear safety instructional efforts could benefit from addressing areas of uncertainty, including climbing a tree, grouping together to appear larger, standing still and waiting for the bear to leave, trying to hide, and walking around the

bear. Regardless of experience, respondents were generally unaware of the appropriateness of these actions. Informing area residents and park visitors on these items could further improve bear safety efforts.

Near the end of the survey, I asked respondents to rank three strategies, as described by Wilson (2008), in their ability to encourage correct behavior. Of 508 complete responses, 66.3% selected being told the logic and reasoning behind instructions or policies as the most effective strategy, followed by relating with the goals of park managers, then using your own personal values to justify safe behavior. These results stress the importance of explaining to visitors and residents not only safe behavior, but the reasoning behind these suggestions as well.

The last survey question asked respondents to write in any suggestions to improve current bear safety education efforts. From these suggestions, three main ideas emerged. In order of frequency, these were 1) broaden the audience by producing public service announcements for television or online, 2) provide scenario-specific information and training, and 3) initiate a mandatory bear safety course or training prior to admission in all relevant parks. Additional suggestions included more extensive signage, classes, and educational materials, teaching bear safety in local schools and communities, providing information on bear behavior, and including the reasoning behind suggested behaviors.

From these results, I developed twelve recommendations to improve the overall effectiveness of bear safety training and education efforts.

1. All bear safety education should warn of potential emotional responses such as fear, hostility, and attentiveness that may occur during an encounter and remind users to remain calm.
2. Education efforts should continue to address the appropriateness of uncertain or popular behaviors, including climbing a tree, running away, trying to hide, grouping together, and walking around the bear.
3. Regions with established brown bear populations, as well as those on the edge of dispersing populations, should release bear safety public service announcements across several forms of media to reach the widest audience possible.
4. Place educational materials (e.g., signs, pamphlets, interactive displays, etc.) at various locations outside of park visitor's centers.
5. Provide residents and area visitors with broad information regarding bear biology, behavior, and management to encourage respect for bears and discourage behaviors that could lead to bear removal.
6. Provide logic and reasoning behind all policies, regulations, and behavioral instructions, including potential negative results.
7. Use photographs, videos, and virtual reality experiences to incorporate various scenarios and bear behaviors in preparing users for potential bear encounters.
8. Develop quizzes or other assessments of proper behavior for residents and park visitors to test their knowledge.

9. If necessary and feasible, mandatory bear safety training prior to park admission may be an effective solution. If not, consider implementing a mandatory bear safety lesson or video prior to purchasing park passes online.
10. Pay special attention to overly confident individuals, those with more experience, and those more likely to respond aggressively, particularly younger males.
11. Emphasize the importance of safe behavior around bears, regardless of an individual's past experience with bears.
12. Continue to develop curriculum and workshops for communities, private organizations, and schools in order to further inspire coexistence among the next generation.

Limitations

Threats to internal validity

A representative sample was collected with adequate sample size, but Qualtrics users and those willing to take the survey may not be entirely representative of the general American public, or those visiting national parks or other protected areas where bear viewing may occur. Although statistically accounted for by appropriate analysis, the repeated use of scales within the survey may have resulted in a testing effect, or dependency between measures.

Threats to external validity

For feasibility, survey respondents were provided with videos representing each scenario as opposed to firsthand experience. The online survey format allowed

respondents to pause and reflect prior to answering and potentially select answers believed to be correct rather than true. Further, despite significant effort to minimize nuisance variables among videos, some were unavoidable and may have unintentionally altered affective responses. Lastly, while used extensively within survey research, due to the nature of Likert-style scales, variation in responses was limited and true variation within the population may have been dampened.

Future research

Research on emotional reactions to viewing wildlife, especially carnivores, has been limited in scope. Many previous studies have addressed feelings towards carnivores (e.g., Farber an Hall 2007, Jacobs, Fehres, and Campbell 2012, Jacobs, Vaske, and Roemer 2012, Raadik and Cottrell 2007) or opinions regarding potential management action (e.g., Gilkman, Vaske, Bath, Ciucci, and Boitani 2012, Hayman, Harvey, Mazzotti, Israel, and Woodward 2014; Johansson, Sjostrom, Karlsson, and Brannlund 2012; McFarlane, Stumpf-Allen, and Watson 2007), but the focus on how these reactions impact behavior is currently understudied. This study begins to address the current knowledge gap, but more importantly, provides a foundation for continued exploration. Future research could use participant observations and onsite qualitative interviews to further understand complex emotional responses beyond what quantitative questionnaires allow. It is also important to test the applicability of virtual reality technology in representing onsite encounters. While still more contrived than firsthand experience, this developing technology could allow park managers and bear safety administrators to accurately represent different scenarios and encourage appropriate behavior despite

affective responses. Further research in virtual reality could also be used to advance visual methods within park and visitor management research.

An additional area of interest is the applicability of this research to other settings or wildlife species. Videos and questions included in this survey were targeted at brown bears, but behavioral similarities and misidentification suggest results may be highly transferable to black bears. Future research efforts should assess this degree of transferability to not only black bears, but entirely different contexts as well, such as African safaris, tiger viewing in India, underwater at coral reefs, or even deer hunting. Although it would need to be tested, I anticipate similar results across contexts. Potential hypotheses and predictions to test include:

H_1: Overall levels of positive and negative affect differ across contexts

P_1: More unique or rarer scenarios result in higher levels of overall positive affect

P_2: More dangerous scenarios result in higher levels of overall negative affect

H_2: Levels of positive and negative affect respond differently across scenarios

P_1: All scenarios produce a similar level of positive affect

P_2: More dangerous scenarios produce higher levels of negative affect

Conclusion

Bear management and safety efforts have kept the level of bear-inflicted injuries to a minimum (Gunther and Hoekstra 1998, Herrero 1970, 2018, Herrero and Fleck 1990). However, the same cannot be said for human-inflicted injuries to bears. Thousands of black bears and over a hundred grizzly bears are killed per year in North America due largely to inappropriate human behavior (Masterson 2016:16). As

interactions between humans and bears continue to increase in frequency, managers must act proactively, encouraging appropriate behavior both at home and during visits to parks and protected areas. I hope these results and recommendations will help to continue improving the efficacy of coexistence efforts across the country.

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CHAPTER FOUR

DISCUSSION

Survey results

Methodologically, results of my online survey demonstrate the potential for videos as feasible surrogates for bear encounter scenarios and associated conditions. Especially when coupled with photographs of the area and directions for respondents, videos may be more immersive and realistic than photographs alone. I also found a relatively effective shortened form of the Positive and Negative Affect Schedule (PANAS), but analysis at the factor level (i.e., positive affect, negative affect) was limited as 'alert' and 'attentive' contributed to both factors. Future use of the PANAS, whether full or a shortened, should take this into account.

In terms of survey results, I found several successes as well as areas of improvement for bear safety education efforts. Respondents were fairly successful at identifying the species of bear in photographs where the defining characteristics were clear, but were less so when the bear was partially obscured or the black bear was slightly brown. Further, many reported seeing brown bears in areas they currently do not exist; likely recalling sightings of black bears. While feelings towards bears ranged from extremely negative to extremely positive, the majority were positive. Respondents reported a wide range of bear safety grades and past experience.

All items within positive affect were consistent across all setting videos while negative affect was the most intense when viewing a sow and cubs in a meadow. While

viewing a sow and cubs is rare and exciting, individuals seemed aware of the potential for danger. However, respondents seemed unsure of how to feel when viewing any bear in a stream setting. Results of the behavior videos reaffirm the success of video methods, as most items within positive affect decreased with more aggressive behavior while all items within negative affect increased. Differences between rankings of appropriateness and likelihood highlighted several areas of concern, including low likelihood of backing away or playing dead and high likelihood of throwing food into the woods, throwing things at the bear, kicking or punching the bear, and running away.

Respondents differed in their ratings of likelihood and appropriateness of potential actions. Past use history, feelings towards bears, and demographics such as gender or age all played a role in determining appropriateness while the level of appropriateness as well as the affective response largely determined the likelihood of performing such actions. For further details and discussion regarding these results, see Chapters 2 and 3.

Expanding the results

While only three survey respondents reside in states with populations of both black and brown bears, comparisons highlight interesting differences. Those in this category were more accurate at identifying bear species and reported much higher bear safety grades but, had less positive feelings towards bears than those who reside in states with black bears only or no bears at all. I did not ask for the reasoning behind these feelings, but it is assumed to be a result of the greater threat to the safety of humans and livestock posed by brown bears. It is important to note though, that this lower value still

represents slightly positive feelings; an encouraging fact given the conflict surrounding the species.

A potentially sensitive result is the rated appropriateness when split by source of bear safety information. Visitors taught by park or destination staff were the most cautious group, often reporting the lowest acceptability of an action. Those taught by commercial guides however, were the least cautious group, reporting significantly higher levels of acceptability for approaching the bear, climbing a tree, kicking or punching the bear, running away, shooting the bear, throwing things at the bear, and trying to hide. Results cannot determine whether commercial guides are teaching these behaviors as appropriate or visitors using commercial guides are simply more likely to behave in such a manner. Regardless of its source, it is important to convey consistent bear safety information across all user groups.

At the end of the survey, each respondent was asked to provide any suggestions for improving bear safety education. Many did not have any suggestions but among those who did, a couple popular ideas emerged. Based on these suggestions alone, conveying the logic and reasoning behind regulations, policies, and suggested actions would improve compliance and safe behavior. Respondents also were eager to learn more about bear behavior and receive training on how to behave in different bear encounter scenarios. Further, online, television, print, or radio advertisements were a popular suggestion to develop a knowledgeable visiting population.

The final idea that received several mentions was mandatory safety training prior to admission at relevant parks and protected areas. While beyond the bounds of the data,

the popularity of this idea suggests relatively high acceptance of such a policy. However, the feasibility of this policy is limited due to the extensive time and staff required as well as the presence of users and bears in areas outside of regulated parks or protected areas. This technique is effective in areas with relatively low levels of visitation, such as Brooks Camp in Katmai National Park, but could be difficult in more popular parks such as Yellowstone or Glacier National Parks.

To my knowledge, this was one of the first national surveys of bear safety knowledge and the first to assess affective responses as a mediator in behavior. The results presented demonstrate the effectiveness of videos as a proxy for environmental conditions. As technology continues to develop and become more accessible, videos could replace photographs within visitor carrying capacity and management research. Despite 'alert' and 'attentive' falling into both affective factors, the shortened PANAS used in this survey was an effective measure of individuals' responses to bear encounter scenarios. Lastly, the eagerness to learn more about bear safety and behavior suggests a highly encouraging improvement in popular opinion regarding coexistence with bears of both species.

Limitations

Threats to internal validity

While the PANAS scale has been well tested and items were chosen to best reflect the viewing experience, its use and abbreviation only approximates the range of true affective responses. The items selected may have different connotations among different individuals and may not have been able to successfully capture the full spectrum of

affective responses. A representative sample was collected with adequate sample size, but Qualtrics users and those willing to take the survey may not be entirely representative of the general American public, or those visiting national parks or other protected areas where bear viewing may occur. Although statistically accounted for by appropriate analysis, the repeated use of scales within the survey may have resulted in a testing effect, or dependency between measures.

Threats to external validity

For feasibility, survey respondents were provided with videos representing each scenario as opposed to firsthand experience. As a result, affective responses may have been limited or dulled. For affect, likelihood, and appropriateness questions, respondents were instructed to imagine themselves within the given scenario and respond based solely on immediate thoughts and feelings. However, the online survey format allowed respondents to select answers believed to be correct rather than true. Further, despite significant effort to minimize nuisance variables among videos, some were unavoidable. Even slight differences between videos in variables such as placement of the bear, microhabitat, lighting, or video quality may have unintentionally altered affective responses. Lastly, while used extensively within survey research, due to the nature of Likert-style scales, variation in responses was limited and true variation within the population may have been dampened.

Future research

Further research is needed to continue developing bear safety and education practices amidst an increasing risk of human-bear interactions. This study provides an

excellent foundation to expand upon. The survey could be adapted to assess residents' knowledge of securing attractants and hazing potential problem bears. Further research is recommended to confirm the use of videos as surrogates for environmental and experiential conditions within visitor use management. As technology continues to improve, virtual reality could provide increasingly realistic simulations to be used in future research as well as bear safety education. This study provides several insights into public perception and knowledge of safe behavior around bears and hopefully will inspire more research of its kind.