Winter 2018

The Impact of Web-Based Visitor Education on Human-Tibetan Macaque (Macaca thibetana) Interactions at Mt. Huangshan, China

KiriLi Stauch
stauchk@cwu.edu

THE IMPACT OF WEB-BASED VISITOR EDUCATION ON

HUMAN-TIBETAN MACAQUE (*MACACA THIBETANA*)

INTERACTIONS AT MT. HUANGSHAN, CHINA

A Thesis

Presented to

The Graduate Faculty

Central Washington University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

Primate Behavior and Ecology

---

by

KiriLi Nan Stauch

March 2018

CENTRAL WASHINGTON UNIVERSITY

Graduate Studies

We hereby approve the thesis of

KiriLi Nan Stauch

Candidate for the degree of Master of Science

APPROVED FOR THE GRADUATE FACULTY

______________ ________________________________
Dr. Lori K. Sheeran, Committee Chair

______________ ________________________________
Dr. Jessica A. Mayhew

______________ ________________________________
Dr. Mary Radeke

______________ ________________________________
Dean of Graduate Studies

ABSTRACT

THE IMPACT OF WEB-BASED VISITOR EDUCATION ON

HUMAN-TIBETAN MACAQUE (*MACACA THIBETANA*)

INTERACTIONS AT MT. HUANGSHAN, CHINA

by

KiriLi Nan Stauch

March 2018

Daily visitor-macaque interactions lead to higher rates of macaque aggression (macaque-human, intragroup), macaque self-directed behaviors (SDBs), and zoonotic disease transfer. At the Valley of the Wild Monkeys in Mt. Huangshan, China, I made an educational website with site-specific information (e.g., guidelines for conduct, park rules, conservation) available and unavailable through QR codes for an equal number of randomized days. I recorded visitor-Tibetan macaque (*Macaca thibetana*) behaviors on all days using human and macaque ethograms. Past researchers at this site found positive correlations between decibel levels and macaque SDBs, as such decibel levels were recorded daily. I compared the frequencies of macaque and human behaviors and average decibel levels on website "on" or "off" days. On website "on" days, visitors exhibited more macaque-directed behaviors, but I found no difference in decibel levels and macaques' rates of aggressive and SDBs. My results indicate that at this site, web-based technology was not correlated with reduced rates of stress-inducing visitor behaviors, perhaps because only one percent of visitors viewed the website.

Keywords: Human-Macaque interactions, Technological education, Tibetan macaques

ACKNOWLEDGMENTS

I would like to thank my advisor and committee chair, Dr. Lori Sheeran for her guidance and support throughout this project. I would like to thank my other committee members, Dr. Jessica Mayhew and Dr. Mary Radeke for their support of this project and their feedback on the study design. I would like to thank Kyle, Dr. Mayhew, and Dr. Sheeran who assisted me in data collection this summer. I would also like to thank Dr. Li and the all of the other Chinese researchers who hosted me and allowed me to collect data at Valley of the Wild Monkeys. I would also like to thank my friends and family for their support throughout the process. I would like to thank my mother, father, and sister for their continuous support. I would like to thank Colin for his support and encouragement throughout my research. My study was funded by a National Science Foundation (NSF) East Asia and Pacific Summer Institute for U.S. Graduate Students (EAPSI) grant (OISE-1713663). I obtained approval from Central Washington University's (CWU) Institutional Animal Care and Use Committee (IACUC) board (protocol # A111606) and CWU's Human Subjects Review Council (exemption HSRC Study #: H17015) Committee before I began data collection.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The rise in human population and the growth of the wildlife tourism industry are leading to increasingly common interactions between humans and wildlife (Maréchal et al., 2011; McCarthy et al., 2009). In the 1950s, primate tourism became popular, centering around the provisioning of primates (hereafter, primates) with the goal of bringing them to tourist viewing areas or habituating primates in their natural environment so that guides could track them (Russon & Wallis, 2014). Tourism centered around provisioning is more common with primates, such as macaques, (*Macaca*) that adapt to human-dominated environments, while habituated tourism focuses on primates, such as gorillas, (*Gorilla*) that live in large, remote habitats (Russon & Wallis, 2014). Primate tourism is becoming popular in areas where visitors can view and interact with wild, but habituated, primates. For primate tourism in the natural environment to be successfully sustained, three key issues need to be researched and addressed: the effect of the experience on the tourists, the effects of tourism on the animal, and whether the site can sustain tourism (Duffus & Dearden, 1993; Hsu, Kao, & Agoramoorthy, 2009).

Sites where tourists are in close proximity to wildlife may have detrimental impacts on both species. Tourists will often give primates food as a means of interacting with them. Close contact with humans can be stressful for primates, leading to increased rates of human and primate aggressive interactions (Beisner et al., 2015; Berman, Ionica, & Li, 2004; Berman & Li, 2002; Berman, Li, Ogawa, Ionica, & Yin, 2007). Human provisioning for tourism and tourist feeding alters primate behavior patterns. Primate researchers have found that provisioning increases intragroup aggression, affects the group's social structure (Berman & Li, 2002; Fuentes & Gamerl, 2005), and affects activity budgets (Majolo et al., 2013). Majolo and colleagues (2013) found that provisioned Barbary macaques (*M. sylvanus*) spent more time resting than foraging and feeding compared to non-provisioned macaques, suggesting that provisioning might decrease the need to forage. When a group is provisioned, group members might gather in a specific location in anticipation of food. Additionally, provisioning leads to an increase in conspecific aggression because the individuals are in closer proximity. In species with linear dominance hierarchies more dominant individuals often feed first, while lower-ranking individuals feed later (Burwell, 2013; Janson, 1985; Whitten, 1983). Such species include: vervet monkeys (*Chlorocebus pygerythrus*) (Whitten, 1983), brown capuchins (*Cebus apella*) (Janson, 1985), and Tibetan macaque (*M. thibetana*) (Burwell, 2013).

Contact with humans can lead to an increase in rates of intragroup aggression and macaque and human aggressive encounters (Fuentes, Shaw, & Cortes, 2007; Majolo et al., 2013). This is potentially dangerous because macaques carry Herpes B and other viruses that can be transmitted to humans, and humans can transfer colds, influenza, and other diseases to macaques (Fuentes & Gamerl, 2005; McCarthy et al., 2009; McKinney, 2014). Macaques' self-directed behaviors (SDBs) (Schino et al., 1988: e.g., yawning, scratching, self-grooming) can be used to explore their stress levels (Maestripieri, 2011; Zhang et al., 2014), and rates of both aggression and SDBs may increase in macaque groups when they are in the presence of tourists. During interspecies interactions, macaques may grab, scratch, and bite humans, resulting in potential points of zoonotic disease transmission. Increased stress is associated with susceptibility to infectious disease (Muehlenbein, 2006).

Macaques, with the exception of humans, are the most geographically widespread primate (Fooden, 1982). Most macaques live in the tropics, but some species live in areas where snowfall occurs. All macaques share the same basic pattern of organization and live in multimale/multifemale groups of approximately 20-50 individuals (Bercovitch & Huffman, 1999). Male dispersal occurs once they reach maturity, while female macaques are philopatric and remain in the natal group throughout their lives (Berman, Ionica & Li, 2004; Li, Wang, & Han, 1996). Each group's structure is based on matrilineal social relationships, with mothers and their offspring sharing rank (Thierry, 2011). Tibetan macaques (*M. thibetana*) are listed as Near Threatened by the International Union for Conservation of Nature (Yongcheng & Richardson, 2008). These monkeys are endemic to China, and they are distributed from Anhui to Sichuan provinces (Ogawa, 2006). Tibetan macaques are semi-terrestrial and live in tropical and subtropical areas (Thierry, 2011). Their groups have linear dominance hierarchies (Berman, Ionica, & Li, 2004). At Mt. Emei (Sichuan Province) and the Valley of the Wild Monkeys (VWM) in Huangshan (Anhui Province), visitors interact with these macaques at tourist sites (McCarthy et al., 2009). Visitors feed the macaques at both sites, and macaques show increased levels of aggression directed towards people and conspecifics. For example, Ruesto and colleagues (2010) found positive correlations between the rates of threat behaviors, visitor behaviors, and visitor noise (measured as decibel values). McCarthy and colleagues (2009) noted that visitors occasionally incited escalations in macaque aggression by mimicking (e.g., eye brow raise, stare, and ground slap) and repeating behaviors (e.g., point, slap rail, mouth noise) (see also Matheson et al., 2006). Zhao (1999) observed macaque-human aggressive interactions at Mt. Emei that were centered around tourist provisioning, some of which resulted in both tourist and macaque injury or death. Interventions that reduce inappropriate visitor behaviors and excessive noise could lead to less stressful lives for macaques, resulting in less macaque intragroup and tourist-directed aggressive behaviors. Furthermore, an educational intervention can lead to improved management at VWM and at other macaque tourist sites (Usui et al., 2014).

In this study, conducted during summer 2017 tourist season at VWM, I explored potential correlations between macaque's aggressive and SDBs and visitors' behaviors and noise levels. I compared the rates of these variables on days when a Tibetan macaque and the VWM educational website was, and was not, available for tourists to view on their smartphones while they were at the macaque viewing site. I predicted that on website "on" days, visitors would exhibit fewer antagonistic behaviors and would be quieter, and monkeys' rates of aggressive and SDBs would be lower. On website "off" days, I predicted that visitors would exhibit more antagonistic behaviors and would be louder, and monkeys would show increased rates of aggressive and SDBs. My results could assist the staff of the Huangshan Garden Bureau (HGB) in their attempts to refine their management of the macaques at this site. My data helped Dr. Lori Sheeran to evaluate the website's utility and content.

CHAPTER II

LITERATURE REVIEW

Ethnoprimatology

In 1997, Leslie Sponsel developed the term "ethnoprimatology" to initiate a new anthropological approach focused on studying human and primate interactions (Sponsel, 1997). Ethnoprimatology specifically focuses on how ecological and cultural factors influence primate conservation (Riley, 2007). As the human population has expanded, humans' and primates' territories and resources increasingly overlap (Riley, 2007). Macaques (*Macaca*) are the most geographically widespread primate, resulting in frequent contact with humans. Increased contact with humans has led to a change in macaque territory and resource use, leading to human-macaque conflict in some areas (Mallapur, 2013). Macaques find new food resources through behaviors, such as crop raiding, and may come to rely on human provisioning (Fuentes, Shaw, & Cortes, 2007; Pritchard, Sheeran, Gabriel, Li, & Wagner, 2014; Riley, 2007; Yamada & Muroyama, 2010). Macaque crop raiding causes antagonistic relationships between macaques and people, leading to the macaques being viewed as pests (Saraswat, Sinha, & Radhakrishna, 2015). Religious and social aspects of a culture influence how tolerant people are towards macaques (Fuentes, Shaw, & Cortes, 2007; Saraswat, Sinha, & Radhakrishna, 2015).

Primate Tourism

Since the 1800s, nature tourism has been promoted as a way of increasing the general public's value of nature with the goal of raising public funding for conservation

(Russon & Wallis, 2014). Historically, profit, not conservation, was the main goal of primate tourism (Russon & Wallis, 2014). Primate tourism is becoming more common as a form of tourist attraction in places where visitors can view and interact with primates in their natural environment (Matheson, Sheeran, Li, &Wagner, 2006). In the 1970s, some populations of primates were shrinking, which led some primatologists to utilize primate tourism as a means of supporting and funding conservation (Russon & Wallis, 2014). The governments of primate range countries developed primate tourism sites as a source of income for conserving their country's natural environment (Russon & Wallis, 2014). As a result, primate tourist sites were advertised as tourist attractions. Ideally, the revenue from there sites helped support local communities' economies along with promoting the conservation of the primates (Russon & Wallis, 2014). However, the revenue generated from the site has to cover the cost of running the site (e.g., management, food for provisioning, etc.) and the remainder of the profit (if any) is not always shared equitably among the local community (Hvenegarrd, 2014).

Primate tourism places new pressures on primates, such as increased human and primate contact, tourist feeding/provisioning, and detrimental impacts on primates' stress levels (Hsu, Kao, & Agoramoorthy, 2009). Researchers found that increased human and primate contact led to increased rates of primate aggression in species such as Tibetan macaques, (Beisner et al., 2015; Berman, Ionica, & Li, 2004; Maréchal, MacLarnon, Majolo, & Semple, 2016; Matheson, Sheeran, Li, & Wagner, 2006). Provisioning at tourist sites also leads to increased rates of both intragroup aggression (Berman, Ionica, & Li, 2004; Berman & Li, 2002; Berman et al., 2007; Maréchal et al., 2016; Matheson, Sheeran, Li, & Wagner, 2006) and tourist-directed aggression (Pritchard et al., 2014;

Usui et al., 2014). At some sites, primates became over-habituated to the point of attacking or approaching tourists for food (Russon & Wallis, 2014). Additionally, the combination of tourist and site provisioning can lead to over-feeding, resulting in overpopulation due to increased group reproductivity. At Takasakiyama Natural Zoo in Japan, Japanese macaque (*M. fuscata*) overpopulation occurred as a result of overprovisioning, which led to increased intra- and intergroup competition for resources, crop raiding, and damage to the habitat (Kurita et al., 2008).

Modern day primate tourism continues to grow with sites reporting increases in the number of visitors ranging from "6-20% per annum" (Russon & Wallis, 2014, p.11). The growth in tourism popularity has led to challenges in management practices, such as not regulating tourist group sizes and overall numbers, tourists being too close to the primates, tourist feeding of the primates, and sick tourists being allowed into the site (Berman et al., 2007; Fuentes, 2010; Fuentes et al., 2007; Muehlenbein et al., 2010; Ruesto et al., 2010), which could potentially spread disease. Goldberg and colleagues (2007) found evidence suggesting that humans and chimpanzees (Pan troglodytes) interacting in the wild can share enteric bacteria that are more similar than one would expect by chance. Researchers were unable to discern whether bacteria transmission was through indirect or direct contact between humans and chimpanzees. However, the researchers hypothesized that it was likely that the transmission was indirect, through common environmental sources. To limit indirect contamination, Goldberg and colleagues (2007) suggest that tourists should wash their hands before entering or leaving the area and should not defecate in the chimpanzees' territory. Additionally, management should monitor the health of tourists and limit how close tourists get to the chimpanzees.

Macaca

Macaques (*Macaca*) are Old World monkeys of the Linnaean family *Cercopithecidae* (Adams et al., 2015). There are 22 species of macaques separated into four main groups (*sylvanus*, *silenus*, *sinica*, and *fascicularis*) based on genetic markers and physiological traits (Fan et al., 2014; Fooden, 1976; Li & Zhang, 2005; Thierry, 2011). Macaques are the most geographically widespread primates, living throughout Asia with the exception of one African and European (introduced) species (Adams et al., 2015; Bercovitch & Huffman, 1999; Fan et al., 2014; Fooden, 1982). Most macaques are highly adaptable and inhabit in a variety of habitats, ranging from tropics, grasslands, swamps, montane environments to areas where snowfall occurs (Thierry, 2011). They are semi-terrestrial, with the amount of time spent on the ground versus in the trees varying based on species and ecology (Thierry, 2011).

Like other species in the subfamily *Cercopithecinae*, macaques have cheek pouches that they use for storing food (Thierry, 2011). Macaques are primarily frugivorous, with fruits making up 60-90% of their diet, but many species have flexible diets based on food availability (Bercovitch & Huffman, 1999; Thierry, 2011). When fruit is not in season, macaques also eat leaves, insects, bark, and buds (Thierry, 2011).

Wild macaques forage and feed for an average of two to four hours daily (Ménard, 2004). Home ranges vary in size ranging from “some dozen hectares and some square kilometers” (Thierry, 2011, p.233). Foraging behaviors vary by species and are influenced by anatomy. Species that are better-suited to arboreal travel tend to spend more time foraging in the trees compared to species better suited for foraging on the ground. Presently, researchers do not know if arborealism is related to food distribution.

For example, long-tailed macaques (*M. silenus*) with their smaller bodies and prehensile tails are better adapted for arboreal travel, while pigtailed macaques (*M. nemestrina*) with their larger bodies and short tail are better suited for terrestrial travel (Thierry, 2011). Most macaques spend the majority of their time on the ground during the day. Resource competition depends on the availability of food, group size, and how easily the food can be defended (Bercovitch & Huffman, 1999).

Macaque societies consist of multi-male and multi-female groups (Bercovitch & Hufman, 1999; Thierry, 2011). Macaque social structures vary by species depending on whether the female hierarchy is strict or fluid (Adams et al., 2015; Thierry, 2011). Different species of macaques have different social styles, with some species being more despotic and others more tolerant (Adams et al., 2015). Macaque societies are divided based on dominance styles, which are reflected in intragroup social interactions. In despotic species, the dominance relationships are strongly nepotistic, while in tolerant species the dominance relationships are more relaxed with less stringent rank transmissions (Bercovitch & Huffman, 1999). High-ranking individuals tend to have a "steady walk and up-held tail carriage," while low-ranking individuals are likely to flee to avoid confrontation (Thierry, 2011, p.237). Dominance status includes variables such as physical strength, personality, experience, and social power (the group mates that the individual can recruit to help him/her) (Thierry, 2011).

Females are philopatric and typically keep their rank throughout their life. Females form subgroups based on kin bonds within their natal group (Thierry, 2011). The amount of kin bias in macaque social relationships is a crucial part of macaque societies (Bercovitch & Huffman, 1999). Each group's structure is based on matrilineal social relationships, with mothers and their offspring in despotic species sharing rank (Bercovitch & Huffman, 1999). As a result, mothers, daughters, and sisters form strong bonds and interact often. A daughter will inherit a rank just below her mother, but rarely will a daughter out rank her mother. Ranks within matrilines are ordered inversely so a younger sister outranks her older sister (Thierry, 2011). A higher ranking female's offspring outranks lower ranking females regardless of their age.

Female macaques reach sexual maturity between two and five years (Thierry, 2011). Once females reach sexual maturity, they typically give birth on an inter-birth interval or two years (Bercovitch & Huffman, 1999). Females typically parturition between four to six years (Thierry, 2011). A mother nurses her infant until the infant is six months to a year old (Thierry, 2011). Females in some species have sexual swellings along with coloration in the anogenital region and rump during breeding season (Thierry, 2011). Additionally, some macaque females give estrous calls, which can be triggered by copulation but are also heard outside of mating (Bernstein, Sheeran, Wagner, Li, & Koda, 2016; Thierry, 2011). Females are no longer able to reproduce between 20-25 years and they can live up to 25-40 years, but in wild populations females usually do not live beyond 20 years (Thierry, 2011).

Male macaques start puberty between three to four years of age (Thierry, 2011). During this time, males have higher rates of agnostic interactions with other males (Thierry, 2011). Most males do not copulate with adult females until they are fully grown at around 7-11 years (Thierry, 2011).

Breeding patterns in macaques vary from species to species along with the period of reproduction (Thierry, 2011). Some macaque species are non-seasonal breeders, while other species are seasonal breeders (Thierry, 2011). For example, Rhesus macaque (*M. mulatta*) females are seasonal, polyestrous breeders with multiple females coming into estrus at the same time, and males and females mate with several individuals during the breeding season (Thierry, 2011). A male's access to females depends on the macaque species. In some species, low-ranking males copulate in remote areas away from the highest–ranking males (Thierry, 2011). For example, the lowest-ranking Barbary macaque (*M. sylvanus*) males must go to a remote area to copulate while mid-ranking males can copulate in the open in front of the highest-ranking males (Thierry, 2011). Males in some macaque species are one-mount ejaculators, while males in other species are multi-mount ejaculators (Thierry, 2011).

Males mate more often with experienced females with prior offspring rather than with young, inexperienced females (Thierry, 2011). Both males and females mate with multiple partners. A male can disperse multiple times throughout his lifetime (Thierry, 2011). Males tend to immigrate into groups adjacent to their natal group where they either assume a low-ranked position and wait to move up or challenge the highest-ranking male (Thierry, 2011). Males tend to remain in a group for around two to four years (Bercovitch & Huffman, 1999).

Macaque population size is dependent on resource availability, susceptibility to diseases, and predation (Bercovitch & Huffman, 1999; Kurita et al., 2008; Sugiyama & Ohsawa, 1982). Artificial feeding often leads to an increase in population (Sugiyama & Ohsawa, 1982). Provisioned macaque groups may become large reaching several hundred monkeys, but non-provisioned groups usually do not exceed 100, with the majority of macaque groups ranging between 15 and 50 individuals (Thierry, 2011). In some macaque species, groups may fission into smaller foraging groups and fuse into a larger group at night. Predation rates on wild macaques is unknown, but leopards, tigers, eagles, pythons, and crocodiles are documented macaque predators (Fooden 1986, 1995, 2000; Thierry, 2011). Humans and feral dogs are primary threats for the majority of macaque populations (Thierry, 2011).

Macaque Tourism

Macaque-tourism is a type of primate tourism in which visitors pay to see and interact with free-ranging or semi-free ranging macaques. The macaques at these sites are wild but habituated to people (Fuentes, Shaw, & Cortes, 2007) and are typically provisioned at the viewing site (Berman & Li, 2002; Fuentes & Gamerl, 2005; Fuentes, Shaw, & Cortes, 2007). Beginning in the 1950s, Japanese monkey parks were established where tourists could observe free-ranging Japanese macaques (Kurita, 2014). The macaques at these parks were habituated to people through provisioning. These monkey parks had small startup costs and they aided in increasing people's interest in Japanese macaque behavior and social structure (Kurita, 2014). Scientific findings and information on Japanese macaques and their behavior were shared with the public through the use of movies, television shows, and newspaper and journal articles (Kurita, 2014). Japanese monkey parks became an important recreational activity at a time that the country was recovering from World War II (Kurita, 2014). Provisioning at the Takasakiyama Natural Zoo was utilized by the mayor of Oita to help prevent crop raiding by drawing the macaques away from the fields. The Japanese macaques were provisioned with high energy/low fiber foods such as sweet potatoes, wheat, soybeans, and peanuts that were more nutritionally dense than their normal diet (Kurita, 2014). The provisioned macaques had improved nutritional levels that impacted reproductive patterns, resulting in increased populations, which led to significant increases in crop raiding and forest damage due to increased macaque feeding (Kurita, 2014). Crop raiding led to an increase in macaques near human areas, which led to the macaques being viewed as pests. In an effort to combat the rise in the macaque population, the government reduced the amount of provisioning occurring at Takasakiyama Natural Zoo. As a result, females had decreased nutritional levels, eventually leading to a decline in births and increased infant mortality (Kurita, 2014).

Visitors who see macaques at religious sites, such as temples, often go there specifically to interact with the macaques (Fuentes, Shaw, & Cortes, 2007). Contact with people can lead to an increase in rates of aggression directed towards humans and other monkeys (Fuentes, Shaw, & Cortes, 2007). Majolo and colleagues (2013) found that male Barbary macaque (*M. sylvanus*) intragroup aggression was significantly associated with tourist proximity and occurrences of tourist provisioning. Researchers have reported increased rates of aggression in Rhesus (*M. mulatta*), Formosan (*M. cyclopis*), and Tibetan macaques (*M. thibetana*) (Berman et al., 2007; Hill, 1999; Hsu, Kao, & Agoramoorthy, 2009). Aggressive behavior is potentially dangerous for humans because macaques carry an incurable disease, Herpes B, which is potentially transmitted through contact with macaque bodily fluids (Centers for Disease Control and Prevention, 2016). Additionally, macaques carry other viruses that can be transmitted to humans, and humans can transfer colds, flus, and other diseases to macaques (Fuentes & Gamerl, 2005; McCarthy et al., 2009; McKinney, 2014).

Self-Directed Behaviors

The majority of literature on SDBs in primates focuses on primates living in captive settings such as in zoos and sanctuaries (Daniel, Dos Santos, Vicente, 2008; Wagner, Hopper, & Ross, 2016). Primates in captivity typically demonstrate more SDBs than those in the wild (Daniel, Dos Santos, Vicente, 2008; Wagner, Hopper, & Ross, 2016). Displacement activities, which are also known as SDBs, are a class of behavior (Judge et al., 2011). SDBs are mostly focused on an individual's own body, such as self-scratching, self-touching, self-grooming, yawning, and body shaking (Castles, Whiten, & Aureli, 1999; Lutz, Well, & Novak, 2003; Wagner, Hopper, & Ross, 2016). SDBs originate from behaviors that have a practical use in daily activities, such as self-scratching, which makes it difficult for researchers to distinguish whether the activity being observed is a SDB or a part of the animals' normal repertoire (Troisi, 2002). A behavior can only be identified as a SDB based on the context during which the action occurs (Troisi, 2002). A behavior is a SDB if it occurs in a situation where a researcher would not expect to normally see that behavior (McFarland, 1966), or if it increases for an individual in a particular context.

The majority of previous research on primate SDBs centers around the proximity of an individual to a more dominant individual (Daniel, Dos Santos, & Vicente, 2008) and its occurrence during post-conflict behavior (Kutsukake & Castles, 2001; Zhang et al., 2014). Individuals from species with strict hierarchies (e.g, Tibetan macaques) that rely upon strong social ties experience stress from conflict (Zhang et al., 2014). Zhang and colleagues (2014) conclude that SDBs in Tibetan macaques might be indicative of anxiety. Female Tibetan macaques have strict linear relationships with strong matrilineal ties. In the presence of dominant males and females, female Tibetan macaques displayed higher rates of SDBs than in the presence of subordinate individuals. Additionally, females displayed higher rates of SDBs in the absence of a neighbor than when a subordinate was present. The researchers suggest that the higher rates of SDBs in the absence of a neighbor might have been due to not having allies nearby (Zhang et al., 2014). Additionally, lower rates of SDBs in the presence of subordinates is most likely attributed to the fact that subordinates rarely threaten a more dominant individual (Zhang et al., 2014). The affiliative relationship between the recipient and the aggressor was found to impact the rates of SDBs. When the recipient had a strong relationship with the aggressor, the individual showed higher rates of SDBs. Additionally, when the recipient had a strong relationship with the aggressor, he/she demonstrated more SDBs prior to reconciliation compared to those weaker ties to the aggressor. A female Tibetan macaque's rank depends on alliances, so breaking an alliance would negatively impact an individual's social rank (Zhang et al., 2014). As a result, the breaking of an alliance would cause a female Tibetan macaque a greater amount of stress, so the individual would exhibit a higher rate of SDBs due to the higher level of stress (Zhang et al., 2014).

Anxiety, frustration, stress, and emotional arousal in animals can be inferred by measuring rates of SDBs (Maestripieri, Schino, Aureli, & Troisi, 1992; Zhang et al., 2014). During interspecies interactions, macaques may grab, scratch, and bite humans, resulting in potential points of zoonotic disease transmission. Monkeys' SDBs (Schino et al., 1988: e.g., yawning, scratching, self-grooming) are common measures of stress levels in animals (Maestripieri, 2011; Zhang et al., 2014), and rates of both aggressive and SDBs may increase in monkey groups when they are in the presence of tourists

(Matheson, Sheeran, Li, & Wagner, 2006). Increased stress is associated with primates' susceptibility to infectious disease (Muehlenbein, 2006).

Macaca thibetana

Tibetan macaques (*Macaca thibetana*), also called the short-tailed Tibetan macaque or Père David's macaque, belong to the *sinica* group and are listed as Near Threatened by the International Union for Conservation of Nature (Yongcheng & Richardson, 2008). Genetically they are most closely related to Assamese macaques (*M. assamensis*) (Hoelzer & Melnick, 1996; Thierry, 2011) but more closely resemble stump-tailed macaques (*M. arctoides*) in appearance (Berman, Ionica, & Li, 2004) with their heavy bodies and short tails (Thierry, 2011). Tibetan macaques are endemic to the subtropical and tropical areas of China and are distributed from Anhui to Sichuan provinces (Ogawa, 2006; Thierry, 2011). Tibetan macaques are primarily leaf eaters (Zhao, 1996), but will also feed on fruits and nuts. At Mt. Emei and the VWM in China where researchers study them, the macaques are provisioned with food such as corn (Usui et al., 2014). Tibetan macaques are mostly terrestrial and forage on the forest floor (Thierry, 2007).

Tibetan macaque males are larger than females (males' average weight is 18.3 kg and females' average weight is 12.8 kg) (Thierry, 2011). Adult Tibetan macaques have similar coat colors that darken with age (Fooden, 1983). Adult males and females have a long, dense coat with a dark brown back with a black tone near the tail (Fooden, 1983). The back surfaces of the limbs are a similar color to the back and they become lighter towards the hands and feet (Fooden, 1983). The hair on their stomach and front portion of their limbs is less dense than the hair on their back and ranges in color from pale buff to pale gray (Fooden, 1983). The skin on the area around the muzzle is pale brown (Fooden, 1983). The area around the eyes may be sexually dimorphic in color: a white color in immature males and females and adult males and a pink color in adult females (Fooden, 1983). Infant Tibetan macaques have lighter and less dense coats than adults (Fooden, 1983). The coats of infants range from gray brown, buff, golden brown, to a reddish brown (Fooden, 1983). Juvenile and sub-adult Tibetan macaques have a slightly lighter color coat than adult macaques with coats that range from medium to dark brown (Fooden, 1983). Adult Tibetan macaques have buff-colored prominent side whiskers, and they typically have a prominent beard that ranges from buff to brown in color (Fooden, 1983). The beard and whiskers are more prominent in adult males than adult females (Fooden, 1983). Adult males and females can be identified conspicuous genital differences (Fooden, 1983).

Tibetan macaque groups have linear dominance hierarchies (Berman, Ionica & Li, 2004). Tibetan macaques' have a strict matrilineal hierarchy with females inheriting their mother's rank. The Tibetan macaque male to female group ratio has more females than males (Thierry, 2011; Li, 1999). Tibetan macaque groups are usually not more than 30-40 individuals (Thierry, 2011).

Like other macaque species, Tibetan macaque females give birth on average at 5.5 years (Thierry, 2011). The ovarian cycle length is 26.4 days (Thierry, 2011). Females have discrete birth seasonality and do not exhibit obvious visual sex skin swelling, but they do have an estrous call (Bernstein et al., 2016; Thierry, 2011). Tibetan macaques perform non-reproductive copulation (Li, Yin, & Zhou, 2007), or mating outside of the breeding season. Tibetan macaque males are single-mount ejaculators (Xiong & Wang, 1991).

In contrast to the majority of macaque species, Tibetan macaque males actively support and regularly handle infants (Thierry, 2011). A male Tibetan macaque will hold or groom an infant even if it is not his offspring (Ogawa, 2006). Males utilize infants to facilitate male-male social interactions. Typically, a male presents an infant to another male and together they hold the infant, with one male holding the infant's legs and the other the infant's shoulders. Ogawa (2006) named this behavior, "bridging behavior" (p. 5). Female-female and female-male bridging behavior is observed in addition to male-male bridging (Bauer, Sheeran, Matheson, Li, & Wagner, 2014; Ogawa, 1995).

The majority of Tibetan macaque research has come from two sites in China: Mt. Emei (Zhao, 1999) and Mt. Huangshan (Berman et al., 2007). The groups at both sites are provisioned to facilitate observation by tourists (Usui et al., 2014). Past studies demonstrate that frequent interactions with tourists impacts the stress behavior levels of Tibetan macaques (Berman & Li 2001; Berman et al., 2007; Ruesto et al., 2010; Usui et al., 2014). Provisioning can lead to increased aggression towards both tourists and conspecifics (Berman & Li, 2002; Berman et al., 2007; Matheson et al., 2006; Ruesto et al., 2010). Tourist behaviors towards the Tibetan macaques can be antagonistic, resulting in aggressive interactions between tourists and the macaques (Ruesto et al., 2010; Usui et al., 2014).

Public Education

A variety of tourist education methods have been tested in previous studies including the distribution of educational booklets to tourists (Zientek, 2014), posting signs stating not to feed the macaques (Fuentes, Shaw, & Cortes, 2007; Ruesto, Sheeran, Matheson, Li, & Wagner, 2010; Usui, et. al., 2014), and having the tour guides and rangers provide tourists with information about the macaques (Usui, et al., 2014). As of yet, no research has been conducted on the impact of an educational website intervention on tourist behaviors at the VWM.

As technology use has become increasingly common, zoos have started investing in using technology as a means of educating the public (Yocco, Danter, Heimlich, Dunckel, & Myers, 2011). Yocco and colleagues (2011) found that two crucial factors determine if visitors will use technology: visitors' learning style and age. In a study conducted at Jacksonville Zoo, Yocco and colleagues (2011) found that visitors were hesitant to utilize their personal phones to complete a zoo activity. When smartphones with an educational application already running was available, visitors requested to use it. The use of the smartphone application was attractive to visitors, specifically to younger individuals. Older participants reported that they would be less likely to use mobile technology at the zoo and believed that younger audiences would find this type of education very attractive. Visitors who used the smartphone application spent more time on average at the exhibit than if they had simply walked through the exhibit.

In a second study at the Cincinnati Zoo, Yocco and colleagues (2011) found that participants were most likely to engage in zoo activities that used technology. The top three activities used by visitors included digital voice recording and playback, touch screen manipulation of pictures and words, and touch screen quizzes. Overall, researchers found that adults tended to not use the technology unless they were assisting their children, because they had the misconception that the educational elements were exclusively for children (Yocco et al., 2011). Visitors who were already attracted to technology preferred to use the technology. Individual attraction to technology was influenced based on the perceived ease of use and usefulness of the type of technology.

Visitors at the Zoo Atlanta orangutan (*Pongo*) exhibit showed a preference for a video or live presentation over no presentation (Perdue, Stoinski, & Maple, 2012). Perdue and colleagues (2012) found that visitors spent significantly more time at the exhibit when an educational video or live presentation occurred. Visitors who viewed the educational video or were present for the live presentation scored significantly better on knowledge questions than visitors who did not view either presentation. Surprisingly, the information that was in the presentations was already present at the exhibit in the form of signs or kiosks. Both the presentation and the video included the same information (i.e., explained the purpose of the on-exhibit touch screen computer used for cognitive research, provided information about orangutan behavior, cognition, and conservation).

Predictions

Past research on human-macaque interactions fueled my research question of whether educating visitors about the macaques and the site would impact the interactions between visitor and macaques. I predicted that humans and macaques would behavior differently on "on" days and "off" days. Specifically, I predicted that macaques would show lower rates of stress-indicating behaviors, such as aggressive behaviors and SDBs, on days when an educational website was available to tourists than on days that the website was not available. My second prediction was that human generated noise levels on the platforms would be different on "on" days and "off" days. Specifically, I predicted that human noise levels on the platforms would be louder on days that the website was not available and quieter on days when the website was available. My next prediction was that visitors would show fewer antagonistic behaviors towards the macaques when the website was available than when the website was not available.

CHAPTER III

METHODS

Subjects and Study Site

Central Washington University's Institutional Animal Care and Use (Protocol #: A111606) and Human Subjects Review Council (exemption HSRC Study #: H17015) Committees reviewed and approved my study methods. Once I arrived in China, CWU's Institutional Animal Care and Use Committee approved a modification to my methods to collect data on both the YA1 and YA2 groups.

We collected all data (on monkeys and visitors) from the viewing platforms Monday-Sunday (July 8, 2017-July 19,2017 and July 24, 2017-August 1, 2017) from 0800h to 1200h and 1400h to 1700h at VWM (N30°10'0.012"/E118°10'59.988"), Anhui Province, China. VWM borders Mt Huangshan, a UNESCO World Heritage site. The most popular tourism time for the site is during the months of June, July, and August (Usui et al., 2014). The Tibetan macaques at the study site have been observed by Anhui University scientists since 1986, and data on their individual identities, kinship, dominance, and life histories have been continuously collected since that time (Berman & Li, 2002) (see also Ruesto et al., 2010; Wang et al., 2016). Staff of HGB initially began provisioning the macaques with corn in the mid-1990s (Ruesto et al., 2010). Since the time the site was first open to tourists, visitors have observed the macaques from viewing platforms that overlook the provisioning area (Berman et al., 2007). VWM is run by a private company that hired a pair of park rangers who provisioned the monkeys with corn daily, managed the monkeys' movements using rocks and other means, and regulated macaque-tourist interactions (Usui et al., 2014). The site has paved steps with a railing that leads up to the viewing platforms that overlook the provisioning site. At VWM, tourists can choose to either go with (60 CNY ≈ 10 USD) or without a guide (40 CNY ≈ 7 USD) (Usui et al, 2014).

The Yulingkeng A1 (YA1) group is the original group that was habituated at the site. Later, the group split into the Yulingkeng A1 (YA1) and Yulingkeng A2 (YA2) groups; however, the YA2 group is no longer provisioned. As a result, I planned on focusing solely on the YA1 group. However, the YA2 monkeys were present at the site the first few weeks we were there. As a result, I decided to include both groups in my study. The age classes I used in my study were the same as the Anhui University researchers used (W. Xi, personal communication, 2017). At the time of my study, the YA1 group consisted of 47 individuals (W. Xi, personal communication, 2017, see Tables 1, 2): 18 males, 29 females; 25 adults (males ≥ 7 years, females ≥ 5 years) (males N = 10, females N = 15), 9 sub-adults (males 4-6 years, females 4 years) (males N = 4, females N = 5), 7 juveniles (1-3 years) (males N = 2, females N = 5), and 6 infants (<1 year) (males N = 2, females N = 4). The YA2 group composition was not known (Matheson, Sheeran, Li, & Wagner, 2006). We estimate that the group consisted of approximately 75 individuals of different age/sex classes (L. Sheeran, personal communication, August 1, 2017). Each age/sex class was identified utilizing coat color, coat texture, and size.

Table 1

YA1 Adult Tibetan Macaques

Males	Mother	Females	Mother
Ye Rongbing	Ye Zhen	Ye Hong	Ye Mai
Tou Gui	Tou Tai	Ye Xiaxue	Ye Hong
Bai Tou		Ye Mai	
Hua xia Ming	Hua Hong	Ye Chunyu	Ye Mai
Zuo Ba		Tou Xiahua	Tou Hong
Huang Ma		Tou Hong	Tou Gou
Duan Shou		Tou Xiaxue	Tou Hong
Tou Ronggang	Tou Tai	Ye Chunlan	Ye Mai
Ye Chunglong	Ye Mai	Hua Hong	Hua
Ye Rongqiang	Ye Zhen	Tou Rui	Tou Tai
		Tou Rongyu	Tou Tai
		Tou Huaxue	Tou Rui
		Tou Tai	
		Ye Zhen	
		Tou Huayu	Tou Rui

Note. W. Xi, personal communication, 2017

Table 2

YA1 Sub-adult, Juvenile, and Infant Tibetan Macaques

Age class	Males	Mother	Age class	Females	Mother
Sub-Adult	Tou Rongyu	Tou Tai	Sub-Adult	Hua Xiawei	Hua Hong
	Tou Xialong	Tou Hong		Tou Qiulan	Tou Xiaxue
	Huang Yu			Tou Rongxi	Tou Tai
	YeXiaKun	YeHong		Ye Ronglan	Ye Zhen
				Ye Chunhua	Immigrated
Juvenile	Tou Huanan	Tou Rui	Juevenile	Hua Xiayue	Hua Hong
	Tou Qiusong	Tou Xiahua		Ye Xiayue	Ye Hong
				Tou Qiuying	Tou Xiaxue
				Tou Fuhua	Tou Huayu
				Tou Huali	Tou Rongyu
Infant	Ye Xiaming	Ye Chulan	Infant	Hua Xiayun	Hua Hong
		Tou Xiahua		Ye Xiaduo	Ye Chunyu
				Ye Xiayun	Ye Hong
					Tou Hong

Note. Tou Xiahua's male infant and Tou Hong's female infant are included in the table, but the names are not known. W. Xi, personal communication, 2017

At the site, the YA1 group was provisioned in the morning around 0800h to draw them to the site. The group was also typically provisioned at 1700h before the rangers left the site. The rangers would sometimes provision the macaques if visitors were present or if the macaques started to leave the site.

I collected human data from the time the guards arrived (0800h) and ended at the time the guards left the site (1700h) with a two-hour lunch break (1200h to 1400h). Visitors would come to the viewing platform during the day to see the macaques. The size and composition of the visitor groups varied. Some Chinese universities sent field students to the area also and they would go to see the macaques for fun. During the summer, families on vacation would go up to see the macaques. During my study, I collected data from a total of 977 visitors (adult male: N = 397, adult female: N = 387, male children: N = 89 female children: N = 68, unknown: N = 36). On the website off days, I collected data from a total of 394 visitors (adult male: N = 158, adult female: N = 134, male children: N = 53, female children: N = 49) and on the website on days I collected data from a total of 583 visitors (adult male: N = 239, adult female: N = 253, male children: N = 36, female children: N = 19, unknown: N = 36).

Procedure

We collected all of our data (on monkeys and visitors) from the viewing platforms Monday-Sunday (July 8, 2017-July 19, 2017 and July 24,2017-August 1, 2017) from 0800h to 1200h and 1400h to 1700h. Since 2010, Internet access has been readily accessible throughout the park, and visitors have complete cell phone connectivity, with over 90% of 2016 visitors having smart phones (L. Sheeran, personal communication, October 24, 2016). An educational website with site-specific information (e.g. guidelines for conduct towards the macaque, park rules, conservation information, information about the macaques) was launched June 2017 (see Appendix B – for this website). I made the website available and unavailable to tourists for an equal amount of randomly selected days. I determined the days the website was available and not available using a random number generator. Originally, I posted five QR codes on the posts on the viewing platform on days that the website was available, which tourists could scan with their smartphones. However, since visitors did not appear interested in the QR codes on the platform, halfway through my data collection, I posted three additional QR codes on the stairs leading up to the platform.

A data collection session started when the first visitor reached the top of the stairs and ended when the last tourist stepped onto the stairs. Both visitors and monkeys had to be present in order for a session to begin. LKS collected data on macaque SDBs (see Table 3) and aggression (see Table 4) using Berman, Ionica, and Li's (2004) and Schino, Scucchi, Maestripieri, and Turillazzi's (1988) published ethograms and all occurrence sampling. JAM also collected data samples and recorded monkey aggressive (see Appendix A for examples of aggressive behaviors) and SDBs on the platform. Additionally, they conducted five minute scans to count the number of monkeys present on or around the viewing platform. Only the number of adult male and female monkeys were individually known since they were easily identified by both LKS and JAM. Researchers classified monkeys (using coat color, coat texture, and size) (Berman, Ionica, & Li, 2004) as adult, sub-adult, juvenile, and infant and the monkey's sex (male or female) was noted on a data sheet.

I collected data on human behaviors utilizing an ethogram (see Table 5) comprised of McCarthy and colleagues' (2009), Ruesto's (2007), and Ruesto and colleagues' (2010) published ethograms. I used all-occurrence sampling to record tourist behaviors. I counted the number of people on the viewing platforms by standing on top of the stairs and counting the people as they came up them. I only recorded the visitors' behaviors and not the guards' or researchers' behaviors. I watched the visitors until the last visitor left or until 1700h (the time the park closed to the public). I recorded behaviors from visitors of all ages (adult and child, male and female). I classified visitors as either adult (based on if they were adult size) or non-adult (smaller than

Table 3

Tibetan Macaque Self-Directed Behavior Ethogram

Behavior	Abbreviation	Definition
Self-Scratching	SS	(usually repeated) Movement of the hand or foot during which the fingertips are drawn across fur or skin.
Self-Grooming	SG	Picking through and/or slowly brushing aside fur with one or both hands.
Self-Touching	ST	Other forms of body touching with the hand.
Shaking	BS	Shaking movement of entire body (similar to that of a wet dog).
Yawning	Y	Brief gaping movement of the mouth. Not recorded as an SDB if accompanied by aggressive signals such as eye flash or canine whetting.
Other	OT	A macaque exhibits a repetitive behavior in the context of an aggressive encounter with either a human or a conspecific.

Note. Self-Directed behavior definitions were modified by KiriLi Stauch and Dr. Lori Sheeran. Originally from Schino, Scucchi, Maestripieri, & Turillazzi (1988).

Table 4

Tibetan Macaque Aggressive Behavior Ethogram

Behavior	Abbreviation	Definition
Threat	T	An individual directs an open mouth threat gesture or any of its components, e.g., stare, raised eyebrows, lowered jaw, ground slap, to another individual.
Lunge	L	An individual directs a lunge at another individual, but does not chase.
Chase	C	An individual runs after another individual.
Slap	S	An individual hits another individual.
Grab	G	An individual seizes another individual.
Bite	B	An individual grabs and bites hard, either releasing the victim quickly or hanging on for several secs. Soft bites occurred in the context of embracing or play were not accounted as aggression.
Fear Grin	FG	Individual shows teeth to another individual in response to a threat or another aggressive behavior.
Ground Slap	GS	Individual hits ground.
Other	O	A macaque exhibits a behavior directed at either a conspecific or a visitor that is not listed.

Note. Aggressive behavior definitions were modified by KiriLi Stauch and Dr. Lori Sheeran. Originally from Berman, Ionica, & Li (2004).

Table 5

Human Behavior Ethogram

Behavior	Abbreviation	Definition
Foot Noise	FN	An individual stamps feet or kicks wall in tourist platform.
Hand Noise	HN	An individual makes noises with one or both hands (clap, snap, smack own body, smack a book).
Mimic[a]	M	An individual mimics facial expressions and/or body movements of a monkey threat (eyebrow raise, stare).
Mouth Noise	MN	An individual makes noise (whistle, kissing noises, shouts) with mouth directed toward monkey.
Hand Motion	HM	An individual directs hand movement at a monkey (i.e. pointing at s monkey) with the arm extended out of tourist platform.
Rock[b]	R	An individual pretends to throw rock at monkeys.
Slap Rail	SR	An individual slaps rail or post on tourist platform using hands and/or objects.
Show Food	SF	An individual holds food so that the monkeys can see it.
Throw Object	TO	An individual drops or throws non-food item (tissue, wrapper, rock) into monkey area.
Wave	W	Using hands or object, individual waves at monkey.
Food	FD	An individual pretends to throw food at monkeys.
Dangle	D	An individual dangles food, body parts, or objects over the viewing platform railing towards monkeys.
Point Object	PO	An individual uses an item (stick, umbrella, etc.) to gesture at a monkey.
Show Object	SO	An individual holds a non-food object so that monkeys can see it.
Spit	S	An individual spits into monkey area.
Other	O	An individual does any macaque directed behavior that does not fit into the categories.

Note. [a] If mimicry included slap, it was coded as Mimic, not Slap rail.
[b] If rock was thrown, it was coded as Throw object not Rock.
Human behavior definitions were modified by KiriLi Stauch and Dr. Lori Sheeran.
Originally from Ruesto (2007), and Ruesto et al (2010).

adult size) and as male or female. I collected the behaviors that were the cause of human-macaque interactions by hand with a notepad and a pen. At VWM, previous researchers found a significant positive correlation between decibel levels and macaque SDB and aggression rates (Duvall-Lash, 2013; Ruesto et al., 2010). I recorded decibel levels at the beginning of a session and every five minutes until the end of a session using a Sper Scientific Sound Level Pen (840018) (following Ruesto et al., 2010).

Reliability

I established reliability of monkey identifications (age group/sex group) and use of the monkey ethograms during the first few days at the site with PQH and WX from Anhui University who were familiar with the macaques. I was reliable for adult monkey identities 84% (21/25) and adult age/sex classes at 100% (25/25).

We spent the first few days at the site coding and comparing the number of matches for each behavior and monkey identification, and I modified my human behavior ethogram. Dr. Sheeran and Dr. Mayhew arrived on July 7, 2017 and again were tested on the monkey identifications. Dr. Sheeran assisted with human and macaque behavior data collection and Dr. Mayhew assisted with macaque data collection.

Dr. Sheeran has been conducting research at the site since 2004 and Dr. Mayhew has been conducting research at the site since 2015. I set a score of ≥ 90% agreement as acceptable for individual adult macaque identities and acceptable for age /sex classes for younger macaque identities. The researchers, LKS, myself, and JAM were reliable for adult monkey identities at 94.4% (66/71) and adult age/sex classes at 100% (71/71).

Analysis

Human and Macaque Behavioral Data Transformation. I converted both the macaque and human behavioral data into rates by combining all of the human and macaque data for each session and dividing the number of behaviors for a session by the duration of the session in minutes. For both the macaque and human behavioral data, I conducted visual exploration of the data in *R-Statistics* to determine if the data were normal with Q-Q plots. Both the human and the macaque data were positively skewed, so I conducted a square-root transformation to normalize the data. I chose a square-root transformation, because a cube-root and log transformation were too powerful. After the square-root transformation, I plotted the transformed data and the data were normalized.

Additionally, I converted the human and adult macaque data into rates per individual by dividing the human and adult macaque rate data by the total number of individuals present for each session. I only converted the adult macaque data into rates per individual, because I did not have the number of individuals for the younger age classes. I conducted visual exploration of the data in *R-Statistics* to determine if the data appeared normal on Q-Q plots. Both the human and the macaque individual data were positively skewed, so I conducted a cube-root transformation to normalize the data. I chose a cube-root transformation because a square-root transformation was not powerful enough and a log transformation was too powerful. After the cube-root transformation, I plotted the transformed data and the data were normalized. For my data analysis I used a $p < 0.05$ for all of the tests.

Human Behavioral Data. After the data were normalized, I ran a Welch's Two Sample *t* test to test the prediction that human behavior rates would be lower on website on days compared to website off days. I also ran a Welch's Two Sample *t* test to test the prediction that individual human behavior rates would be lower on website on days compared to website off days.

Macaque Behavioral Data. After the data were normalized, I ran a Welch's Two Sample *t* test to test the prediction that macaque behavior rates (aggressive and SDBs) would be lower on website on days compared to website off days. Once both the human and macaque data were normalized, I ran a general linear regression in *R-Statistics* to test whether human behavior rates predicted monkey behavior rates. I ran a Welch's Two Sample *t* test to test the prediction that macaque behavior rates would be lower on website on days compared to website off days. Once both the human and macaque rates per individual data were normalized, I ran a general linear regression in *R-Statistics* to test whether human behavior rates predicted adult macaque behavior rates.

Decibel Data. For each session, I averaged all decibel levels by adding them and dividing by the total number of recordings in a session. I calculated an average for each session to account for differences in session lengths. Some sessions were longer and had more recordings, while others were shorter with fewer recordings. As a result, I decided to calculate an overall average for each session rather than calculating an average minimum and maximum for each session. I conducted a visual exploration of the decibel data with a Q-Q plot, and the data were positively skewed, but after a log transformation, the data appeared normal. I chose a log transformation, because a square-root transformation and a cube-root transformation were not powerful enough. To test the prediction that human decibel levels would be lower on website on days, I ran a Welch's Two Sample *t* test.

CHAPTER IV

RESULTS

Over 20 days (10 on days, 10 off days), I recorded a total of 70 on and off sessions, and I collected a total of 2,077 minutes of human and monkey behavioral data via all occurrence sampling. The 70 total sessions consisted of 32 on sessions and 38 off sessions. The on sessions accounted for 940 minutes of data collection, while the off days accounted for 1,137 minutes of data collection. I collected data from a total of 977 visitors (adult male: N = 397, adult female: N = 387, male children: N = 89, female children: N = 68, unknown: N = 36). On the off days, I collected data from a total of 394 visitors (adult male: N = 158, adult female: N = 134, male children: N = 53, female children: N = 49) and on the on days I collected data from a total of 547 visitors (adult male: N = 239, adult female: N = 253, male children: N = 36, female children: N = 19, unknown: N = 36). I collected macaque data from the YA1 troop which consisted of a total of 47 macaques (adult male: N = 10, adult female: N = 15, sub-adult male: N = 4, sub-adult female: N = 5, juvenile: N = 7, infant N = 6). I also collected macaque behavioral data from the YA2 troop whose exact group composition is unknown. The YA2 group was composed of approximately 75 individuals of different age/sex classes.

During the 10 website on days the Squarespace page had a total of 11 views. Out of those eleven views, two of the views were from a desktop computer. All of the views came from individuals located in China. Ten out of the eleven views were direct views, which means that the viewers either had the link to the webpage or they scanned a QR code. One of the desktop views was accessed through a Google search. The website averaged 1.1 hit per day during the ten days that it was available.

Human Behavioral Data

To test the prediction that human behavior rates would be lower on website on days, I ran a Welch's Two Sample *t* test. I considered all human behaviors as negative because they often elicited aggressive or SDBs from the macaques. The results of the *t* test indicate human behavioral rates were significantly different between website on days (M = 1.80, SD = 0.53) and website off days (M = 1.48, SD = 0.46), t (61.75) = -2.68, p = 0.01, 95% CI [-0.56, -0.08]. Human behavior rates were significantly higher on days that the website was available (see Tables 6,7 for human behavioral data counts for website off and on days).

To test the prediction that human behavior rates per individual would be lower on website on days, I ran a Welch's Two Sample *t* test. The results of the *t* test indicate human behavioral rates per individual were non-significant with website on days (M = 0.66, SD = 0.19) compared to website off days (M = 0.77, SD = 0.20), t (66.45) = 1.53, p = 0.13, 95% CI [-0.03, 0.25]. Individual human behavior rates did not differ between days the website was available and unavailable.

Table 6

Website Off Day Human Behavior Counts

Behavior	Adult Male	Adult Female	Male Children	Female Children
Foot Noise (FN)	8	24	18	5
Hand Noise (HN)	45	29	14	1
Mimic[a] (M)	1	0	2	4
Mouth Noise (MN	75	83	63	9
Hand Motion (HM)	608	609	178	137
Rock[b] (R)	0	0	0	0
Slap Rail (SR)	0	0	0	0
Show Food (SF)	3	0	0	0
Throw Object (TO)	8	3	4	1
Wave (W)	0	0	0	0
Food (FD)	46	17	4	4
Dangle (D)	11	13	0	0
Point Object (PO)	34	9	2	10
Show Object (SO)	7	1	0	0
Spit (S)	0	0	0	0
Other (O)	3	1	0	0

Note. Total number of humans present on website off days (*N*=394): adult male (*N*=158), adult female (*N*=134), male children (*N*=53), female children (*N*=49).

Table 7

Website On Day Human Behavior Counts

Behavior	Adult Male	Adult Female	Male Children	Female Children
Foot Noise (FN)	5	20	13	3
Hand Noise (HN)	44	14	21	11
Mimic[a] (M)	21	11	1	0
Mouth Noise (MN	143	92	31	8
Hand Motion (HM)	829	1136	209	117
Rock[b] (R)	0	0	0	0
Slap Rail (SR)	0	0	0	0
Show Food (SF)	12	1	2	1
Throw Object (TO)	11	2	12	0
Wave (W)	0	0	0	0
Food (FD)	40	29	52	2
Dangle (D)	0	2	0	0
Point Object (PO)	13	12	4	0
Show Object (SO)	10	0	0	0
Spit (S)	11	2	0	0
Other (O)	0	0	0	0

Note. Total number of humans present on website on days (N = 547): adult male (N = 239), adult female (N = 253), male children (N = 36), female children (N = 19).

Macaque Behavioral Data

To test the prediction that macaque behavior rates would be lower on website on days, I ran a Welch's Two Sample *t* test. The results of the *t* test indicate macaque behavioral rates were non-significant with website on days (M = 0.90, SD = 0.33) compared to website off days (M = 0.79, SD = 0.43), t (67.48) = -1.25, p = 0.22, 95% CI [0.79, 0.90]. Macaque behavior rates did not differ between days the website was available and unavailable (see Tables 8, 9, 10, 11, 12, 13 for macaque SDB and aggressive behavioral data counts for website off and on days).

Table 8

Website Off Day Tibetan Macaque Self-Directed Behavior Counts

Behavior	Adult Male	Adult Female	Sub-Adult Male	Sub-Adult Female	Juvenile	Infant
Self-Scratching (SS)	137	215	27	3	83	2
Self-Grooming (SG)	15	54	4	0	3	0
Self-Touching (ST)	2	1	0	0	0	0
Shaking (BS)	17	30	1	3	9	2
Yawning (Y)	9	1	0	0	0	0
Self-Bite (SB)	0	0	4	0	2	0
Other (OT)	0	0	0	0	0	0

Table 9

Website On Day Tibetan Macaque Self-Directed Behavior Counts

Behavior	Adult Male	Adult Female	Sub-Adult Male	Sub-Adult Female	Juvenile	Infant
Self-Scratching (SS)	103	213	28	4	83	1
Self-Grooming (SG)	19	56	2	3	25	0
Self-Touching (ST)	1	2	1	0	0	0
Shaking (BS)	20	33	9	1	10	1
Yawning (Y)	6	4	0	0	0	0
Self-Bite (SB)	0	0	12	0	0	0
Other (OT)	0	0	0	0	0	0

Table 10

Website Off Day Tibetan Macaque Conspecific Directed Aggressive Behavior Counts

Behavior	Adult Male	Adult Female	Sub-Adult Male	Sub-Adult Female	Juvenile	Infant
Threat (T)	11	26	6	2	2	0
Lunge (L)	4	4	0	0	0	0
Chase (C)	20	9	1	1	0	0
Slap (S)	0	0	0	0	1	0
Grab (G)	2	0	0	1	0	0
Bite (B)	2	0	0	0	0	0
Fear Grin (FG)	2	5	2	0	1	1
Ground Slap (GS)	1	1	0	0	0	0
Other (O)	2	0	0	0	0	0

Table 11

Website On Day Tibetan Macaque Conspecific Directed Aggressive Behavior Counts

Behavior	Adult Male	Adult Female	Sub-Adult Male	Sub-Adult Female	Juvenile	Infant
Threat (T)	5	7	2	0	3	0
Lunge (L)	0	0	0	0	0	0
Chase (C)	18	3	2	0	0	0
Slap (S)	0	0	0	0	0	0
Grab (G)	1	1	0	0	1	0
Bite (B)	0	1	0	0	0	0
Fear Grin (FG)	3	4	1	0	0	0
Ground Slap (GS)	1	3	1	0	1	0
Other (O)	2	3	2	0	1	0

Table 12

Website Off Day Tibetan Macaque Human Directed Aggressive Behavior Counts

Behavior	Adult Male	Adult Female	Sub-Adult Male	Sub-Adult Female	Juvenile	Infant
Threat (T)	21	29	15	3	7	0
Lunge (L)	6	2	0	0	2	0
Chase (C)	1	1	0	0	1	0
Slap (S)	1	0	0	0	2	0
Grab (G)	1	0	0	0	2	0
Bite (B)	0	0	0	0	0	0
Fear Grin (FG)	0	10	1	0	4	0
Ground Slap (GS)	4	7	2	0	2	0
Other (O)	0	0	0	0	0	0

Table 13

Website On Day Tibetan Macaque Human Directed Aggressive Behavior Counts

Behavior	Adult Male	Adult Female	Sub-Adult Male	Sub-Adult Female	Juvenile	Infant
Threat (T)	28	14	7	1	34	0
Lunge (L)	3	1	0	0	9	0
Chase (C)	1	1	1	0	2	1
Slap (S)	1	0	0	0	0	0
Grab (G)	0	1	1	0	0	0
Bite (B)	0	0	0	0	0	0
Fear Grin (FG)	2	7	0	0	1	0
Ground Slap (GS)	6	1	1	0	5	0
Other (O)	0	0	0	0	0	0

Additionally, I ran a general linear regression to test whether human behavior rates predicted macaque behavior rates. The results of the regression indicated that human behavior rates predicted 7% of the macaque behavior rates (R^2= 0.07, F (1, 68) =6.54, p = 0.01). Since the regression results were significant, I conducted a Pearson's Correlation Test to test if human and macaque behavior rates were correlated. Human behavior rates and macaque behavior rates were positively correlated, *r* (68) = 0.30, *p* = 0.01, 95% CI [0.07, 0.50] (see Figure 1; scatterplot of visitor and macaque behavior). Macaque behavior rates positively correlated with human behavior rates. Macaque behavior rates were higher when human behavior rates were higher.

To test the prediction that individual adult macaque behavior rates would be lower on website on days than website off days, I ran a Welch's Two Samples *t* test. The results of the *t* test indicate individual adult macaque behaviors did not differ between website on days (*M* = 0.39, *SD* = 0.13) and website off days (*M* = 0.34, *SD* = 0.20), *t* (64.66) = -1.11, *p* = 0.27, 95% CI [0.34, 0.39].

Additionally, I ran a general linear regression to test whether human behavior rates per individual predicted adult macaque behavior rates per individual. The results of the regression indicate that human behavior rates per individual did not predict macaque behavior rates per individual (R^2= 0.00, *F*(1, 68) =0.66, p = 0.42). Human behavior rates per individual predicted 0% of the adult macaque behavior rates per individual.

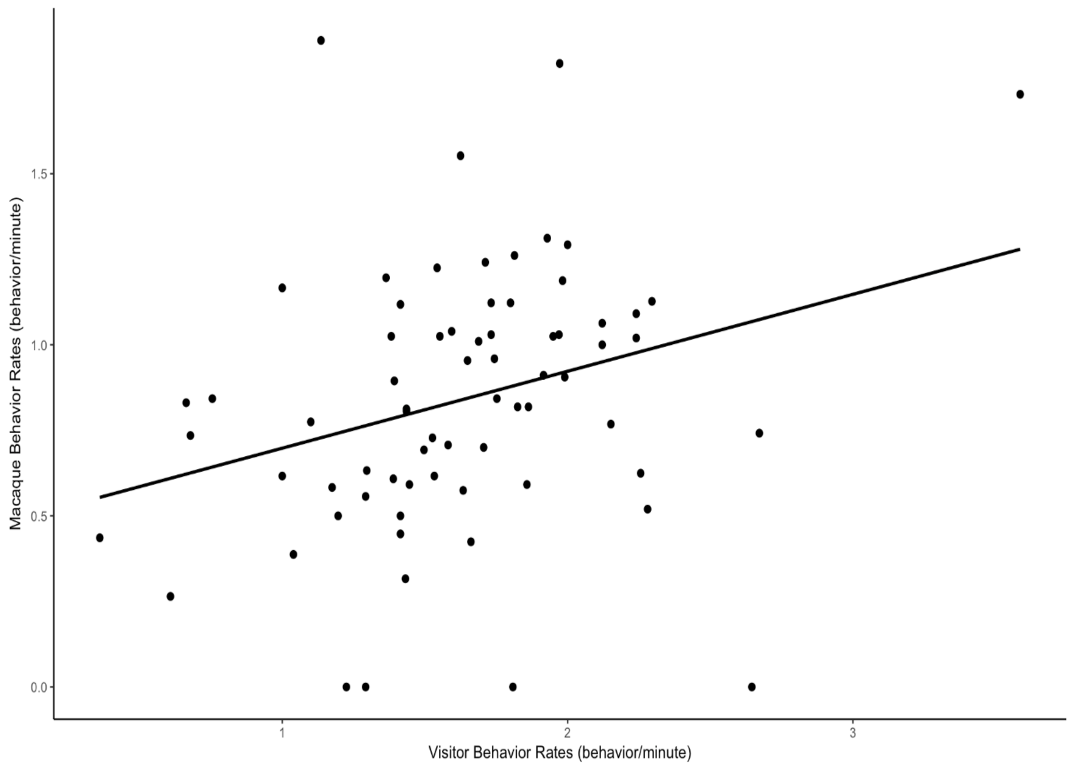

Figure 1. Scatterplot of visitor and combined macaque behavior rates with a best fit line (*r* (68) = 0.30, *p* = 0.01).

Decibel Data

To test the prediction that visitors would be significantly quieter on website on days than website off days, I ran a Welch's Two Sample *t* test. The results of the *t* test indicate average decibel levels were non-significant with website on days (*M* = 4.28, *SD* = 0.03) compared to website off days (*M* = 4.25, *SD* = 0.04), *t* (59.76) = -1.57, *p* = 0.12, 95% CI [-0.07, 0.00]. Average decibel levels did not differ between days the website was available and unavailable.

I ran general linear regressions to test whether average decibel levels predicted macaque behavior rates. Average decibel levels significantly predicted macaque behavior rates (R^2= 0.07, F (1, 60) =5.35, p = 0.02). The results from the regression indicate that average decibel levels predicted 7% of the macaque behavior rates. Since the regression results were significant, I conducted a Pearson's Correlation Test to test if average decibel levels and macaque behavior rates were correlated. Average decibel levels and macaque behavior rates were positively correlated, *r* (60) = 0.29, *p* = 0.02, 95% CI [0.04, 0.50] (see Figure 2; scatter plot of average decibel level and macaque behavior rates). Macaque behavior rates were higher when the average decibel levels were higher.

I ran a general linear regression to test whether average decibel levels predicted individual adult macaque behavior rates. The results of the regression indicated that average decibel levels were non-significant and only predicted 3% of the adult macaque behavior rates per individual (R^2= 0.03, F (1, 60) =0.05, p=0.09). Individual adult macaque behavior rates were not predicted by average decibel levels.

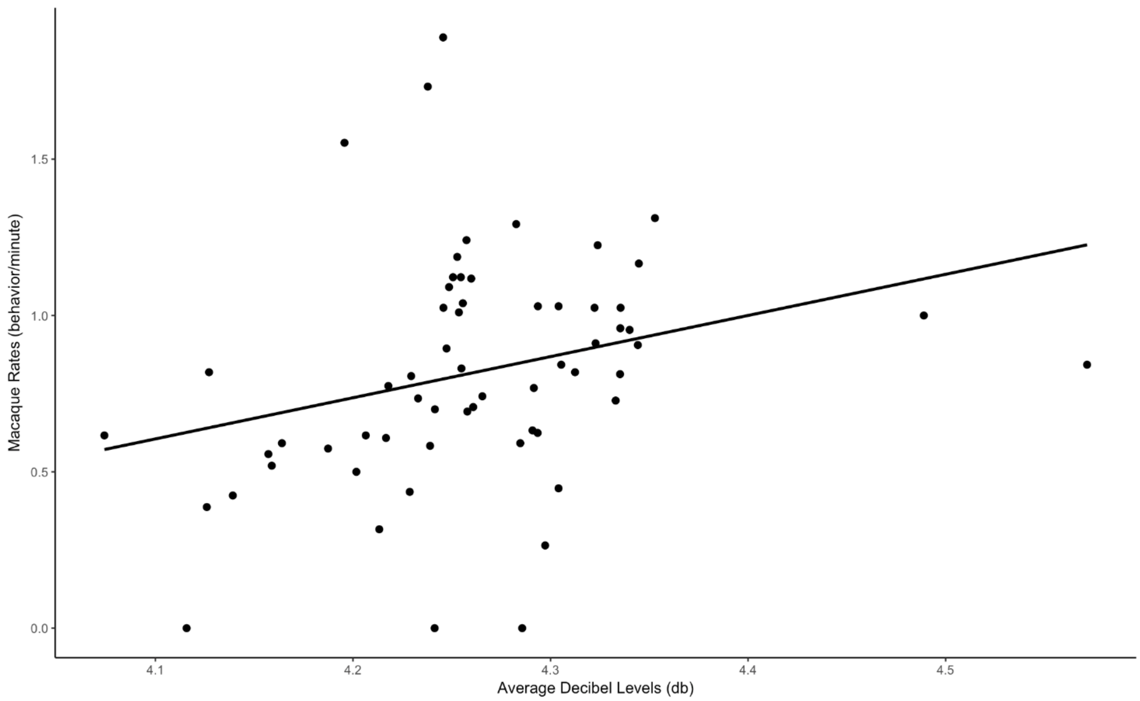

Figure 2. Scatterplot of average decibel level and combined macaque behavior rates with a best fit line (r (60) = 0.29, p = 0.02).

CHAPTER V

DISCUSSION

The impact of human-primate interactions at tourist sites has been extensively studied (Berman & Li, 2002; Fuentes & Gamerl, 2005; Fuentes, Shaw, & Cortes, 2007; Majolo et al., 2013; McCarthy et al., 2009; McKinney, 2014), but little is known about the impact of visitor education on rates of visitor and primate behaviors. SDBs in primates has been studied substantially in captive animals (Daniel, Dos Santos, Vicente, 2008; Kutsukake & Castles, 2001; Maestripieri, 2011; Schino et al., 1988; Wagner, Hopper, & Ross, 2016; Zhang et al., 2014), but less is known regarding SDBs in primates in the wild. The aim of my study was to determine if the use of an educational website would lower the rates of visitor-macaque directed behaviors and macaque-macaque and macaque-visitor aggressive and SDBs. Additionally, my aim was to determine if the use of an education website would lead to lower decibel levels on the visitor viewing platform when the website was available. Sites where visitors can interact closely with primates can lead to aggressive human and primate interactions, which is potentially dangerous to both the visitors and the primates (Beisner et al., 2015; Berman, Ionica, & Li, 2004; Fuentes, Shaw, & Cortes, 2007; Hsu, Kao, & Agoramoorthy, 2009; Majolo et al., 2013; Maréchal, MacLarnon, Majolo, & Semple, 2016; Matheson, Sheeran, Li, & Wagner, 2006). Visitors to sites will sometimes give primates food and get too close to the primates, which can lead to potential pathogen transmission between humans and primates (Berman et al., 2007; Fuentes, 2010; Fuentes et al., 2007; Muehlenbein et al., 2010; Ruesto et al., 2010).

Visitors are not always educated on how to interact with the primates at the site and of the dangers of disease transmission from themselves to the primates and vice versa. Food is used by visitors as a means of interacting with the primates, which can alter primate behavioral patterns. Provisioning by visitors can lead to increased rates of conspecific and primate-human aggressive behaviors due to individuals being drawn into a closer proximity to feed or primates stealing food from visitors (Majolo et al., 2013; Russon & Wallis, 2014). Additionally, more dominant individuals can attack or chase off lower ranking individuals in order to obtain the resource.

The stress caused by close contact with visitors might result in the occurrence of SDBs. SDBs are a type of displacement activity, which are mainly focused on an individual's body (Castles, Whiten, & Aureli, 1999; Lutz, Well, & Novak, 2003; Wagner, Hopper, & Ross, 2016). These behaviors originate from normal daily behaviors and are distinguished based on the context that the behavior occurs. My study showed that the visitor-macaque directed behavior rates significantly predicted macaque aggressive and SDB rates. However, visitor education through the website did not correlate with lower the rates of the visitor-macaque directed behaviors. Rather, visitors exhibited significantly higher rates of macaque directed behaviors on the days that the website was available. Meanwhile, the aggregated rates of macaque aggressive and SDBs were non-significant with website availability. Furthermore, the average decibel level on the platform was non-significant when the website was available.

Human Behavioral Data

For the human behavioral data, a Welch's Two Sample *t* test showed a significant difference in the human behavior rates on website on days compared to website off days. My first prediction, which states that rates of human and monkey behavior rates will differ based on website availability, was supported. While the rates of human behaviors did differ based on website availability, the results did not support my prediction. The prediction that human behavior rates would be lower on days that the website was available was not supported. The data revealed that humans had significantly higher behavior rates on days that the website was available, which might be due to the low number of website views. When the human behavioral data was converted to rate per individual, the Welch's Two Sample *t* test I ran showed no significant difference in the human behavior rates on website on days compared to website off days. My first prediction which states that rates of human and monkey behavior rates will differ based on website availability was not supported.

These results are consistent with previous studies conducted at the site (Ruesto, Sheeran, Matheson, Li, & Wagner, 2010; Usui, et al., 2014; Zientek, 2014). Tourist education was implemented at the site in the form of educational booklets that contained information suggesting how to act around the macaques (Zientek, 2014), but no difference in tourist behaviors were found between groups that had received the booklet and those that had not (Zientek, 2014). Visitors at the VWM ignored signs posted at the site that said monkeys should not be fed and continued to feed the primates (Ruesto, Sheeran, Matheson, Li, & Wagner, 2010). Additionally, visitors appeared to ignore both tour guides and rangers at VWM when they provided them with information about the monkeys and guidelines for interacting with them (Usui et al., 2014). Park rangers' warnings were ignored as well. At this site "passive" forms of education do not work (e.g., educational booklets, signs, ranger), but "active" forms of education might work (e.g., researcher talk, video, etc.). At Zoo Atlanta, a researcher presentation was effective in conveying information about orangutans to visitors (Perdue, Stoinski, & Maple, 2012). Having a researcher provide a talk about the macaques may be more effective.

Macaque Behavioral Data

A Welch's Two Sample *t* test did not show a significantly lower difference in monkey behavior rates on website on days compared to website off days. Macaque behavior rates did not differ based on website availability. The prediction that monkey behavior rates would be lower on days when the website was available was not supported.

For the macaque and visitor behavior data, a general linear regression showed that overall visitor behavior rates significantly impacted macaque behavior rates. Higher rates of visitor behaviors predicted higher rates of macaque behaviors when I analyzed the data for the on and off days together. Additionally, the results of the Pearson correlation test showed visitor behavior rates positively correlated with macaque behavior rates. These results are surprising since they appeared to contradict Usui and colleagues' (2014) finding that visitor behaviors did not significantly correlate with macaque aggressive and SDB rates. One possible explanation for this discrepancy is that my data were collected from both the entire provisioning area and the platform. In contrast, McCarthy and colleagues (2009) found a significant correlation between visitor behavior and macaque aggressive behavior rates, a finding which is consistent with my results.

When I converted the adult macaque behavioral data to rate per individual, the results of my Welch's Two Sample *t* test showed monkey behavior rates were non-significant with website availability. My first prediction, which states that rates of human and monkey behavior rates will differ based on website availability, was supported. Adult macaque behavior rates per individual did not differ based on website availability.

For the visitor rates per individual data and the adult macaque rates per individual data, the results of the general linear regression showed that individual visitor behavior rates were non-significant with individual adult macaque behavior rates. This result was not surprising because the macaque behavior rates per individual only included the adult macaque data. Adding the juvenile macaque data might change the results because the adult and juvenile age groups exhibited the majority of the behaviors. Fuentes and Gamerl (2005) reported that male long-tailed macaques and sub-adult long-tailed macaques exhibited more tourist-directed aggression than expected, which might be due to size and temperament similarities between the two age groups.

At sites where visitors can interact with macaques, macaque-visitor interactions tend to be initiated by humans more than by macaques (Hsu, Kao, & Agoramoorthy 2009; McCarthy, Matheson, Lester, Sheeran, Li, & Wagner, 2009). These interactions can lead to heightened levels of macaque-visitor and conspecific aggression. An interaction can escalate when the macaques are provisioned with food by the visitors, which can increase the length of the interaction (Hsu, Kao, & Agoramoorthy 2009).

Agonistic interactions between visitors and macaques can lead to injury to both and result in a negative experience for both.

Higher rates of macaque-visitor and conspecific aggression in Bali and Gibraltar were attributed to species-specific differences as well as social context differences (Fuentes, 2006). Tibetan macaques are ranked as Grade 2 on the macaque dominance and tolerance grade, which makes them more despotic than tolerant (Berman, Ionica, & Li, 2004). Additionally, Tibetan macaques have a strict dominance hierarchy where males usually disperse once they reach maturity and females remain in their natal group. As a result, male-male relationships are more competitive, while female-female kin relationships are strong (Zhang, Li, Xia, Zhu, Wang, & Zhang, 2014). The rangers at the site control the macaques through dominance in the form of gestural and vocal threats, which can escalate to the ranger throwing rocks at the monkeys (Usui et al., 2014). The use of these methods of control might cause the macaques at the site to be more reactive to certain visitor behaviors. Pointing at a macaque versus showing or throwing a rock at a macaque would be considered as less threatening and would thus elicit a different response.

Park rangers sometimes provided visitors with corn to feed the monkeys, which can influence the visitors' behaviors (Usui et al., 2014). Some visitors would bring their own food to the site with the intent to feed the monkeys. Often the visitors would try to lure the macaques closer to the platform. Tibetan macaques demonstrated exaggerated rates of agonistic behaviors when they were provisioned (Schnepel, 2015). The rangers tended not to interfere when visitors fed the macaques. In general, the park rangers did not intervene in the interactions between the macaques and the visitors. The lack of intervention could have resulted in longer behavioral exchanges between macaques and visitors.

Decibel Data

For the decibel data, the results of the Welch's Two Sample *t* test showed that decibel levels were non-significant with website availability. My prediction that visitors will be quieter on website on days was not supported. The general linear regression showed that average platform decibel levels significantly predicted macaque behavioral rates. Additionally, the results from the Pearson Correlation showed that average platform decibel levels positively correlated with macaque behavioral rates. An increase in human-generated decibel levels correlated with increased rates of monkeys' threats and fear grins at the VWM (DuVall-Lash, 2013). Ruesto and colleagues (2010) also noted a positive correlation between the decibel levels on the platform and occurrence of monkey threat behaviors. Similar to Ruesto and colleagues (2010) and DuVall-Lash (2013), I found that the average platform decibel levels correlated with the macaque behavioral rates. The macaque behavior rates were significantly higher on days that the average decibel levels were higher.

These results do not, however, support my prediction that the decibel levels will be different on website on and off days. The reason for the lack of difference might be because I took decibel readings only when the visitors were present on the platform. As a result, the number of decibel readings for each session varied. Due to the variation in the number of readings for each session, I was unable to calculate average minimum and maximum decibel levels. Also, I had one day that I did not have decibel readings for, because the battery for the decibel reader died.

Conclusions and Future Recommendations

In conclusion, visitor behavior rates were significantly higher on website on days, but the average decibel levels and macaque behavior rates at the site were not significantly higher on those days. The educational website was not viewed by many visitors and the visitors who viewed the website might not have read through it. Given that 1% of visitors viewed the site, it is difficult to say if the website affected peoples' behaviors positively or negatively. Visitor behavioral rates positively correlated with macaque behavior rates. Macaques exhibited higher rates of aggressive and SDBs when visitor behavior rates were also high. The average decibel levels on the platform significantly influence the rates of macaque behaviors, with higher macaque behavior rates when the average decibel levels were louder. The results of my study show that visitor behaviors and noise levels significantly impact the macaques at the site. The findings of my study indicate that visitor behavior rates influence monkey behavior rates, but that a web-based intervention might not be the best means of educating visitors without a mechanism to ensure people view it.

Recommendations for Future Research

For future research, I recommend adding additional researchers to collect behavioral data. Ruesto and colleagues (2010) had three data collectors who recorded data, while my study had two individuals recording data. In my study, I collected the visitor data and the decibel levels, while another researcher collected the macaque data. They had two individuals recording macaque data and one individual recording visitor data and decibel levels. Additionally, they established interobserver reliability for adult monkey identities, age/sex class for immatures, and monkey threat behaviors. For my study, reliability was not established for the human and macaque behavioral data. We did not receive permission to film at the site, so a video was not utilized to test the reliability of human behavioral data collection. This might account for the outcome of the results of the study. Another factor that might have contributed to our human behavioral data results was that some sessions were interrupted by visitors asking questions about the macaques and what we were doing at the site. In these situations, some data might not have been collected due to not being able to collect data while talking to the visitors.

In another study, the format of the educational intervention should be taken into account. I did have some issues with the educational website while in China. While the human behavior data is statistically significant, visitors were unable to view the website on the website on days. I did not take into account issues with accessing the website in China. The website was made available through the use of Squarespace, which was not available in China unless the user had a virtual private network (VPN). Additionally, due to translation issues, the website was only available in English. The website recorded 11 hits on the website on days, which provides evidence that visitors were not scanning the QR codes with their phones. In the website analytics the hits on the website are further broken down based on how the website was accessed (e.g. mobile, tablet, desktop, and unknown). Additionally, the website analytics showed how the individual found the site (e.g., direct access, Google search, unknown). The use of our QR codes is considered direct access as well as if the individual had the specific link to the site.

While on the platform, I noticed that the visitors were taking pictures or videos of the macaques with their phones. I did not consider that the visitors would be utilizing their phones for other uses while at the site. It appeared that the visitors elected to use their phones to take pictures or videos of the macaques while at the site. Additionally, while the macaques were at the site, the visitors preferred to pay attention to them and seemed to ignore the QR codes. A more interactive educational intervention might be preferred by visitors.

Researchers and staff at other sites where visitors interact with the animals may want to explore other avenues of teaching visitors about the animals and site. One method of education that might work is making the learning experience more interactive through the use of a look and find sheet or get to know me sheet. At VWM, visitors had the option to pay for a guided tour. The tour guide would walk them up the mountain and talk to them briefly about the macaques. When visitors would ask the guide questions, the questions would center around the name of the macaque and asking for information about the macaques at the site. Having visitors at a site doing an activity sheet such as one where they look for a certain macaque or learn about the lineage of a particular family line might gain more visitor interest. Making the learning more interactive could lead to a more personable experience for the visitors. One of the positive aspects about the visitors at the site is that quite a few visitors were interested in learning about the macaques. The visitors asked us questions about the macaques while we were at the site. Several individuals expressed that they returned to the site every year to view the macaques. It may be beneficial to create a dialog between the researchers and the visitors at the site through the use of educational materials to enhance the visitor experience.

REFERENCES

Adams, M. J., Majolo, B., Ostner, J., Schülke, O., De Marco, A., Thierry, B., ... & King, L. A. (2015). Personality structure and social style in macaques. *Journal of Personality and Social Psychology*, *109*(2), 338-353.

Bauer, B., Sheeran, L. K., Matheson, M. D., Li, J. H., & Wagner, S. R. (2014). Male Tibetan macaques' (*Macaca thibetana*) choice of infant bridging partners. *Zoological Research*, *35*(3), 222-230.

Beisner, B. A., Heagerty, A., Seil, S. K., Balasubramaniam, K. N., Atwill, E. R., Gupta, B. K., … & McCowan, B. (2015). Human-Wildlife conflict: proximate predictors of aggression between humans and rhesus macaques in India. *American Journal of Physical Anthropology*, *156*, 286-294.

Bercovitch, F. B., & Huffman, M. A. (1999). The macaques. In P. Dolhinow & A. Fuentes (Eds.), *The nonhuman primates* (pp. 77-85). Mountain View, CA: Mayfield Publishing Company.

Berman, C. M., Ionica, C. S., & Li, J. (2004). Dominance style among *Macaca thibetana* on Mt. Huangshan, China. *International Journal of Primatology*, *25*(6), 1283-1312.

Berman, C. M., & Li., J. H. (2002). Impact of translocation, provisioning and range restriction on a group of *Macaca thibetana*. *International Journal of Primatology*, 23(2), 383-397.

Berman, C. M., Li, J. H., Ogawa, H., Ionica, C. S., & Yin, H. (2007). Primate tourism, range restriction, and infant risk among *Macaca thibetana* at Mt. Huangshan, China. *International Journal of Primatology*, *28*, 1123-1141.

Bernstein, S. K., Sheeran, L. K., Wagner, S. R, Li, J. H., & Koda, H. (2016). The vocal repertoire of Tibetan macaques (*Macaca thibetana*): A quantitative classification. *American Journal of Primatology*, *78*(9), 937-949.

Burwell, L. M. (2013). *The effectiveness of scattering corn as a management technique for Macaca thibetana at Mt. Huangshan, China* (Unpublished master's thesis). Central Washington University. Ellensburg, WA.

Castles, D. L., Whiten, A., & Aureli, F. (1999). Social anxiety, relationships and self-directed behaviour among wild female olive baboons. *Animal Behaviour*, *58*, 1207-1215.

Centers for Disease Control and Prevention. (2016). Retrieved from https://www.cdc.gov/herpesbvirus/cause-incidence.html Downloaded on 20 March 2017.

Daniel, J. R., Dos Santos, A. J., & Vicente, L. (2008). Correlates of self-directed behaviors in captive *Cercopithecus aethiops*. *International Journal of Primatology*, *29*(5), 1219-1226.

Duffus, D. A., & Dearden, P. (1993). Recreational use, valuation, and management, of killer whales (*Orcinus orca*) on Canada's Pacific Coast. *Environmental Conservation*, *20*, 149-156.

Duvall-Lash, A. (2013). *Effect of human noise on stress-indicating behaviors of Tibetan macaques (Macaca thibetana) at Mt. Huangshan, China* (Unpublished master's thesis). Central Washington University, Ellensburg, WA.

Fan, Z., Zhao, G., Li, O., Osada, N., Xing, J., Yi, Y., … & Li, J. (2014). Whole-genome sequencing of Tibetan macaque (*Macaca thibetana*) provides new insight into the macaque evolutionary history. *Molecular Biology and Evolution*, *31*, 1475-1489.

Fooden, J. (1976). Provisional classifications and key to living species of macaques (Primates: *Macaca*). *Folia Primatologica*, *25*(2-3), 225-236.

Fooden, J. (1982). Ecogeographic segregation of macaque species. *Primates*, *23*(4), 574-579.

Fooden, J. (1983). Taxonomy and evolution of the *Sinica* group of macaques: 4. Species account of *Macaca thibetana*. *Fieldiana Zoology*, *17*, 1-20.

Fooden, J. (1986). Taxonomy and evolution of the *Sinica* group of macaques: 5. Overview of natural history. *Fieldiana Zoology*, *29*, 1-22.

Fooden, J. (1995). Systematic review of Southeast Asian longtailed macaques, *Macaca fascicularis* (Raffles, [1821]), *Fieldiana Zoology*, *81*, 1-206.

Fooden, J. (2000). Systematic review of the rhesus macaque *Macaca mulatta* (Zimmermann, 1780). *Fieldiana Zoology*, *96*, 1-179.

Fuentes, A. (2006). Human culture and monkey behavior: Assessing the contexts of potential pathogen transmission between macaques and humans. *American Journal of Primatology, 68*(9):880-896.

Fuentes, A. (2010). Natural cultural encounters in Bali: monkeys, temples, tourists, and ethnoprimatology. *Cultural Anthropology*, *25*(4), 600-624.

Fuentes, A., & Gamerl, S. (2005). Disproportionate participation by age/sex classes in aggressive interactions between long-tailed macaques (*Macaca fascicularis*) and human tourists at Padangtegal Monkey Forest, Bali, Indonesia. *American Journal of Primatology, 66,* 197-204.

Fuentes, A., Shaw, E., & Cortes, J. (2007). Qualitative assessment of macaque tourist sites in Padangtegal, Bali, Indonesia, and the Upper Rock Nature Reserve, Gibraltar. *International Journal of Primatology, 28,* 1143-1158.

Goldberg, T. L., Gillespie, T. R., Rwego, I. B., Wheeler, E., Estoff, E. L., & Chapman, C. A. (2007). Patterns of gastrointestinal bacterial exchange between chimpanzees and humans involved in research and tourism in western Uganda. *Biological Conservation*, *135*(4), 511-517.

Hill, D. A. (1999). Effects of provisioning on the social behaviour of Japanese and rhesus macaques: Implications for socioecology. *Primates*, *40*, 179-185.

Hoelzer, G. A., & Melnick, D. J. (1996). Evolutionary relationships of the macaques. In J. Fa, & D. G. Lindburg (Eds.), *Evolution and ecology of macaque societies* (pp. 3-19). Cambridge, UK: Cambridge University Press.

Hsu, M. J., Kao, C.C., & Agoramoorthy, G. (2009). Interactions between visitors and Formosan macaques (*Macaca cyclopis*) at Shou-Shan Nature Park, Taiwan. *American Journal of Primatology*, *71*, 214-222.

Hvenegaard, G. T. (2014). Economic aspects of primate tourism associated with primate conservation. In A. E. Russon, & J. Wallis (Eds.), *Primate tourism: A tool for conservation* (pp. 44-55). Cambridge, UK: Cambridge University Press.

Janson, C. H. (1985). Aggressive competition and individual food consumption in wild brown capuchin monkeys (*Cebus apella*). *Behavioral Ecology Sociobiology*, *18*, 125–138.

Judge, P. G., Evans, D. W., Schroepfer, K. K., & Gross, A. C. (2011). Perseveration on a reversal-learning task correlates with self-directed behavior in nonhuman primates. *Behavioural Brain Research*, *222*, 57-65.

Kurita, H. (2014). Provisioning and tourism in free-ranging Japanese macaques. In A. E. Russon, & J. Wallis (Eds.), *Primate tourism: A tool for conservation* (pp.44-55). Cambridge, UK: Cambridge University Press.

Kurita, H., Sugiyama, Y., Ohsawa, H., Hamada, Y., & Watanabe, T. (2008). Changes in demographic parameters of *Macaca fuscata* at Takasakiyama in relation to decrease of provisioned foods. *International Journal of Primatology*, *29*(5),1189-1202.

Kutsukake, N., & Castles, D. L. (2001). Reconciliation and variation in post-conflict stress in Japanese macaques (*Macaca fuscata*): testing the integrated hypothesis. *Animal Cognition*, *4*(3), 259-268.

Li, J. H. (1999). The Tibetan macaque society: a field study. Hefei: Anhui University Press.

Li, J. H., Yin, H., & Zhou, L. (2007). Non-Reproductive copulation behavior among Tibetan macaques (*Macaca thibetana*) at Huangshan, China. *Primates*, *48*, 64-72.

Li, J. H., Wang, Q. S., & Han, D. M. (1996). Fission in a free-ranging Tibetan macaque troop at Huangshan Mountain, China. *Chinese Science Bulletin*, *41*, 1377-1381.

Li, Q. Q., & Zhang, Y. P. (2005). Phylogenetic relationships of the (*Cercopithecidae*: *Macaca*), inferred from mitochondrial DNA sequences. *Biochemical Genetics*, *43*, 375-386.

Lutz, C., Well, A., & Novak, M. (2003). Stereotypic and self-injurious behavior in rhesus macaques: A survey and retrospective analysis of environment and early experience. *American Journal of Primatology*, *60*, 1-15.

Maestripieri, D. (2011). Emotions, stress, and maternal motivation in primates. *American Journal of Primatology*, *73*(6), 516-529.

Maestripieri, D., Schino, G., Aureli, F., & Troisi A. (1992). A modest proposal: Displacement activities as an indicator of emotions in primates. *Animal Behavior*, *44*, 967–79.

Majolo, B., Lavieren, E. V., Maréchal, L., MacLarnon, A., Marvin, G., Qarro, M., & Semple, S. (2013). Out of Asia: The singular case of the Barbary macaque. In Radhakrishna, S., Sinha, A., & Huffman, M. (Eds.), *The macaque connection: Cooperation and conflict between humans and macaques* (pp. 167-183). New York, NY: Springer-Verlag.

Mallapur, A. (2013). Macaque tourism: Implications for their management and conservation. In S. Radhakrishna, A. Sinha, & M. Huffman (Eds.), *The macaque connection: Cooperation and conflict between humans and macaques* (pp. 93-105). New York, NY: Springer-Verlag.

Maréchal, L., MacLarnon, A., Majolo, B., & Semple, S. (2016). Primates' behavioral responses to tourists evidence for a trade-off between potential risks and benefits. *Scientific Reports*, *6*, 1-11.

Maréchal, L., Semple, S., Majolo, B., Qarro, M., Heistermann, M., & MacLarnon, A. (2011). Impacts of tourism on anxiety and physiological stress levels in wild male Barbary macaques. *Biological Conservation*, *144*(9), 2188-2193.

Matheson, M. D., Sheeran, L. K., Li, J. H., & Wagner, S. R. (2006). Tourist impact on Tibetan macaques. *Anthrozoös 19*(2), 158-168.

McCarthy, M. S., Matheson, M. D., Lester, J. D., Sheeran, L. K., Li, J. H., & Wagner, S. R. (2009). Sequences of Tibetan macaque (*Macaca thibetana*) and tourist behaviors at Mt. Huangshan, China. *Primate Conservation*, *24,* 145-151.

McFarland, D. J. (1966). On the casual and functional significance of displacement activities. *Ethology*, *23*(2), 217-235.

McKinney, T. (2014). Species-Specific responses to tourist interactions by white-faced capuchins (*Cebus imitator)* and mantled howlers (*Alouatta palliata*) in a Costa Rican wildlife refuge. *International Journal of Primatology*, *35*, 573-589.

Ménard, 2004. Do ecological factors explain variation in social organization? In B. Thierry, M. Singh, & W. Kaumanns (Eds.), *Macaque societies: A model for the study of social organization* (pp. 237-261). Cambridge, UK: Cambridge University Press.

Muehlenbein, M. P. (2006). Intestinal parasite infection and fecal steroid levels in wild chimpanzees. *American Journal of Physical Anthropology, 130*, 546-550.

Muehlenbein, M. P., Martinez, L. A., Lemke, A. A., Ambu, L., Nathan, A., Alsisto, S., & Sakong, R. (2010). Unhealthy travelers present challenges to sustainable primate ecotourim. *Travel Medicine and Infectious Disease*, *8*(3), 169-175.

Ogawa, H. (1995). Recognition of social relationships in bridging behavior among Tibetan macaques (*Macaca thibetana*). *American Journal of Primatology*, *35*(4), 305-310.

Ogawa, H. (2006). *Wily monkeys: Social intelligence of Tibetan macaques*. Kyoto, Japan: Kyoto University Press; Melbourne, AU: Trans Pacific Press.

Perdue B., Stoinski, T., & Maple, T. (2012). Using technology to educate zoo visitors about conservation. *Visitor Studies*, *15*(1), 16-27.

Pritchard A. J., Sheeran, L. K., Gabriel, K. I., Li, J. H., & Wagner, R. S. (2014). Behaviors that predict personality components in adult free-ranging Tibetan macaques *Macaca thibetana. Current Zoology*, *60*(3), 362-372.

Riley, E. P. (2007). The human-macaque interface: conservation implications of current and future overlap and conflict in Lore Lindu National Park, Sulawesi, Indonesia. *American Anthropology, 109*, 473-484.

Ruesto, L. A. (2007). Investigation of possible impacts of tourist density, decibel levels, and behavior of threats in Tibetan macaques (*Macaca thibetana*) (Unpublished master's thesis). Central Washington University, Ellensburg, WA.

Ruesto, L. A., Sheeran, L. K., Matheson, M. D., Li, J. H., & Wagner, S. R. (2010). Tourist behavior and decibel levels correlate with threat frequency in Tibetan macaques (*Macaca thibetana*) at Mt. Huangshan, China. *Primate Conservation*, *25*, 99-104.

Russon, A. E., & Wallis, J. (2014). Reconsidering primate tourism as a conservation tool: an introduction to the issues. In A. E. Russon, & J. Wallis (Eds.), *Primate tourism: A tool for conservation* (pp. 3-18), Cambridge, UK: Cambridge University Press.

Saraswat, R., Sinha, A., & Radhakrishna, S. (2015). A god becomes a pest? Human-Rhesus macaque interactions in Himachal Pradesh, northern India. *European Journal of Wildlife Research, 61*, 435-443.

Schino, G., Scucchi, S., Maestripieri, D., & Turillazzi, P. G. (1988). Allogrooming as a tension-reduction mechanism: a behavioral approach. *American Journal of Primatology*, *16*(1), 43-50.

Schnepel, B. (2015). Provisioning and its effects on the social interactions of Tibetan macaques (*Macaca thibetana*) at Mt. Huangshan, China (Unpublished master's thesis). Central Washington University, Ellensburg, WA.

Sponsel, L. E. (1997). The human niche in Amazonia: Explorations in ethnoprimatology. In W. G. Kizey (Ed.), *New world primates: Ecology, evolution, and behavior* (pp. 143-165). New York, NY: Aldine de Gruyter.

Sugiyama, Y., & Ohsawa, H. (1982). Population dynamics of Japanese monkeys with special reference to the effect of artificial feeding. *Folia Primatologica*, *39*, 238-263.

Thierry, B. (2011). The macaques: A double-layered social organization. In C. J. Campbell, A. Fuentes, K. C. MacKinnon, M. Panger, & S. K. Bearder (Eds.), *Primates in Perspective* (pp. 224-239). New York, NY: Oxford University Press.

Troisi, A. (2002). Displacement activities as a behavioral measure of stress in nonhuman primates and human subjects. *Stress*, *5*(1), 47-54.

Usui, R., Sheeran, L. K., Li, J. H., Sun, L., Wang, X., Pritchard, A. J., DuVall-Lash, A. S., & Wagner, S. R. (2014). Park rangers' behaviors and their effects on tourists and Tibetan macaques (*Macaca thibetana*) at Mt. Huangshan, China. *Animals*, *4*, 546-561.

Wagner, K. E., Hopper, L. M., & Ross, S. R. (2016). Asymmetries in the production of self-directed behavior by chimpanzees and gorillas during a computerized cognitive test. *Animal Cognition*, *19*, 343-350.

Wang, X., Sun, L., Sheeran, L. K., Sun, B. H., Zhang, Q. X., Zhang, D., Xia, D. P., & Li, J. H. (2016). Social rank versus affiliation: Which is more closely related to leadership of group movements in Tibetan macaques (*Macaca thibetana*)? *American Journal of Primatology*, *78*(8), 816-824.

Whitten, P. L. 1983. Diet and dominance among female vervet monkeys (*Cercopithecus aethiops*). *American Journal of Primatology*, *5*, 139-159.

Xiong, C. P., & Wang, Q. S. (1991). A comparison of sexual behaviors between *Macaca thibetana* and *Macaca fuscata*. *Acta Theriologica Sinica*, *11*, 13-22.

Yamada, A., & Muroyama, Y. (2010). Effects of vegetation type on habitat use by crop-raiding Japanese macaques during a food-scarce season. *Primates, 51*, 159-166.

Yocco, V., Danter, E. H., Heimlich, J. E., Dunckel, B. A., & Myers, C. (2011). Exploring use of new media in environmental education contexts: Introducing visitors' technology uses in zoo model. *Environmental Education Research*, *17*(6), 801-814.

Yongcheng, L., & Richardson, M. (2008). *Macaca thibetana*. The IUCN Red List of Threatened Species 2008 Retrieved from http://www.iucnredlist.org/details/12562/0 Downloaded on 20 March 2017.

Zhang, Q. X., Li, J. H., Xia, D. P., Zhu, Y., Wang, X., & Zhang, D. (2014). Influence of dominance rank and affiliation relationships on self-directed behavior in female Tibetan macaques (*Macaca thibetana*). *Zoological Research*, *35*(3), 214-221.

Zhao, Q. K. (1996). Etho-Ecology of Tibetan macaques at Mount Emei. China. In: Fa, J. E., & Lindburg, D. G. (Eds.), *Evolution and ecology of macaque societies* (pp.263-289). Cambridge, UK: Cambridge University Press.

Zhao, Q. K. (1999). Responses to seasonal changes in nutrient quality and patchiness of food in a multigroup community of Tibetan macaques at Mt. Emei. *International Journal of Primatology*, *20*(4), 511-524.

Zientek, N. (2014). Impacts of behavioral education on actions and conservation attitudes of tourists at the Valley of the Wild Monkeys, Mt. Huangshan, China (Unpublished master's thesis). Central Washington University, Ellensburg, WA.

Appendix A

Facial Expression Photos

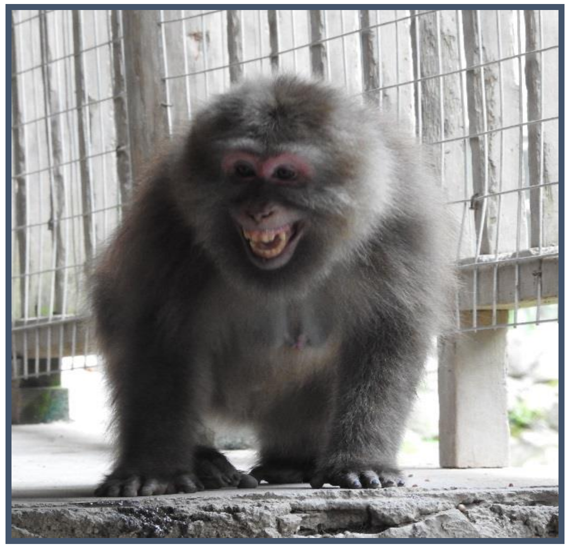

Figure 1A. Fear grin by adult Female Tou Rongyu.
Runzel, K. (Photographer). (2017)
Valley of the Wild Monkeys

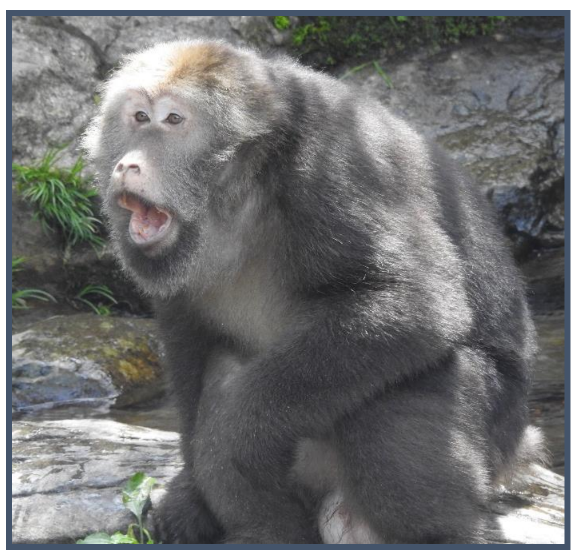

Figure 1B. Threat face by adult male Ye Rongbing.
Runzel, K. (Photographer). (2017)
Valley of the Wild Monkeys

Appendix B

Educational Website Photos

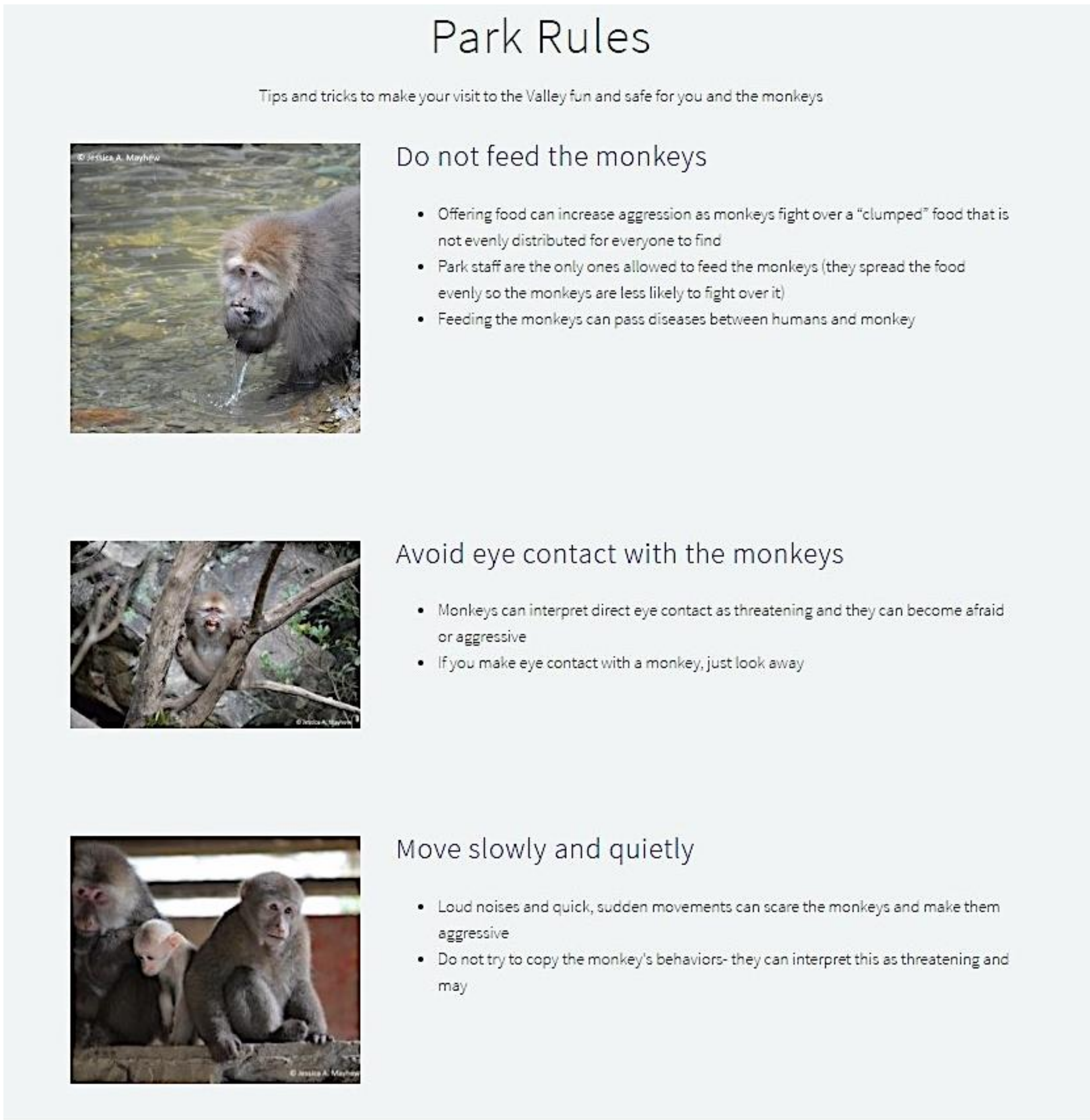

Figure 2A. Educational website: Park Rules (Summer 2017)

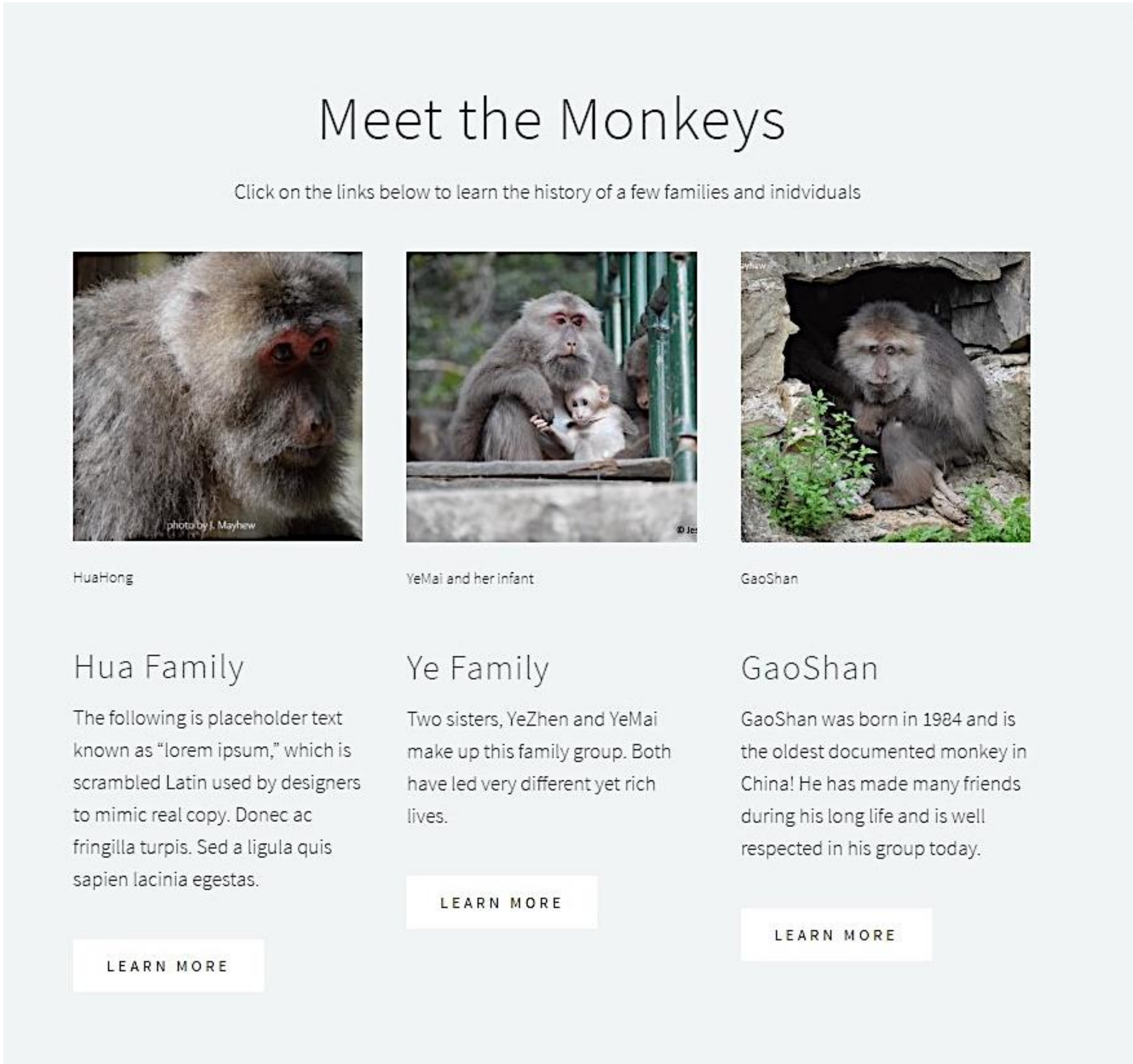

Figure 2B. Educational website: Meet the Monkeys (Summer 2017)