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Sequences of Tibetan Macaque (*Macaca thibetana*) and Tourist Behaviors at Mt. Huangshan, China

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Abstract: Previous research on Tibetan macaques (*Macaca thibetana*) at Mt. Huangshan, China, suggested that ecotourism can have detrimental consequences. This study identified sequences of behaviors that typically occur in macaque-tourist interactions to examine whether particular tourist behaviors precipitate monkey responses. Focal sampling was used to record relevant behaviors from tourists and 10 macaques over 28 data collection sessions in August 2006. Data collectors recorded whether each behavior occurred as part of a sequence. Sequences were defined as two or more behaviors in which each behavior occurred within five seconds of the previous behavior. Of 3,129 total behaviors, 2,539 (81.1%) were from tourists and 590 (18.9%) were from monkeys. Tourists initiated significantly more sequences than did macaques (412 [84.6%] versus 75 [15.4%]). Tourist *pointing*, *rail slapping*, *fleeing*, and *rock showing* occurred significantly more than expected in tourist-macaque sequences. *Points* were also among the most common tourist behaviors preceding macaque threats. By discouraging tourists from engaging in these behaviors, macaque threats could be reduced, thereby improving macaque-tourist interactions. These results may aid in the management of other macaque tourist sites to minimize stress-inducing interactions.
Key words: *Macaca thibetana*, tourism, stress, behavior sequences

Introduction

In recent years, anthropogenic ecological changes and increased human populations worldwide have led to heightened opportunities for interactions between human and nonhuman primates. Sponsel (1997) first coined the term ethnoprimatology to refer to the interconnections between human and nonhuman primates. In little more than a decade since then, studies in ethnoprimatology have become increasingly common (Riley 2006; Wolfe and Fuentes 2007). Many of these studies have examined the effects of primate ecotourism on the species it aims to conserve. Of wild primate populations at tourism sites, perhaps the most studied has been the genus *Macaca*. Macaques have a wide-ranging distribution, spanning East Asia to Northern Africa and Gibraltar, and their home ranges frequently overlap with human habitat and tourist sites (Fuentes 2004). Close contact between humans and macaques can have deleterious consequences for the health of both species. Macaques can transmit simian foamy virus, herpes B virus, simian T cell lymphotropic viruses, and simian retrovirus to humans (Engel *et al.* 2002; Jones-Engel *et al.* 2005; Wolfe *et al.* 2004). In turn, humans can transmit measles, influenza, and respiratory pathogens to macaques (Jones-Engel *et al.* 2001). Human-macaque interactions can also lead to heightened intragroup aggression in macaques, injury to both macaques and humans, and missed or negative educational experiences for humans (Zhao and Deng 1992; Berman and Li 2002; Berman *et al.* 2007). Macaque food provisioning has potentially harmful consequences as well (see, for example, Southwick *et al*. 1976; Sugiyama and Ohsawa 1982; Zhao and Deng 1992).

Hsu *et al.* (2009) studied interactions between Formosan macaques (*Macaca cyclopis*) and tourists at a nature park in Taiwan. Illegally provisioned food significantly increased the duration and frequency of aggressive interactions between the two species. Agonistic behaviors were involved in 16.4% of overall interactions, with adult males of both species as the age/sex class most likely to engage in these behaviors. Human-initiated interactions exceeded macaque-initiated interactions by 2.44:1.

O'Leary and Fa (1993) found some similar patterns when they examined the effects of tourists on the behavior of Barbary macaques (*M. sylvanus*) in Gibraltar. Tourist-initiated

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interactions outnumbered macaque-initiated interactions by 3.2:1. Furthermore, macaques adjusted their diurnal activity patterns based on tourist visitation routines and were much more sedentary compared to their unhabituated counterparts, most likely due to frequent food provisioning. More recently, Fuentes (2006a) found significantly more contact than non-contact interactions between Barbary macaques and humans, as well as a high proportion of interactions and food provisioning involving taxi drivers and tour guides.

Fuentes (2006b) also compared human-macaque interactions at sites in Gibraltar and Bali. In Bali, humans interact with long-tailed macaques (*M. fascicularis*) primarily at Hindu temple sites. Tourists are more frequently bitten by long-tailed macaques in Bali than by Barbary macaques in Gibraltar. There are also higher rates of macaque-macaque aggression as well as macaque-human aggression in Bali than on Gibraltar, which Fuentes attributes to both the contexts of interactions and to species-specific differences between *M. sylvanus* and *M. fascicularis*. At both Gibraltar and Bali, adult male macaques are overrepresented in interactions while adult females are underrepresented. Fuentes *et al.* (2007) used qualitative assessment techniques to compare these same two sites. They emphasize the importance of incorporating human variables into assessments of macaque behavior and ecology. Political, cultural, and economic factors at both sites play relevant roles in macaque behaviors and macaque-human interactions. These factors affect the types of interactions that occur, as well as human attitudes toward the macaques and the potential for disease transmission. Fuentes and colleagues underscore the importance of considering the needs of all stakeholders when developing management strategies to maintain macaque ecotourism sites. Indeed, Loudon *et al.* (2006) noted substantial differences in human attitudes toward long-tailed macaques across 11 different Hindu temple sites in Bali. These attitudinal differences are most likely due to varying cultural and economic conditions between the sites. Their results highlight the importance of evaluating each macaque-human interaction site individually before developing management practices.

Additional studies have focused solely on interactions between long-tailed macaques and humans in Bali. Wheatley and Harya Putra (1994) reported that the macaques were positively reinforced for aggressive behaviors toward tourists via food handouts. The speed and intensity of aggressive macaque behaviors were positively correlated with the quantity and quality of available food. Wheatley and Harya Putra also found a positive correlation between the frequency of redirected monkey-monkey aggression and the presence of provisioned food. Patzschke *et al.* (2000) found potentially deleterious consequences related to food-provisioning in long-tailed macaques. Monkeys spent twice as much time near humans and ate five times as much anthropogenic food on days with high versus low levels of food provisioning. Macaques spent less time on the ground and showed more social behaviors when away from the presence of tourists. Fuentes and Gamerl (2005) examined interactions between tourists and long-tailed macaques, reporting that adult and subadult male macaques were involved in more aggressive interactions with humans than expected by chance, whereas adult females and immatures were involved in fewer. Adult male humans received more aggressive behaviors than expected by chance, and human female children received less. While long-tailed macaques in Bali appear to be afforded some protection through their interactions with humans, these interactions may not be sustainable. Increased tourism, changes in patterns of land use, increased pesticide use, and the potential for disease transmission may eventually lead to a less stable environment for the macaques (Fuentes *et al.* 2005).

In Singapore, long-tailed macaques are significantly more likely to interact with humans if food is present rather than absent (Fuentes *et al.* 2008). Although adult humans typically provision food to the macaques, significantly more children were present at feeding times than at nonfeeding times, suggesting that food provisioning is influenced by children urging their parents to feed the monkeys, or by parents attempting to entertain their children. These results suggest that, similar to other sites, food may be strongly involved in perpetuating macaque-human interactions. Levels of contact interactions and aggression are relatively low between macaques and humans at this site, largely because interactions typically take place along roadsides, where humans throw food from cars. Additionally, unlike at many other interaction sites, Singapore has an education program to minimize contact interactions between macaques and humans and sometimes enforces fines and penalties for doing so (Fuentes *et al.* 2008).

Tibetan macaques (*M. thibetana*) interact with tourists at two sites in China: Mt. Emei and Mt. Huangshan. Tibetan macaques at Mt. Emei often rob visitors of food and other possessions (Zhao and Deng 1992). Visitors are sometimes injured by the macaques, with ten human deaths in a period of eight years as an indirect result of macaque interactions. Zhao and Deng concluded that close interactions were most likely to lead to aggressive encounters, and that visitor behaviors involving food-carrying and submission were most likely to provoke such encounters. More recently, Zhao (2005) assessed data from Mt. Emei and concluded that a combination of classical and operant conditioning procedures have led to aggressive interactions between macaques and humans. The macaques have been classically conditioned to associate tourists with food, and have been shaped through operant conditioning to beg, approach, and use aggression to obtain food. Zhao suggests placing restrictions on food carrying and tourist-macaque interactions at Mt. Emei.

Long-term data from a group of Tibetan macaques at Mt. Huangshan, China, also indicate that ecotourism may negatively impact macaques. Berman *et al.* (2007) reported that the group displayed heightened signs of disturbance, such as increased aggression and infant mortality, as a function of range restriction for tourism purposes. Ruesto (2007) found a significant positive correlation between the frequencies of macaque threats and tourist behaviors directed at macaques. Matheson *et al.* (2006) found that monkeys' threats were

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usually directed from adults to juveniles and from juveniles to humans, possibly due to redirection. Self-directed behaviors in this group were positively correlated with tourist density in an area of the home range in close proximity to tourist platforms (Matheson *et al.* 2007). Additionally, grooming bouts among these macaques were significantly more frequent when tourists were present rather than absent. Tourist density showed a positive trend with regard to female grooming, and was positively correlated with self-grooming by adult males (Mack *et al.* 2008).

Although these data demonstrate a relationship between overall frequency of tourist behaviors and macaque threats, the causal relationship between them has remained unclear. The aim of the present study was to clarify the order of events that typically occurs during macaque-human interactions at Mt. Huangshan.

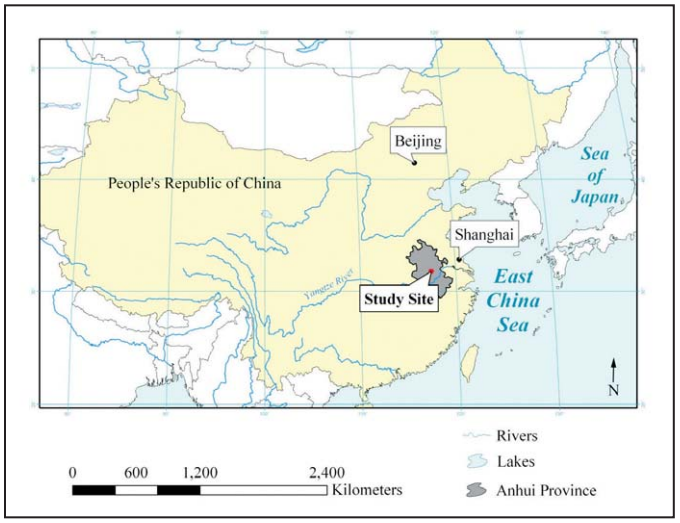


Figure 1. Location of study site. Map by Lucy A. Ruesto, using ArcGIS (v.8).

Methods

Subjects and Study Site

Data were collected over 28 sessions from 17–26 August 2006 at Mt. Huangshan, Anhui Province, China (30°07'09"N, 118°09'41"E; elevation 1,841 m). Mt. Huangshan is a tourist site in east-central China (see Fig. 1). The middle and lower elevations of the site support mixed evergreen and deciduous forests that are home to several groups of Tibetan macaques (*Macaca thibetana*).

Yulingkeng A1 (YA1), the group observed for this study, has been studied by Chinese researchers since 1986, and subjected to tourism since 1992 (see Fig. 2). All YA1 subadult and adult macaques (three adult males, five adult females and two subadult males) served as the focus of this study. Infants and juveniles were excluded, since they do not display the full range of species-typical social behaviors under study, and are difficult to identify reliably (Kutsukake and Castles 2001). Data were collected from a tourist viewing platform located in the macaques' home range (see Fig. 3).



Figure 2. *Macaca thibetana* adult male, adult female, and infant. Photo by Lucy A. Ruesto.

Table 1. Ethogram of human tourist behaviors.[1]

Behavior	Description
Barbed Wire Shake	Tourist shakes the barbed wire that borders the viewing platform railing.
Dangle	Tourist dangles food, body parts, or objects over the viewing platform railing toward macaques.
Flee	Tourist turns and runs away from macaques.
Foot Noise	Tourist stamps feet or kicks wall in observation area.
Hand Noise	Tourist makes noises with one or both hands.
Mimic	Tourist mimics facial expressions and/or body language of a macaque threat, e.g., eyebrow raise, stare, and ground slap.
Mouth Noise	Tourist makes noise with mouth directed toward macaque.
Show Rock	Tourist pretends to throw rock at macaques.
Point	Tourist points at macaques, with arm extending toward macaques' feeding area.
Railing Slap	Tourist slaps rail or post in observation area, which may be done with hands or objects.
Spit	Tourist spits into macaque area.
Throw Food	Tourist drops or throws food item into the macaque area, or directly to a macaque.
Throw Object	Tourist drops or throws non-food item into macaque area (includes rock).
Wave	Tourist waves at macaque. Can be done with hands or objects.

[1]Derived from Ruesto (2007) and data collectors' observations in this study.

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Procedures

Data collectors achieved 100%, 92% and 95% interobserver reliability for macaque identity, macaque behaviors and tourist behaviors, respectively, prior to beginning data collection. Table 1 shows an ethogram of human behaviors, and macaque behaviors were those described by Berman *et al.* (2004). In each session, data collectors selected a focal animal opportunistically based on their visibility and orientation toward a tourist. Two data collectors recorded the occurrence of any ethogram-defined behaviors, with one data collector speaking the macaque behaviors aloud while the second recorded these and the behavior of the relevant tourist(s) so that the sequence was preserved. A sequence was defined as a string of behaviors in which each behavior occurs within five seconds of the previous behavior. Data collection ceased when the macaques left the area and were no longer visible from the viewing platforms. Data collectors attempted to distribute focal observations equally across macaques; however, the opportunistic nature of data collection meant that some macaques were observed more than others, or contributed more behaviors to sequences. To ensure equal representation under different conditions, observation sessions were distributed across the day, as well as during times of high and low tourist density. Research methods were approved by the Institutional Animal Care and Use Committee and the Human Subjects Research Committee of Central Washington University.

Results

In all, 3,129 behaviors were recorded; 2,539 (81.1%) were performed by tourists and 590 (18.9%) were performed by macaques. The most commonly observed (macaque and tourist) behaviors overall were *points*, *waves*, and *facial threats*. Of macaque behaviors, 387 (65.6%) were performed by adult females, 151 (25.6%) by subadult males, and 52 (8.8%) by adult males. Overall, 250 behaviors (8.0%) occurred singly and 2,879 (92.0%) occurred in sequences.

A total of 487 sequences were observed. These ranged in length from 2 to 109 behaviors, with two-behavior sequences occurring most frequently ($n = 108$). Of these sequences, 343 (70.4%) involved only human behaviors, 117 (24.4%) involved a combination of human and macaque behaviors, and 27 (5.1%) involved only macaque behaviors. There were significantly more tourist-only sequences than tourist-macaque and macaque-only sequences ($\chi^2 = 326.6$, $p < .005$). Sequences involving both human and macaque behaviors



Figure 3. Macaques and tourists at the provisioning site. Photo by Maureen S. McCarthy.

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consisted of significantly more behaviors than tourist-only and macaque-only sequences (M = 9.56 behaviors vs. 4.75 and 4.89, respectively; $F(2, 484) = 13.24$, $p < .001$; see Fig. 4). Humans initiated significantly more sequences than did macaques (412 [84.6%] vs. 75 [15.4%]; $z = 15.4$, $p < .005$; see Fig. 5).

The prevalence of tourist behaviors involved in tourist-only sequences and in tourist-macaque sequences were compared. *Flee* ($n = 13$, $z = -2.19$, $p < .05$), *point* ($n = 1{,}588$, $z = -2.35$, $p < .05$), *show rock* ($n = 15$, $z = -2.34$, $p < .05$), and *railing slap* ($n = 137$, $z = -3.59$, $p < .05$) all occurred more frequently than expected in tourist-macaque sequences. The behaviors following the occurrence of tourist *point* and *railing slap* in sequences were examined. *Flee* and *show rock* were excluded from this analysis due to their low total numbers of occurrences (13 and 15, respectively). For *point*, another *point* (72.6%), *wave* (11.9%), and *railing slap* (2.3%) were the most common tourist behaviors to directly follow. The most frequent macaque behavior to follow a tourist's *point* was a *facial threat* (3.4%). For *railing slap*, another *railing slap* (33.3%), *point* (18.9%), and *wave* (11.7%) were the most common behaviors overall to directly follow. The most frequent macaque behavior to follow a *railing slap* was a *lunge/ground slap* (10.8%).

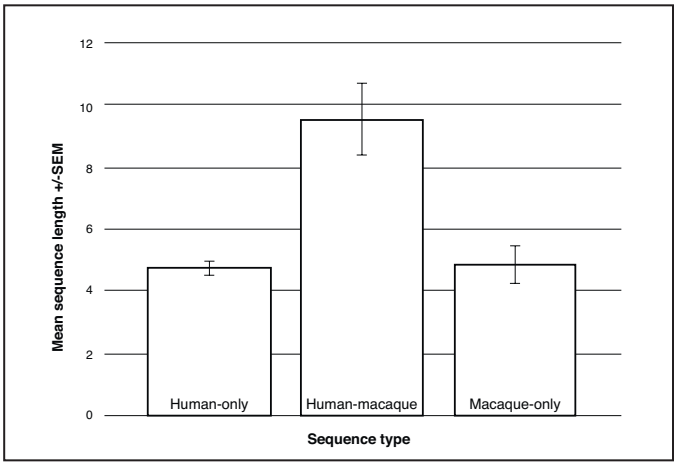


Figure 4. Mean sequence length by sequence type.

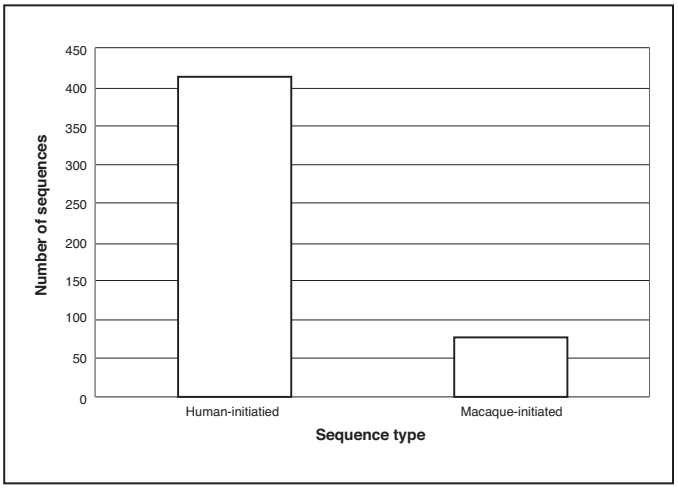


Figure 5. Sequence initiations.

The most common macaque behaviors were also examined to determine which overall behaviors directly preceded them. For *facial threats*, another *facial threat* most often preceded it (34.2%), followed by a tourist's *point* (18.7%) or a *lunge/ground slap* (14.6%). For *lunge/ground slap*, another *lunge/ground slap* commonly preceded it (33.9%), as well as a *facial threat* (28.7%) or a tourist's *point* (9.2%). For *charge*, a tourist's *point* commonly preceded it (32%), as well as a *facial threat* (22%) or *lunge/ground slap* (18%). Finally, *full grins* were commonly preceded by another *full grin* (30.4%), as well as a *facial threat* or a tourist's *point* (each 17.4%). All other macaque behaviors occurred less than 10 times overall.

Discussion

The most prevalent behaviors by far were those performed by tourists. Not only did they perform the most behaviors, but they also initiated far more sequences than macaques. Despite this, sequences containing both tourist and macaque behaviors were significantly longer than those containing only tourist or macaque behaviors. This suggests that true interactions occurred, not just independent behaviors from each species. Tourist behaviors prompted macaque behaviors and vice versa, thus extending interactions. *Point* and *railing slap* were the tourist behaviors that occurred more than expected in tourist-macaque behavioral sequences. That these behaviors were most commonly followed by another occurrence of the same behavior suggests that tourists repeated behaviors in an attempt to elicit macaque responses. Tourist behaviors such as *show rock* and *throw object* may be considered more intensely threatening to monkeys but occurred much less frequently, possibly because they more effectively elicited frightening macaque responses.

Although *points* and *railing slaps* were most commonly followed by additional tourist behaviors, macaque threats sometimes followed. These macaque threats demonstrate a meaningful pattern based on the human behavior preceding them. A *facial threat* was the most common macaque behavior to follow a tourist's *point*, but a *lunge/ground slap* was the most common macaque behavior to follow a tourist's *railing slap*. Based on its noise component and abruptness, a *railing slap* may be considered a more intense tourist behavior than a *point*, and thus not surprisingly was more commonly followed by a more intense macaque behavior, namely a *lunge/ground slap* as opposed to a *facial threat*. In contrast, a *point*, while occurring very frequently, may be relatively benign and thus result more commonly in a milder response from the macaque, a *facial threat*. However, that a macaque's *charge* was most commonly preceded by a tourist's *point* suggests that the macaques can sometimes be aggressively provoked by *point*.

Data collectors observed anecdotally that some tourist behaviors varied widely in intensity levels while still falling within the operational definitions that had been assigned

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a priori. For example, *points* that broke the plane of the viewing platforms and extended over the railings and into the macaques' feeding area appeared more likely to evoke threats than those that occurred further back on the platforms and away from the feeding area. Behaviors involving an auditory component, such as *hand noise*, *foot noise*, *mouth noise*, and *railing slap* appeared to vary in their likelihood to evoke macaque behaviors based at least partly on the noise level accompanying them. Similarly, Ruesto (2007) reported a significant positive correlation between decibel levels produced by tourists and the frequency of macaque threats.

The current study suggests directions for future research as well as recommendations for tourism management. For example, since *points* and *railing slaps* occur significantly more than expected by chance in human-macaque sequences, and since *points* commonly preceded the most prevalent macaque threats, reduction or elimination of these behaviors could result in a significant reduction in macaque threats. If a reduction in the occurrence of two simple but frequent tourist behaviors could indeed result in a reduction in macaque threats, macaque-tourist interactions could be significantly improved. The long-term consequences of such improvements for macaque well-being and tourist education could potentially be great. In addition, if tourist behavioral adjustments successfully result in the reduction of macaque threats and aggression, this information could be shared with the many other ecotourist sites worldwide where humans and macaques closely interact.

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