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AGONISTIC BEHAVIOR BETWEEN RHESUS MONKEYS (*Macaca
mulatta*) AND HUMANS IN NEPAL

A Thesis

Presented to

The Department of Graduate Studies

San Jose State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

by

Bonnie Lynn Pedersen

May 1997

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ABSTRACT

AGONISTIC BEHAVIOR BETWEEN RHESUS MONKEYS (*Macaca mulatta*) AND HUMANS IN NEPAL

by Bonnie Pedersen

Monkeys and humans coexisting in urban areas frequently engage in interactions, many of which are aggressive in nature. This project investigated aggressive interactions between rhesus monkeys, *Macaca mulatta*, and humans in Kathmandu, Nepal from July 15 to November 1, 1993. The purpose was to determine if most agonistic encounters involved the acquisition of food by monkeys, what category of people (tourists, priests or residents of Nepal) are most often involved, and whether there was a relation between the distance between monkeys and humans and aggressive encounters.

The statistical analysis of collected data revealed that food visible during an encounter was not a cause of aggression; however, monkeys searching for food often led to aggressive behaviors. Tourists were far more likely to be involved in aggressive encounters with monkeys than priests or Nepalese. Most aggressive encounters occurred when the distance between human and monkey was two meters or less.

DEDICATION

To Naveen. Without your faith, encouragement and unending help it would not have happened. Dhanyawad, Mero Manche.

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INTRODUCTION

Agonistic encounters between rhesus monkeys (*Macaca mulatta*) and humans are often observed in areas of co-habitation throughout Asia. Many rhesus monkeys have adapted quite well to living in close quarters with humans while still maintaining their wild state. The purpose of this project was to evaluate the aggressive encounters between rhesus temple monkeys and humans. There were three main objectives. The first was to determine the role of food in an aggressive encounter. The second was to discover whether tourists were involved in aggressive encounters more than Nepalese (residents of Nepal) or Buddhist priests in residence at Swayambhu. The third objective was to determine the distance between humans and monkeys at the time most aggressive interactions occurred.

The study was conducted from July 15 to November 1, 1993 at Swayambhu temple, in Kathmandu, Nepal. Rhesus monkeys and humans have been coexisting in this temple for at least 2000 years, making it an excellent place to observe interactions between the two species. The temple is home to several troops of monkeys totaling more than 200 individuals. Swayambhu is both a Buddhist and a Hindu temple accessible to anyone. It is situated on the top of a hill surrounded by a strip of forest that confines most human/monkey interactions to the temple and the stairs leading to it.

Study results indicated that the presence of food in an interaction was not a primary cause of aggression; however the absence of food may cause monkeys to search for food leading to aggressive encounters. Non-Nepalese tourists were the most common category of human involved in aggressive encounters. Observations suggested tourists' ignorance of monkey behavior was a likely cause of some aggressive encounters. A monkey's "comfortable space" was determined to be at least two meters from humans, unless being fed. Aggressive interactions seldom occurred beyond this distance.

By examining the respective roles of monkeys and humans in these interactions, new insights may be gained into better management of areas where humans and wildlife come into close contact.

BACKGROUND

Rhesus monkeys were among the first non-human primates to be studied, beginning more than sixty years ago. Initially, they were only of interest biologically and they were "the primate of choice" for laboratory experiments. Breeding colonies for laboratory use were established in 1939 on Cayo Santiago and in 1962 on La Parguera, both of which are islands off the coast of Puerto Rico. Population and behavior studies did not begin on these groups until the early 1960's (Koford, 1966). However, early studies were not limited to captive or semi-captive rhesus groups. In 1959 field studies began on free ranging troops in India by Southwick, Beg and Siddiqi (1961). It was not until 1969 that preliminary observations began in Nepal by Southwick and Teas, leading to an ecological study by the same team in 1971 and 1972.

Rhesus monkeys occur throughout most of Asia in a wide range of habitats including desert, rain forest, mountains and arid plains. They have adapted exceptionally well to human encroachment and can be found living in villages, towns, temples, railway stations, and even some isolated spots in large cities (Ciani, 1986; Singh, 1969; Teas, 1978). Chance and Jolly (1970) stated: "Rhesus monkeys of today have taken advantage of an ecological niche provided by man in which food is plentiful, and it seems likely that they have done so for the past five thousand years" (p. 50). Some of

their success at co-existing with humans is due to Hindu, Buddhist and animist religions, all prevalent in the East. All of these religions discourage the killing of animals. Monkeys in particular are revered in the Hindu religion. One of the stories in the Ramayana, a Hindu holy book, is about a monkey warrior called Hanuman. Seeta, the Lord Raama's wife, is stolen by the evil Raman while Ramma is out hunting. When he comes home and finds Seeta gone he sends Hanuman to find her. Hanuman finds Seeta under a tree and identifies himself by dropping Raama's ring into her lap. Seeing the ring, Seeta goes with Hanuman back to Ramma (Rajagopalachari, 1990). Because of his bravery, Hanuman and all his relatives are considered sacred.

In literature, Hanuman is usually depicted as a langur (*Presbytis entellus*), a more arboreal species than the rhesus. Langurs are still found in or around Hindu temples in India, where they are fed and protected (Southwick 1962). However, most humans fail to make a specific philosophical distinction between rhesus monkeys and langurs, allowing the more prevalent rhesus to enjoy the same sacred status as the langurs. This religious veneration of monkeys has kept them relatively safe in Hindu countries. However, because of increasing human population size, the monkeys have become not only a nuisance but an increasing problem to people. They invade homes and stores in urban developments and raid crops in rural areas. Due to their sacred status, monkeys have not

been killed outright in many of the Asian countries, however, they have been commercially trapped and exported (Lindburg, 1972; Southwick 1962). Nepal is an exception to this rule. The Nepalese government to date has never allowed any commercial or private hunting or trapping of monkeys (Jiang, Liu, Zhang, & Southwick, 1991; Schultheis, 1986). As a result of this policy, monkeys are not as fearful of humans as their counterparts in other countries. This protective policy is also thought to be partially responsible for the relative stability of troop size and social structure in urban monkeys (Johnson, Teas, Bishop, & Southwick, 1988; Malik, Seth, & Southwick, 1984; Southwick, Teas, Richie, & Taylor, 1982; Teas, Richie, Taylor, & Southwick, 1980). It is interesting to note that although all monkeys are granted religious status in many Asian countries, macaques are the most common non-human primate living in close contact with humans (Teas, 1978).

The genus *Macaca* tends to be among the most aggressive of the Old World monkeys and within the genus, the rhesus monkey, *Macaca mulatta*, displays the most xenophobic and agonistic behaviors (Bernstein, 1974; Bernstein, Gordon & Rose, 1974; Clark & Mason, 1988; Lindburg, 1980; Southwick, Siddiqi, Farooqui & Pal, 1976). The majority of behavioral field studies done on rhesus monkeys deal with social relations within the species. There are a number of studies that compare forest dwelling monkeys to urban monkeys in

which there are occasional references to agonistic behaviors between rhesus and humans (Carpenter, 1974; Ciani, 1986; Lindburg, 1972; Nevile, 1968; Singh, 1969; Southwick & Siddiqi, 1985; Thierry, (1986). The few studies dealing specifically with monkey/human interactions have been on captive animals (Bernstein, 1962; Bernstein, Schusterman & Sharpe, 1963; Clark & Mason, 1988; Fa, 1992) Many researchers have suggested that urban monkeys in general are more aggressive, both within their species and towards other species, than their "wild" counterparts (Fa, 1992; Lindburg, 1980; Southwick, 1965). Singh (1969) believes this is due to the restrictive urban environment and a more limited food supply.

Most aggressive encounters between rhesus macaques and humans are limited to threats and do not involve physical contact, but there are exceptions. Lindburg (1980) noted that rhesus monkeys in North India often chased pedestrian and bicycle traffic without provocation. They have even been known to jump on passersby, bounce off and run away (Fa, 1992). Monkeys also occasionally bite people, especially when food is present (Fa, 1992; Small, 1992). However, aggression is not always initiated by monkeys. Indeed, humans have been frequently observed shoos monkeys away with loud yells and arm gestures, and shopkeepers and farmers have been seen hitting monkeys with sticks and stones to drive them off (Singh, 1969; Teas, 1978; Small, 1992). According to

Southwick, et al., (1974), in a study of free-ranging rhesus troops in India, human feeding of monkeys resulted in "considerable aggression and competitive activity centered around getting the food" (p. 193). Volunteers at Swayambhu temple, usually women, were often seen sitting in the plaza sorting rice, money, and other food gathered from the various offering plates around the temple. When this activity occurred, monkeys congregated around and frequently dashed in to grab a handful of food and run off. The women threatened them with yells and arm gestures and the monkeys returned their threats with stares and vocalizations. Sometimes the monkeys retreated a few steps but quickly returned to try again. Monkeys investigating open doors were routinely driven away by residents. Young boys from the Buddhist school within the temple have been observed teasing monkeys with taunts and aggressive gestures. These sessions usually ended with the boys being chased inside by angry monkeys.

There are a number of free ranging rhesus troops living in and around Swayambhu temple in Kathmandu. Because this temple is completely surrounded by urban development and small farms, the monkeys that live at Swayambhu are isolated from other macaque groups. The temple is a popular tourist stop as well as being the daily destination of many Hindu and Buddhist worshipers. This makes it an ideal setting for observations of human/monkey interactions. Because of their isolation, these monkeys are primarily dependent on humans

for provisioning. Their diet consists of the food placed around various shrines within the temple as religious offerings, feeding by visitors and pilfering from nearby fields, shops and houses (Teas, 1978; Southwick & Siddiqi, 1985). Although there is a forested area around the temple it offers only a small supplement to their diet.

Behavioral studies of free ranging monkeys interacting with humans are rare. Dr. Small (1992) recently completed a survey of the effects of tourism on long-tailed macaques in Bali. Her conclusions suggest widespread misunderstanding of humans towards their fellow primates and a need for better management in areas of co-existence. Since humans continue to encroach on other species' habitats and force either co-existence or extinction, more studies of this problem are important.

METHODS

Study Sites

The project was conducted in the Kathmandu Valley of Nepal at an altitude of 1341 meters. The city of Kathmandu is the capital of Nepal with a population of about twenty million people. The study site was Swayambhu, a temple that has been used by Buddhists and Hindus for over 1000 years. Today it is primarily a Buddhist temple but there is an important Hindu shrine within the compound that attracts many Hindu worshipers to visit. This temple is open to the public, making it a favorite destination for tour buses.

Swayambhu temple is located on the far western edge of Kathmandu city, atop a hill that rises to 90 meters (Figure 1). The temple complex is completely surrounded by a wide band of parkland consisting of dense shrubs, underbrush and many trees. Other than the stairways to the temple and a few shrines close to the stairs, the wooded area is uninhabited by humans. The temple complex and surrounding parkland forms the majority of the home ranges of resident rhesus monkey troops. The base of the hill is encircled by a narrow paved road and urban development. On the south and southwest side is a busy commercial area with many stores and small factories. To the north and northeast is an area with some small farms and light industry and on the east is central Kathmandu. The Swayambhu monkey population is actively discouraged from leaving the temple and surrounding forest by

merchants, farmers and residents who chase them off, frequently with rocks and sticks.

Only one road leads from the base of the hill to the lower portion of the temple compound. It is paved and passes a Buddhist elementary school and two Buddhist monasteries before ending in a small parking lot used by tour buses, taxi cabs and private vehicles. From the parking lot, five steps lead to a large paved plaza from which another stairway (115 steps) leads up and into the temple compound. The main entrance faces east and consists of a wide stairway of 327 steps interrupted here and there by broad landings with various shrines. These stairs connect the temple to the road from central Kathmandu. The third entrance is a narrow, infrequently used stairway on the north side joining the temple to the road where there are a few small farms and a Buddhist cemetery.

Observations at Swayambhu were confined to the exterior of the temple buildings and the surrounding courtyard which occupies about 1700 square meters (Figure 2). In the center of the courtyard is a large cement stupa that measures 30.5 meters in circumference and is approximately nine meters tall and crowned by an equally tall conical spire. Set into the lower perimeter of the stupa are niches containing shrines about 1.5 meters high, one meter wide and one half meter deep. There is a bronze carved figure in each shrine and a place to set food offerings. The surrounding courtyard

varies in width from 18 to 35 meters. Bordering the courtyard on the east is a multi-storied residential building with the lower floor open on three sides, the stairs leading to Kathmandu, and a walled courtyard a few steps below the main level. The south end is enclosed by a one meter wall. Between the wall and the stupa is a large, single story building with many small cement shrines in front and large ones on either end. On the southwest side are the stairs to the parking lot. The west side of the courtyard is enclosed by multi-storied buildings, the main one having the lower floor open on three sides. Between this building and the stupa is a small structure containing a frequently visited Hindu shrine. The northwest corner opens onto a separate plaza surrounded by multi-storied residential buildings with commercial shops on the ground floors. A very large rectangular building, a Buddhist prayer room with residences above, occupies the north side.

There were two observation sites which divided the total area approximately in half. Data were collected by two observers, myself and Naveen Chaudhary. Each observer was responsible for recording all monkey/human interactions within their observation area. The observers moved around within their area if their view became obstructed.

Field Methods

Preliminary observations acquainted us with the daily migration patterns of the resident monkey troops. The greatest activity period was from very early dawn to late morning (6:00-11:00 a.m.) when the monkeys were foraging for food. This activity period coincided with the largest number of people at the temple. Early morning being the time most Hindu and Buddhist worshipers came to pray. Different monkey troops would pass through and around the temple searching shrines for offerings and watching human visitors for possible handouts or a chance to snatch an unguarded tidbit. From 11:00 a.m. to 3:00 p.m. there were seldom any monkeys in the temple compound. This was the hottest time of the day and they usually went into the forest areas and away from human contact. From late afternoon to dusk (3:00 p.m.-7:00 p.m.), monkeys returned to the temple compound. Some troops simply passed through searching for food, others remained throughout the afternoon then left, and still others stayed to find sleeping places on and around the stupa.

The number of humans in the temple area varied greatly depending on religious festivals, time of year and the weather. However, their numbers were always greatest in the morning. Southwick, (1965), in a study of rhesus monkeys in North India also noted the greatest monkey activity periods coincided with the greatest human activity periods. In contrast Neville (1968), found monkeys to be more active in

the early morning before humans arrived. The early morning Swayambhu visitors consisted mostly of priests and Kathmandu residents coming to pray. Tourists usually arrived after 11:00 a. m. and frequently never encountered monkeys. For this reason most data were collected early in the morning and late in the afternoon. Observation periods lasted from two to five hours, depending on the presence of monkeys. During rainy periods both humans and monkeys sought cover and there were no interactions between them.

A count of the total number of monkeys and humans present in the two observation sites was taken every 30 minutes during observation periods. This was accomplished by one observer walking completely around the stupa and counting all monkeys and humans visible in the two areas. Weather conditions were also noted at the beginning of each observation period.

Every observed encounter between monkeys and humans within the designated observation area was recorded. An encounter was defined as an interaction between a monkey and a human when each became aware of the other through eye contact.

Encounters were recorded on a coded check list (Appendixes A-C). Data recorded included the number of participants involved in an encounter, the distance between the monkey and human when the encounter began and whether food was present or absent.

Monkeys and humans were categorized by age and sex. Monkeys were recorded as adult, juvenile or infant. Adult females were distinguished by the presence of red sexual skin and adult males by descended testes. Juveniles were smaller and sexually immature. Infants were nursing babies carried by their mother, and these were not distinguished by sex. Humans were loosely ranked into three categories by subjective observation, adult (20 years and over), young adult (12-20 years) and child (under 12 years). Humans were further classified as priest, tourist or Nepalese, recognized by dress, language and manner.

Each encounter was classified as aggressive or non-aggressive. For purposes of this study, aggressive behavior was defined as threats, chases and/or attacks by either monkeys or humans. Hinde and Rowell (1962), Rowell and Hinde (1961), and Sade (1973) provide excellent descriptions of various rhesus monkey behaviors, including facial expressions, vocalizations and body postures indicating threat, attack, fear, and food soliciting. These descriptions as well as the behavioral studies of Teas (1978), Southwick (1965) and Lindburg (1980) were combined with my personal observations of rhesus behavior from a three-month study at the California Regional Primate Center, Davis, to form the basis of aggressive monkey behavior recognition and classification. The initial behavior in an encounter and its resulting behavior were recorded for both

monkeys and humans from a coded list of possibilities (Tables 1-4). The initiator, monkey or human, was also recorded. Anything unusual or of particular interest during an encounter was noted as a memo.

Hierarchical log linear analysis, a test of independence of three or more variables, was used to analyze the data (Zar, 1996). An alpha level of 0.05 was used to determine significance. We ran four hierarchical log linear analyses using the variables, ENCOUNTER*FOOD*INITIATOR*SEX, MONKEY BEHAVIOR*FOOD*HUMAN REACTION, and HUMAN TYPE*ENCOUNTER*FOOD*DISTANCE. Components of the best models from these analysis are presented as two-way frequency tables or three-way frequency tables.

Table 1: Types of initial behavior displayed by monkeys in an encounter with humans.

Monkey behavior	Description
No aggression	There was an encounter but the monkey displayed no aggression.
Threat Face	A tense facial expression directed towards a perceived threat. The eyebrows are raised over wide open eyes, the mouth is opened slightly with a tense forward position of the lips and lower jaw, and the ears are back and flattened (Hinde and Rowell, 1962).
Grab Food	A monkey grabbed something, usually food, from an unsuspecting human.
Physical Contact	Whenever a monkey touched a human, whether it was a non-aggressive encounter such as begging, or aggressive such as biting.
Chase	Whenever a human runs from a monkey and the monkey pursues.
Bite	Whenever a monkey bites a human.

Table 2: Types of initial behavior displayed by humans in an encounter with a monkey.

Human behavior	Description
No aggression	There was an encounter but the human displayed no aggression.
Feed	Human purposely fed monkey/monkeys. A non-aggressive behavior.
Stare	Human stares directly into monkeys eyes. Considered a threat by monkeys (Hinde and Rowell, 1962).
Arm threat	Human waves arm/arms at monkey in a threatening manner.
Tease	Any recognized form of deliberate teasing.
Wave stick	Threatening monkey with a stick or other object.
Throw object	Throwing something at monkey.
Chase	Chasing a monkey or monkeys, usually accompanied by arm threats and/or vocalizations.
Physical contact	Hitting or kicking a monkey.

Table 3: Types of monkey behaviors resulting from an encounter with a human.

Monkey reaction	Description
Eat	The monkey was either fed deliberately or stole food.
Other interest	The encounter concluded with the monkey's attention diverted to something else.
Leave	A neutral end to an encounter. The animal walks away.
Stare	A mild threat. The eyes are wide open, the mouth closed and lips slightly protruding.
Retreat	A fear response. Animal backs off cautiously watching perceived threat.
Flee	A strong fear response. Animal runs from threatening human.

Table 4: Types of human behaviors resulting from an encounter with a monkey.

Human reaction	Description
Watch	Continues to watch monkey/monkeys after encounter.
Other interest	Attention changes to something else.
Leave	Walks away from scene of encounter
Retreat	Backs up, usually a sign of fear.
Flee	Turns and runs from monkey/monkeys.
Chase	Human chases monkey

Figure 1: Map showing location of Swayambhu Temple
* Not to scale

Figure 2: Plot plan of study area at Swayambhu Temple in Kathmandu

• Not to scale

RESULTS

There were 869 interactions between monkeys and humans analyzed by computer generated hierarchical log linear analysis. Hierarchical log linear analysis is a test of independence of three or more variables. This test results in one or more significant interaction or "model." As defined by Zar (1996), "A 'model' in statistical analysis is an expression of how observed data are affected by variables and combinations of variables" (p. 509).

The best models generated by the hierarchical log linear analysis (denoted VARIABLE*VARIABLE*VARIABLE) of ENCOUNTER*FOOD*INITIATE* SEX were, ENCOUNTER*FOOD, INITIATE*FOOD and ENCOUNTER*FOOD*SEX. In the first frequency table using the model ENCOUNTER*FOOD (Table 5), a significant interaction between the presence or absence of food and the type of encounter (non-aggressive or aggressive) was indicated. Food was present 67% of the time where non-aggressive encounters outnumbered aggressive encounters by a ratio of 2:1. However, when food was absent, aggressive encounters outnumbered non-aggressive encounters by a ratio of 32:1. The number of aggressive encounters (466) and non-aggressive encounters (403) were statistically equivalent.

The second model generated, INITIATE*FOOD, also indicated a significant interaction (Table 6). Humans initiated more encounters than monkeys at a ratio of 2:1 when

both aggressive and non-aggressive interactions were considered. When only the aggressive (466) interactions between humans and monkeys were analyzed, monkeys initiated more encounters than humans (57.7%, 42.3%). The presence or absence of food did not significantly affect the number of monkey initiated aggressive encounters (less than a 5% difference), but, aggressive encounters initiated by humans increased with the absence food at a ratio of 2:1.

The third model generated, ENCOUNTER*FOOD*SEX, indicated a significant three-way interaction between the sex of the monkey, the type of encounter (aggressive or non-aggressive) and food (presence or absence). Table 7, showing only aggressive encounters, indicates male monkeys were involved in aggressive encounters only 2% more than female monkeys. The presence or absence of food did not make a significant difference in aggressive male encounters (109 present, 140 absent). However, female monkeys were more aggressive when food was not present by a ratio 2:1.

The best models generated by the hierarchical log linear analysis of MONKEY BEHAVIOR*FOOD*HUMAN REACTION were MONKEY BEHAVIOR*FOOD and MONKEY BEHAVIOR*HUMAN REACTION. Initial monkey behaviors were categorized into six types (passive, threat face, grab food, physical contact, chase, bite), recorded and analyzed (Detailed description in Table 1, p. 10). The log linear model, MONKEY BEHAVIOR*FOOD, indicated the type of monkey behavior during an encounter with a

human/humans was influenced by food (presence or absence) (Table 8). Most interactions were non-aggressive (91%) and involved food. Two of the aggressive behaviors, threat face and chase, increased with the absence of food at a ratio of 32:1 and 5:1. Physical contact encounters were not significantly affected by the presence or absence of food (44,41). The only recorded incident of a monkey biting a human occurred with food present.

A threat face was the most common aggressive monkey behavior (25%) and the most common human reaction to this behavior was to retreat (58), watch (53), or walk away (49) (Table 9). Usually the human reaction to any initial monkey behavior was to leave the scene (41%) or simply to watch the monkeys (29%).

The best models generated by the analysis of HUMAN BEHAVIOR*FOOD*MONKEY REACTION were HUMAN BEHAVIOR*FOOD and HUMAN BEHAVIOR*MONKEY REACTION. Out of nine initial human behaviors selected for study (described in Table 2, p. 17), feeding monkeys was the most frequent (47%). Humans feeding monkeys resulted in a passive encounter (monkeys eating) 88% of the time. The more aggressive type of human behaviors (tease, threaten with object, throw object, chase, physical contact) decreased with the presence of food (Table 10). The most common monkey response (descriptions in Table 3, p. 18) to an initial human behavior, other than eating when fed, was

to flee (21%) (Table 11). This was especially true if the human waved their arms at the monkey (52% flee).

The best models generated by the analysis of HUMAN TYPE*ENCOUNTER*FOOD*DISTANCE were HUMAN TYPE*ENCOUNTER*FOOD and HUMAN TYPE*DISTANCE. The significant three-way interaction that occurred between the category of human (Nepalese, tourist, priest), type of encounter (aggressive or non-aggressive), and food (presence or absence) is shown in table 12. Tourists were involved in a higher percentage (76.4%) of aggressive encounters with monkeys than were priests (53.2%) or Nepalese (50.1%). All three human categories were involved in more aggressive encounters when food was absent than when food was present. This was especially true of tourists, where aggressive encounters without food outnumbered aggressive encounters with food by a ratio of 6:1.

Analysis did not indicate a relationship between distance of monkeys from humans and aggressive encounters ($P=0.032$). However, the highest percentage of aggressive encounters occurred under 0.5 meters (41%) and gradually decreased as the distance increased, an inverse relationship. When food was absent, most aggressive encounters occurred from 0.5 meters to 1 meter (43%). Log linear analysis indicated a significant three way interaction between the type of human, the distance between human and monkey, and aggression (Table 13). Each human category had a different

distance at which most aggressive encounters occurred. For Nepalese this distance was below 0.5 meters, for tourists it was from 0.5 meters to 1 meter, and for priests it was 1 meter to 2 meters.

TABLES

Table 5: Two-way frequency table of the significant ($p < 0.05$) ENCOUNTER*FOOD component from the log linear analysis. Food was either absent or visibly present during an encounter. Encounters were classified as either passive or aggressive.

ENCOUNTER	FOOD	
	Present	Absent
Non-aggressive	394	9
Aggressive	198	277

Table 6: Two-way frequency table, showing only aggressive interactions, of the significant ($p < 0.05$) INITIATE*FOOD component from the log linear analysis. Food was either absent or visibly present. "Initiate" was the subject that started the interaction.

INITIATE	FOOD	
	Present	Absent
Monkey	130	139
Human	59	138

Table 7: Two-way frequency table of the significant ($p < 0.05$) MONKEY SEX*FOOD interaction from the log linear analysis. This table presents only aggressive interactions. Food was either absent or visibly present during an encounter.

MONKEY SEX	FOOD	
	Present	Absent
Male	109	140
Female	54	103

Table 8: Two-way frequency table of the significant ($p < 0.05$) MONKEY BEHAVIOR*FOOD component from the log linear analysis. Food was either absent or visibly present during an encounter. "Monkey behavior" describes the initial action of the monkey.

MONKEY BEHAVIOR	FOOD	
	Present	Absent
Non-aggressive	358	36
Threat Face	52	168
Grab Food	94	3
Physical contact	44	41
Chase	7	38
Bite	1	0

Table 9: Two-way frequency table of the significant ($p < 0.05$) MONKEY BEHAVIOR*HUMAN REACTION component from the log linear analysis. "Human reaction" describes the response of the human immediately following the initial monkey behavior. Complete descriptions of monkey behaviors and human reactions are in tables 1 and 4.

MONKEY BEHAVIOR	HUMAN REACTION					
	Watch	Other interest	Leave	Retreat	Flee	Chase
Non-aggressive	125	32	260	0	0	4
Threat face	53	23	49	58	16	21
Grab food	45	7	19	10	3	13
Physical contact	21	2	28	17	9	21
Chase	8	1	3	15	17	1
Bite	0	0	0	0	0	1

Table 10: Two-way frequency table of the significant ($p < 0.05$) HUMAN BEHAVIOR*FOOD component from the log linear analysis. "Human behavior" describes the initial action of the human.

HUMAN BEHAVIOR	FOOD	
	Present	Absent
Watch	46	77
Feeding monkeys*	397	7
Taking photos	2	30
Yell at monkeys	33	11
Arm threat	73	65
Tease	8	33
Threaten with object	10	19
Throw object	7	27
Chase	5	13
Physical contact	2	4

*Humans offering monkeys empty food containers accounts for the 7 feeding interactions with food absent.

Table 11: Two-way frequency table of the significant ($p < 0.05$) HUMAN BEHAVIOR*MONKEY REACTION component from the log linear analysis. "Monkey reaction" describes the response of the monkey immediately following the initial human behavior. Complete descriptions of human behaviors and monkey reactions are in tables 2 and 3.

HUMAN BEHAVIOR	MONKEY REACTION						
	Eat	Other interest	Leave	Stare	Retreat	Flee	Chase
Watch	23	3	30	44	5	16	2
Feed	390	2	5	2	1	3	1
Camera	1	0	13	9	2	3	4
Yell	2	0	8	2	2	30	0
Arm Threat	15	0	28	8	11	72	4
Tease	4	1	11	5	5	10	5
Wave Stick	1	0	9	1	3	15	0
Throw object	4	0	4	1	5	19	1
Chase	0	0	2	0	1	14	1
Physical Contact	1	0	2	1	0	2	0

Table 12: Three-way frequency table of the significant ($p < 0.05$) HUMAN TYPE*ENCOUNTER*FOOD component from the log linear analysis. An encounter was either passive or aggressive and food was either absent or visibly present during an encounter. Humans were separated into three categories.

MONKEY BEHAVIOR	HUMAN TYPE		
	Nepalese	Priest	Tourist
Aggressive food	168	10	11
Aggressive no food	176	31	70
Total aggressive	344	41	81
Non-aggressive food	336	36	22
Non-aggressive no food	6	0	3
Total passive	342	36	25

Table 13: Two-way frequency table, showing only aggressive interactions, of the significant ($p < 0.05$) HUMAN TYPE*DISTANCE component from the log linear analysis. "Distance" refers to the space between human and monkey when the interaction occurred. Percentages are for rows.

HUMAN TYPE	DISTANCE (meters)				
	0 to 0.5	0.5 to 1	1 to 2	2 to 3	Over 3
Nepalese	162 47.1%	91 26.5%	57 16.6%	19 5.4%	15 4.4%
Tourist	21 25.9%	47 58%	11 13.6%	0	2 2.5%
Priest	11 26.8%	8 19.5%	18 43.9%	4 9.8%	0

* Percentages are for rows

DISCUSSION

Earlier studies suggested food was the cause of most aggressive encounters between humans and monkeys. Small (1992), Lindburg (1972), Southwick (1965), and Teas (1978) have all documented aggressive actions of monkeys directed at humans in situations where food was a factor. Our preliminary observations seemed to substantiate this theory. However, later in the study we began to have doubts about the validity of the hypothesis that the presence of food caused aggressive behavior towards humans among the rhesus monkeys at Swayambhu temple. The numbers of passive and aggressive encounters were not significantly different, but the vast majority of passive encounters involved food, while most aggressive encounters did not. After detailed analysis we did find that food, when visibly present during an encounter, was not a major cause of monkey aggression towards humans.

Even though our statistics indicated the presence of food did not cause aggression, the absence of food, or at least its lack of visibility to monkeys, was a major cause; aggressive encounters outnumbered passive encounters by a ratio of 32:1. Many of these aggressive encounters were the result of monkeys looking for food that was either not present or was well concealed. This was probably the case when monkeys tried to reach into purses or to steal bags. Nepalese visitors to the temple frequently brought rice, corn, or fruit as offerings to be left in various shrines.

Most Nepalese, being familiar with monkey behavior, kept food concealed, in bags or purses, until they were at the offering site. At that point, they would open their bags and place their offerings in the appropriate place. It was generally accepted by worshipers and priests that once the offerings were given, the monkeys would eat them. During festival days the various shrines became congested with worshipers. At these times humans were often observed driving monkeys away from a shrine in order to safely place their offerings inside. The actual number of aggressive encounters that occurred at these sites was not analysed separately from other aggressive interactions. This was unfortunate, because it would have allowed for some interesting comparisons.

Monkeys were frequently observed trying to enter stores and homes within the temple compound. They were probably looking for food. However, curiosity, especially in juveniles, undoubtedly contributed to this behavior. They would go through open windows and doors even trying to push open those that were closed. When this happened they were chased away by shopkeepers, residents and even priests who waved their arms or a stick, yelled and sometimes threw rocks. Humans were less consistent in trying to prevent monkeys from entering the more open public areas covered only by a roof. They seemed more tolerant of monkeys in these spaces, probably because it would not be feasible to keep them out. Nevertheless, a number of aggressive encounters

occurred in the public open roofed areas. These included humans threatening monkeys inside or trying to enter or monkeys dashing in to grab food and running off with it. According to Southwick and Siddiqi (1985), rhesus monkeys "raid crops and rob food stores at every opportunity" (p.56) It would be difficult to separate the number of aggressive encounters caused by monkeys searching for food and those resulting from other situations. However, if the food searching aggressive encounters were combined with aggressive food present encounters, food may have indeed been a major cause of aggression.

The effects of artificial provisioning on aggressive behavior have been studied by Koford (1963) and Loy (1970) in the seminatural rhesus troops in Puerto Rico, Wrangham (1974), in chimpanzees and baboons in Africa, and Southwick, Siddiqui, Farooqui, and Pal (1976) in rhesus monkeys in India. Their results have confirmed that artificial feeding causes an increase in aggressive behavior both within and between species. Southwick (1976) stated, "artificial feeding increased aggregation and aggressive interaction, and that the type and level of feeding also influenced the amount of aggression" (p. 14). The results of our study differ in that the absence of visible food caused more aggressive interactions than humans feeding monkeys. However, previous studies have not focused exclusively on monkey/human interactions and that may account for the difference.

Most passive encounters involving food were initiated by local people feeding monkeys. Small's 1992 study of long-tailed macaques in Sangeh Monkey Forest, Bali, also found local people feeding monkeys. However, the feeding there was done to bait monkeys into an interaction with a tourist to enable a "guide" an opportunity for a Polaroid picture which he could sell to the tourist. These interactions frequently ended with the tourist being bitten by an angry monkey. At Swayambhu temple tourists are definitely not encouraged to feed monkeys. However, specially prepared "monkey biscuits" are available at shops within the temple and are purchased by Nepalese and resident priests. Items other than monkey biscuits commonly fed to monkeys included rice, corn, other grains, a variety of fruit, cookies and other sweets and even eggs. Much of this feeding was due to religious beliefs.

It is a common practice in the Hindu religion to give food offerings to representations of the various gods which would include Hanuman, the monkey warrior and protector. Deliberate feeding of monkeys in addition to food offerings left in shrines, was especially prevalent during religious holidays but very rare during the monsoon season when heavy rains discouraged human visitors. However, some Nepalese and priests were observed feeding monkeys on a regular basis, and these individuals seemed to be recognized by at least two different monkey troops. Studies of urban monkeys in India by both Ciani (1986) and Lindberg (1972) confirm monkey

recognition of certain people. Monkeys were observed avoiding humans that had chased them in the past and congregating around those that had fed them. The Nepalese or priest "feeder" would sit or stand in the same area and usually at the same time of day. A group of monkeys would soon congregate around him and the human would toss food to the waiting monkeys. When the food was gone, the human would usually show his empty hands to the monkeys and then leave. When the monkeys finished eating they too would disperse. Most Nepalese did not try to hand feed monkeys; in fact, physical contact was discouraged. Nepalese were never observed trying to make a monkey do "tricks" for food, nor was any adult Nepalese observed teasing monkeys. This same pattern was also seen during the unofficial observations we made at other temples in Nepal.

Most aggressive encounters were initiated by monkeys. Since the monkeys at Swayambhu are partially dependent on human provisioning, it is not surprising to find them actively seeking food from humans. Unlike the relationship between humans and domestic animals, they cannot rely on humans to feed them at a certain time and place. Provisioning is chaotic and unpredictable. During festivals there is an abundance of food available in various shrines and, because of religious beliefs, an abundance of people actively feeding the monkeys. At other times little food is brought to the shrines and humans are as apt to chase monkeys

away as feed them. The results of this study suggest that the unpredictability of humans has made the monkeys wary, fearful and potentially aggressive.

The majority (49%) of aggressive encounters initiated by monkeys were brief and limited to a threat face, posturing, and/or verbal threatening. The common human reaction to these behaviors was to continue to watch the monkey (23.6%), walk away (22.3%), or quickly retreat (26.4%). When humans initiated the encounter they usually stared threateningly at a monkey (27%) or made threatening arm gestures (30%) which usually resulted in monkeys walking away (13%) or fleeing (21%). This behavioral accommodation of the threatened party leaving the scene and avoiding a more serious confrontation, has probably evolved over years of coexistence in Swayambhu temple.

Of the 85 physical contact encounters, about half were made with no food visibly present. The majority of these contacts occurred when monkeys looked for food in pockets, bags or purses, standing bipedally and grabbing with their hands. There were very few incidents of monkeys jumping onto or climbing onto a human which is in contrast to Small's (1992) work in Bali where such encounters were common. The remainder of the physical contact encounters, with food present, involved humans feeding monkeys or monkeys grabbing food from humans. Again, monkeys usually stood bipedally and

took or grabbed food but occasionally they were observed reaching out to snatch food while perched on a structure.

Our only observation of a monkey biting a human took place when a monkey attempted to take food from that individual. A woman had taken out an egg from her bag and was placing it on an offering plate in a shrine when an adult female monkey that had been watching her from a perch above the shrine, jumped down on her back and shoulder and tried to grab the egg. The woman screamed, hit at the monkey and refused to let go of the egg. The monkey bit her hand and ran away without the egg.

Other overtly aggressive monkey behaviors, such as chasing humans or physical contact with them, most often occurred when food was absent. These encounters were usually initiated by humans. Some of these forms of aggression were observed between monkeys and young Nepalese, usually boys. Children were observed throwing rocks and chasing monkeys, sometimes away from a food source but usually just for amusement. Juvenile monkeys always fled but adults, especially males would often charge after the children who would run to adult protection or into a building. There was only one observation of physical contact resulting from this type of interaction. A large male monkey chased a rock-throwing young priest, grabbed his tunic, pulled it off and took it to the top of the stupa where he left it. The young disrobed priest continued to run and cry. Teenagers were

seen teasing monkeys by pretending to have food, offering food to one monkey then giving it to another, poking at a monkey with a stick or staring at an individual monkey. Prolonged, direct eye contact with a monkey is considered to be a threat by the monkey (Cheney and Seyfarth, 1990; Hinde and Rowell, 1962; Mitchell, Obradovich, Herring, Dowd & Tromborg 1991). The usual result was a loudly vocalizing, angry monkey making a quick, short charge toward the human who, expecting this behavior, would run to a safe place either inside a building or among a large group of humans. This teasing behavior, while infrequent, contributes to the monkeys' apparent tension while around humans, especially teenagers. On the other hand, monkeys frequently target young children to steal food from, apparently realizing their vulnerability.

Male and female monkeys were involved in nearly the same number of aggressive encounters, 157 and 149 respectively. While the presence or absence of food was not a factor for males, for females it was quite significant. They had nearly twice as many aggressive interactions with no food present than when present. Observations suggested females may be involved in more food searching activities than males which would make them more vulnerable to human threats. Acquisition of food may also account for a relaxation of normal infant protective aggression when food was present and

the resumption of protective behavior when food was not present.

Although tourists were less frequent visitors to Swayambhu temple than were local residents, proportionately more tourists were involved in aggressive encounters with monkeys. Most of these encounters did not involve food (86%), in fact, tourists seldom feed monkeys at Swayambhu. If they were with a private guide or a tour group they were warned that feeding monkeys is potentially dangerous and often results in serious bites. There are no signs in or around Swayambhu about the dangers of feeding monkeys, but neither is there any indication that monkey biscuits are available to buy in the temple shops. During our study no tourist was observed buying or feeding these biscuits to monkeys. In contrast, Small (1992) found that native Balinese people encouraged monkeys to interact with tourists.

Our findings suggest that aggressive encounters between tourists and monkeys are the result of tourists in too close proximity to monkeys, staring at them, or attempting to touch them. Temple monkeys were often inside shrines keeping cool or looking for food. Unsuspecting tourists peering into darkened shrines were often greeted by a surprised monkey who felt threatened. The result was a vocal, arm waving frightened tourist and a shrieking, threat faced monkey. Tourists with cameras were often involved in aggressive encounters. The monkeys appeared to feel threatened when a

camera was pointed at them and their usual reaction was to return the threat. If the human attempted a closer shot, the monkey frequently made a short threatening charge toward the human, especially if the monkey was a female with an infant. Juveniles would usually run away. Tourists occasionally tried to touch monkeys. Surprisingly we never observed a bite resulting from this behavior. However, all our observations of this attempt resulted in screeching, charging monkeys and fleeing humans.

Most tourists are ignorant of monkey etiquette, not realizing that staring at a monkey is regarded as a challenge (Cheney and Seyfarth, 1990). A monkey's reaction to this sort of perceived threat depends in part on its age and sex. Juveniles and females without infants usually just made threat faces. Females with infants made threat faces then often left the area. Adult males were more likely to threaten, posture, and/or charge. The tourists interviewed after this type of interaction had no idea they had initiated the original threat. In contrast, an interaction of this sort rarely happens between priests and monkeys or Nepalese people and monkeys. When it does occur, it is usually due to teasing by children or teenagers. Through generations of co-existence most adult Nepalese and priests have learned basic monkey etiquette: do not stare, do not get too close, and do not carry unconcealed food not intended for monkeys.

It is generally acknowledged that temple monkeys tolerate humans in closer proximity than forest dwelling monkeys (Lindburg, 1972; Southwick, et al., 1961; Southwick et al., 1976). Trying to establish the relation between the distance of monkeys from humans and aggressive encounters was difficult. We were only able to use data with no food present, food having an obvious influence on the distance a monkey would normally keep between itself and a human. Using only the "no food present" data, observations indicated a monkey's "personal space" was between one to two meters. This "space" was defined as the closest distance between a human and a monkey that would not cause visible tension in the monkey. It was the distance which allowed normal monkey activities (grooming, resting, play) to proceed without human influence. Aggressive encounters declined rapidly when monkeys and humans were more than two meters apart. There were many variables influencing this zero to two meter distance and what made it "comfortable." Females with infants always threatened if humans were closer than two meters while males were more tolerant. In fact, single adult males consistently seemed to be "comfortable" at one meter unless specifically threatened by a human. Monkey/human encounters over two meters were more likely to involve juveniles than adults. This was attributed to youthful curiosity and playfulness. A large group of monkeys appeared to be more secure than a single monkey, but even this

depended on the number of infants in the group. The immediate physical surroundings, the availability of escape routes, or whether monkeys were on structures or the ground, were also a factor.

Other studies have indicated large groups of people in close proximity to monkeys are a cause of monkey anxiety (Fa, 1992; Singh 1969). Such a factor was also seen in our study. Data analysis showed a surprising relationship between the type of human involved in an aggressive encounter and the distance between the monkey and the human. Most Nepalese encounters (47%) occurred at zero to one-half meter, tourists (58%), from one-half to one meter, and priests (43.9%), from one to two meters. Most physical contact and monkey food grabbing encounters involved Nepalese, which would account for the close proximity of interactions. The fact that Nepalese were the most likely to have food, concealed or not, could also be a factor. Tourists, who seldom had food and were often fearful of monkeys, were not as likely to be within arm's distance of them. Priests were the least often involved in aggressive encounters and when they were it was usually shooing approaching monkeys away from school and temple entrances.

Conclusions

Aggressive encounters between monkeys and humans were not usually caused by the presence of food. There were more

aggressive encounters when food was absent or not visible. Observations indicated that many of these encounters occurred as a result of monkeys searching for food. Some examples were: monkeys attempting to enter buildings and humans chasing them away; or monkeys trying to grab articles from humans that might contain food.

Tourists were found to be involved in aggressive encounters with monkeys more often than Nepalese or priests. Most tourists were not familiar with monkey behavior and although most were warned not to feed monkeys, knowledge of behavior that might be considered threatening to monkeys was not generally available.

When food was absent, most monkeys did not appear threatened by humans if there was at least two meters distance between them. This distance, however, was influenced by other factors such as mothers with infants, group size (both monkey and human), and the sex of the monkey. Further studies, taking into account the numerous variables affecting the distance factor, would be necessary to establish a more valid "comfortable distance" for monkeys.

Increased public awareness of human behaviors that may appear threatening to monkeys might decrease the number of aggressive interactions between humans and monkeys. But, unless urban monkeys have an adequate and reliable food source they will continue to pilfer from humans.

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BEHAVIOR DATA SHEET

LOCATION _____

[illegible]

APPENDIX B

Code sheet for monkey behavior**Age, sex and number of monkeys involved in encounter**

Age: A=adult males and females distinguished by the presence
of red sexual skin, and males by descended testes
J=juvenile, absence of above characteristics
I=infant (carried and nursing)
Sex: M=male
F=female

Age, sex, category and number of human involved in encounter

Age: S=senior
A=adult
A=adolescent
C=child
Sex: M=male
F=female
Category: T=tourist
P=resident priest
N=native Nepalese

Distance

The distance in meters between monkey and human when aggression starts, (0-0.5; 0.5-1; 1-2; 2 and above)

Food

O=offered (to monkey)
NO=not offered but visibly present
C=concealed but sought after by monkey
NF=no food present

Monkey behavior

No=no show of aggression
TF=threat face
GF=grab food
PC=physical contact
C=chase
C=charge
B=bite

Monkey reaction to human behavior

Eat=eat
OI=other interest
L=leave
S=stare
R=retreat
F=flee

APPENDIX C

Code sheet for human behavior**Age, sex, category and number of human involved in encounter**

Age: A=adult
YA=adult
C=child
Sex: M=male
F=female
Category: T=tourist
P=resident priest
N=Nepalese

Distance

The distance between monkey and human when aggression starts,
(0-0.5; 0.5-1; 1-2; 2 and above)

Food

Yes=food present
No=no food present
Different kinds of foods if identifiable

Initiate

M=monkey
H=human=2

Human behavior

No=no aggression
F=feed
C=taking pictures, camera
S=stare
AT=arm threat
T=tease
WS=wave stick
TO=throw object
C=chase
PC=physical contact

Human reaction to monkey behavior

WA=watch
OI=other interest
L=leave
R=retreat
F=flee
C=chase