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Behavioral Observations of Western Lowland Gorillas: Understanding the Relationship Between Diets and Behaviors in Primate Bachelor Groups

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Abstract

Gorillas are one of the many animals throughout the world that are an endangered species. Studies have also shown that, genetically speaking; gorillas are closely related to humans. Because of this it should be a high priority of all people to better understand these creatures and their biology and behavior. Currently the Jacksonville Zoo is home to four male Western Lowland gorillas. These gorillas demonstrate some abnormal behaviors; behaviors that are not seen with regularity in the wild. These behaviors include regurgitating and then re-eating consumed foods and eating feces. This study explored the possibility that these abnormal behaviors are related to aspects of captive life and feeding as compared to known patterns in nature.

Introduction

The dense primary and secondary forests of lowland western Africa are home to the Western Lowland gorillas (*Gorilla gorilla gorilla*). They range from Nigeria to Zaire. As their name suggests, they are also found frequenting the African lowland swamps. A typical home range for these gorillas is around 800 hectares. They are the most numerous of the three subspecies of gorilla, with estimated numbers ranging in the low one hundred thousands (Dolhinow 1972: 85; Rowe 1996:226-227; Yerks 1929:381).

Mature female gorillas weigh approximately 71.5 kilograms on average. A mature male weighs on average 169.5 kilograms. This illustrates the large degree of sexual dimorphism present in gorillas. Western Lowland gorillas are of average weight in comparison to the other two subspecies, with the mountain gorilla being somewhat smaller and the eastern lowland being larger (Rowe 1996:226-227; Yerks 1929:381).

Gorillas form social groupings around a single male called a silverback. Silverbacks are fully mature males that reproduce with multiple females. These groups will typically have one male, several females and their offspring. However, if a group is large there may be two silverbacks. A group of gorillas can range from three to twenty-one individuals (Rowe 1996:226-227; Yerks 1929:381).

Juvenile males are permitted to stay within a group as adolescents and young adults until they start to act in a way that threatens the cohesive, hierarchical nature of the group. When they start to challenge the silverback, the females in the group will chase off the troublesome male and he will be forced to leave the group. This male will then wander around his home range that will expand by several hundred hectares until he can mature and gain females of his own and form a family group. During this period, male gorillas may form what are known as bachelor groups, where several male gorillas cluster for the

purpose of foraging and sleeping together. These groups last only until the males can find their own females. Males may also remain solitary (Rowe 1996:226-227).

Western Lowland gorillas have a very distinct dietary pattern that resembles that of the Chimpanzee much more closely than with the other two sub-species of gorillas. Western Lowland gorillas are primarily frugivorious, that is, they eat mostly fruit. Fruit makes up about 67% of their diet. In times when fruit is plentiful, such as during the rainy season, these gorillas become very selective in the fruit that they eat. They will choose only the ripest of the fruit and stick to the kinds that they enjoy the best. Gorillas will expand their home range by several hundred-hectares during the prime fruit seasons so that they have more access to the fruits that they like. Females spend more time in the trees during the prime fruit seasons (Rowe 1996:226-227).

When fruit becomes scarce, through the dry season, Western Lowland gorillas will begin to eat other plant material in larger quantity, such as leaves, bark, pith, stems, and herbs. This other vegetative matter makes up about 17% of their diet. An important part of this diet is made up of herbs that are found both on land and in the water. Western Lowland gorillas have been observed swimming in the lowland swamps and collecting the herbs that grow there (Rowe 1996:226-227).

Another part of the gorilla diet is animal material. Only about 3% of gorilla's diets come from animal material. This consists of invertebrates such as caterpillars and termites. Gorillas have been observed eating termites on a daily basis. Gorillas do not eat any other sort of animal food. It is also important to note that gorillas avoid eating foods that have high lipid contents in favor of those with a high fiber and sugar content (Rowe 1996:226-227).

Jacksonville Gorillas

The Jacksonville Zoo is home to four male Western Lowland gorillas (*Gorilla gorilla gorilla*). Each has its own distinctive personality. Quito is the largest of the four weighing in at approximately 250 kilograms. He was twenty-two years old when this project was started but had a birthday on the first of June. He was born at the Stoneham Zoo in Massachusetts, where he was hand reared by keepers. Quito is a human-oriented gorilla. He spends a large portion of his time near the observation windows interacting or simply watching visitors. He seems to have a fondness for human females, often spending time staring at female visitors through the glass (Figure 1).

Quito is about 100 kilograms heavier than average for a male Western Lowland gorilla and seems to have an unlimited eating capacity. He seems extremely motivated by food. Indeed, at one point he smuggled a stool out of his paddock and into the outdoor enclosure, which he used to reach the high branches of a large tree in his yard (see Figure 2 for a diagram of his paddock). He pulled down a sizable branch, stripped it of and eating its leaves and bark. The zoo has put him on a strict diet and he is loosing weight.

Figure 1. Quito interacting with the author at a visitor-viewing window

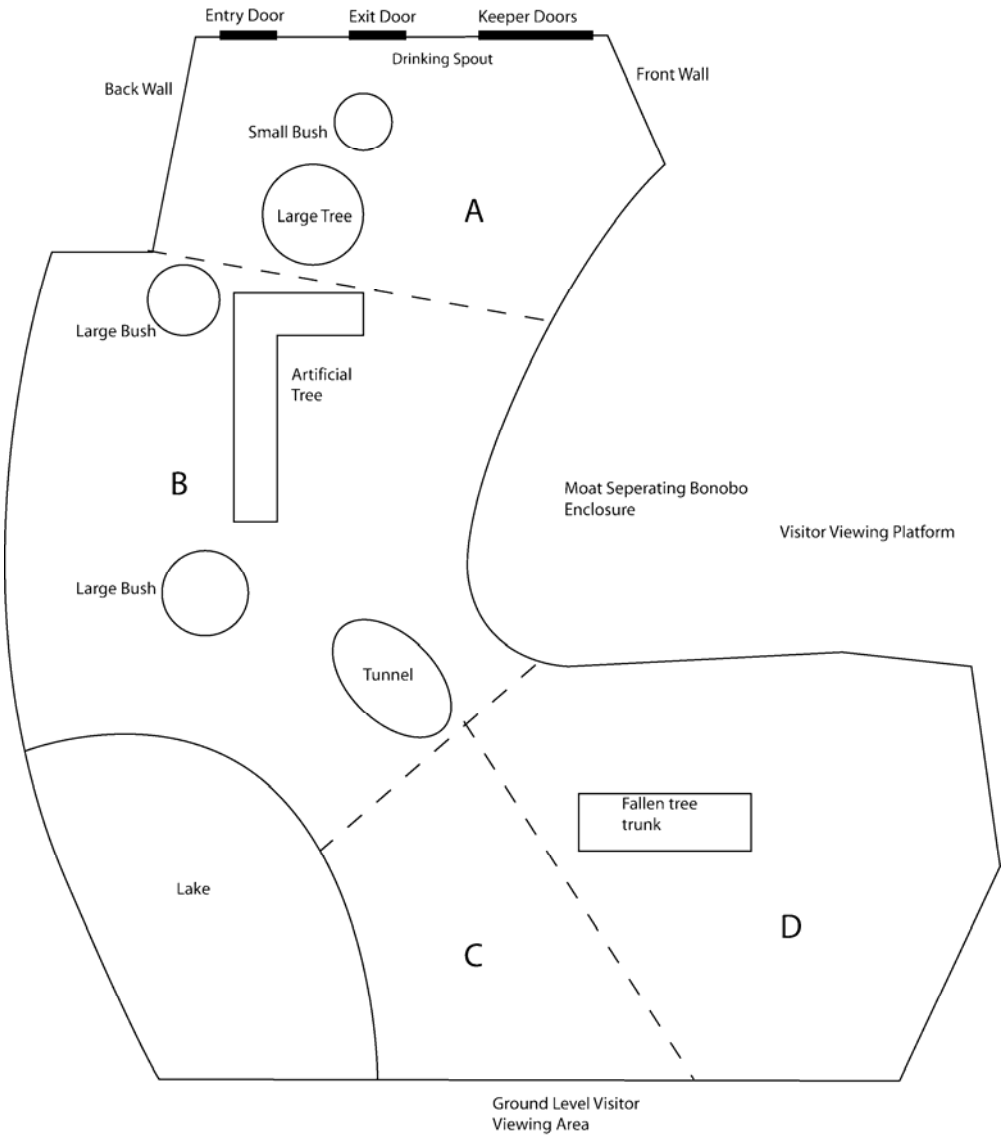

Figure 2. Diagram of the paddock shared by Quito and Rumpelstiltskin

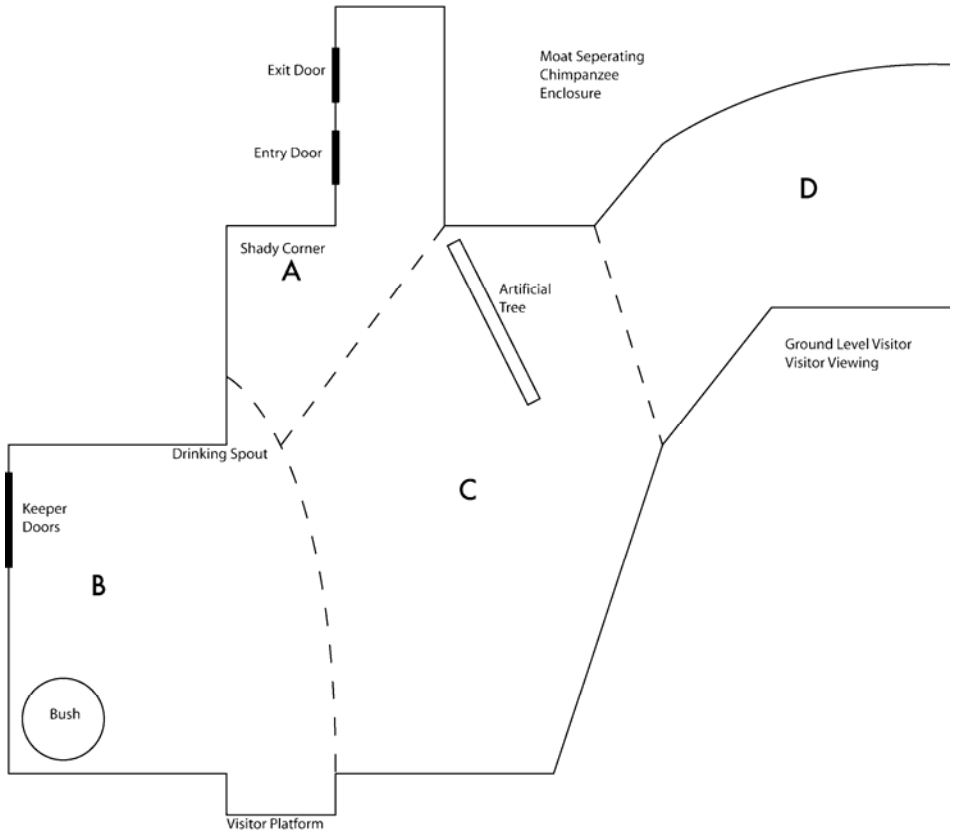

Figure 3. Diagram of the paddock shared by Lash and Ben

Rumpelstiltskin (or Rumples) shares an exhibit and den alternately with Quito. He was born at the Cincinnati Zoo and is nineteen years old. Rumples does not like being outside on exhibit, the keepers often have a hard time getting him to leave his indoor paddock. When he is out, he does not move very far away from the doors and does not interact with visitors. Rumples has been observed regurgitating and re-eating his food also known as R&Rs. He is adept at hiding them though, often times puffing up his cheeks, and performing them entirely in his mouth.

Ben is the youngest of the four gorillas, being only eighteen years old. He was born at the Oklahoma Zoo where he was parent-reared. He is the easiest to recognize because he has a concave skull due to a life-long habit of holding his hand to his head as if he were on an imaginary telephone. Ben also performs R&Rs; however he does not try to hide them from viewers.

When Ben is on exhibit, he spends a large amount of time either sitting or sleeping in the shady corner of his enclosure (see Figure 3). He does not spend much time near the visitor areas or

observation window. Despite this, he does seem to show curiosity about what is going on around him. For instance, during the first period observing Ben, he came over to the glass and spent several minutes looking at both the author and her clipboard.

Lash is the oldest gorilla at twenty-seven. He was born on Christmas Day, December 25th, 1976 at the Cincinnati Zoo. Lash was parent-reared. Weighing in at only 159 kilograms, Lash is the smallest of the four. Lash moves around his entire enclosure (which in till recently he shared alternately with Ben), spending time by the two visitor areas, either just watching the visitors or banging on the glass to interact with them. Lash is most interactive with people he knows. He will play games with the zoo staff when visitors are not around. Lash also performs R&Rs often. His R&Rs are often times preceded by a sneering expression on his face followed by an immediate turning away from anyone watching him. He is also very adept at hiding his R&Rs and they are often difficult to observe.

Since the study concluded, Ben and Lash were introduced successfully. They now share their enclosure, with both being present in the paddock at the same time during the day. They were also placed in the enclosure that formally belonged to Quito and Rumples because it is larger than their original one. This study only includes data collected prior to this switch.

Data Collection

The data for this research was conducted using a technique known as focal observations; that is, collecting data on only one individual gorilla at a time. Data was collected on a Palm Tungsten T2 handheld computer, using palm Data Base software. The method used for collecting data involved observing an activity, recording its start time, noting if there were visitors or keepers present, determining the location it was taking place, and finally recording its duration. Along with these observations, notes were also recorded for observations using a Palm keyboard. The presumed, default activity was sitting or lying down. These activities were not recorded but were assumed to be occurring during the time in between other activities. A complete list of observed activities and their definitions appears in Table 1.

Table 1

Activity	Description
Chest Wipe-Lick	Licking chest with the tongue or wiping the chest with the hand and licking the hand
Door Hang	Hanging off the top of the keeper doors standing only on hind legs
Drink	Drinking from the water spout
Eating (Wild Food-Heavy)	Pulling branches off of bushes or tree to eat or sitting in a bush stripping the leaves
Eating (Wild Food-Light)	Picking up leaves or other plant material off the ground to eat
Eating (Zoo Food)	Eating food placed outside by the zoo staff
Eating Food	Any eating of food as relating to Lash, Ben or Rumples
Knock Glass	Hitting the glass at the visitor areas
Knock on Door	Knocking on the doors that lead to the inside of the ape building
Other (See Notes)	Any other activity otherwise not listed
Pull-Eat Hair	Pulling out hair and eating it
R&R	Regurgitating food and then re-eating it
Stick Use	Using a stick to dig in the dirt or to scratch, any variety of using a stick
Toss Dirt (On Self)	Picking up dirt and tossing it on the body
Visitor Interaction	Any sort of interaction with zoo visitors

The data statistically analyzed for this study were collected between June 8th and June 26th. They include separate databases that are customized for each gorilla according to what activities were relevant to them, and in the case of Rumples, a different set of locations due to his restricted movement pattern. There is also a large body of data that was taken at the initial period of the study, between May 15th, and June 3rd. This body of data was taken using a single database for all four gorillas and provided a basis for refining the overall data collection protocols and the individualized databases for each of the four gorillas. This preliminary observational data was not used in the statistical analysis, but was used for general conclusions.

Accompanying this data is a daily log in which weather conditions such as temperature and precipitation values were recorded using information obtained from the National Weather Service's website. Also included is information on what time data collection was started, when the gorillas in the paddock being observed that day were switched out, and what time data collection was concluded. This data is summarized in Table 2.

Augmenting the data collected by the author, the zoo staff provided a listing of all foods given to the gorillas that were being observed for most observation periods. This data lists the different types of food, the amount of food, the time it was given and whether it was given inside or outside. The entire data set is available upon request.

Table 2

Date	Temperature (Ave oF)	Temperature (Max oF)	Amount of Sunshine	Precipitation (inches)	Subject Observed	Start Time	End Time	Total Observation Time
6/5/2004	81	92	partly cloudy	0.09	Quito	11:29 AM	12:32 PM	1:03:00
6/5/2004	81	92	partly cloudy	0.09	Rumples	12:32 PM	2:01 PM	1:29:00
6/8/2004	78	88	partly cloudy	0.00	Lash	11:36 AM	12:32 PM	0:56:00
6/10/2004	83	91	partly cloudy	0.20	Rumples	11:19 AM	1:10 PM	1:51:00
6/10/2004	83	91	partly cloudy	0.20	Quito	1:10 PM	1:42 PM	0:32:00
6/15/2004	82	90	Cloudy	0.66	Quito	11:22 AM	2:21 PM	2:59:00
6/17/2004	81	88	partly cloudy	0.00	Lash	11:40 AM	12:50 PM	1:10:00
6/17/2004	81	88	partly cloudy	0.00	Ben	12:50 PM	1:35 PM	0:45:00
6/19/2004	84	92	partly cloudy	0.02	Rumples	11:27 AM	12:09 PM	0:42:00
6/19/2004	84	92	partly cloudy	0.02	Quito	12:09 PM	12:42 PM	0:33:00
6/22/2004	81	90	partly cloudy	1.20	Ben	11:24 AM	12:34 PM	1:10:00
6/22/2004	81	90	partly cloudy	1.20	Lash	12:34 PM	12:44 PM	0:10:00
6/26/2004	83	95	Cloudy	0.70	Ben	11:15 AM	12:49 PM	1:34:00
6/26/2004	83	95	Cloudy	0.70	Lash	12:49 PM	1:27 PM	0:38:00

Results of Observation

Data was collected for a total of 18 days. The total observation time was approximately 37 hours. The data that was collected on the Palm Pilot was exported into a series of Excel spreadsheets. The dietary data was also put into a spreadsheet format. All the data was then placed into a master data table that summarizes the data from the study.

Hypotheses

Five hypotheses regarding the abnormal behaviors exhibited in the four gorillas are developed and tested using the data collected in this study. These hypotheses and their rationale are listed below. Hypotheses 4 and 5 relate specifically to the gorillas Quito and Rumples and were only assessed in regards to data collected through observations of them.

- *Hypothesis 1: the amount of R&Rs is correlated with a variance from the mean change time of thirty minutes or more.* Some of the gorillas started to act increasingly agitated when they were left out on display longer than was normal. This may be a cause of some of their R&Rs.

- *Hypothesis 2: R&Rs are correlated with ambient temperature.* Observation was done during the summer months. As such, some observation days were very hot. The heat may have been a factor in the gorillas overall agitation, resulting in more R&Rs.

- *Hypothesis 3: R&Rs are correlated with the amount of precipitation.* During observation, it became obvious that the gorillas did not like to be out in the rain, as they would always try to seek what shelter they could. This factor could be something that led to R&Rs.
- *Hypothesis 4: a high amount of wild food eating is correlated to the amount of zoo food given (this hypothesis relates only to Quito).* Since Quito was on a diet, he may not have been getting the amount of food that he was used to, so he may have been supplementing it with wild food from his enclosure.
- *Hypothesis 5: R&Rs are correlated to pull/eat hair activities as well as knock on door and door hang activities (this hypothesis relates only to Rumples).* All of Rumples behaviors seem to be induced by stress. Therefore, his stress-related activities are probably related to each other.

Analysis

Hypothesis 1 states that the amount of R&Rs is related to a variance from the mean change time of thirty minutes or more. The assumption being that if the time when the gorillas were changed out of and in to the paddock varied considerably from the average time, then this might result in stress-induced R&Rs. When the deviation from the mean was calculated for Lash, Ben, and Rumples (this hypothesis was not testable for Quito as he was never observed performing an R&R) it showed that there was no correlation between the

time the gorillas were let out and their performing of R&Rs. For example on June 10th, Rumples was let out at exactly 1:10, which is the mean, however he was still recorded as performing R&Rs that day. Also on May 18th, he was let out fifty-five minutes late and performed R&Rs, but on June 19th, he was let in early by sixty-one minutes and was not observed performing any R&Rs. This suggests that there is no relationship to a variation of change times, therefore I rejected hypothesis 1. (See Table 3 and Table 4)

Table 3

Date	Change Time	Deviation from the mean in minutes	Ben RR's	Lash RR's
15-May	14:05	39	no	yes
20-May	13:06	10	no	yes
25-May	13:21	5	no	yes
3-Jun	12:44	42	no	yes
17-Jun	12:50	36	yes	no
22-Jun	12:34	52	no	yes
26-Jun	12:49	37	no	no

Table 4

Date	Change Time	Deviation from the mean in minutes	Rumples RR
18-May	14:05	61	yes
22-May	13:22	18	no
27-May	12:29	35	no
5-Jun	12:32	32	yes
10-Jun	13:10	6	yes
15-Jun	14:21	77	n/a
19-Jun	12:09	54	no

Hypothesis 2 states that R&Rs are correlated to ambient temperature. To test this hypothesis a Students' T-Test was run comparing the average temperature on dates when R&Rs were observed and those dates when they were not observed. The average temperature on both sets of days was almost exactly same. The mean temperature for days when R&Rs were observed was 79.67° F, while the mean for days R&Rs were not observed was 80.68°F. The T-Test resulted in a *p-value* of 0.345 (equal variances assumed); thus, hypothesis 2 was rejected.

Hypothesis 3 states that R&Rs are correlated to the amount of precipitation. A Students T-Test was run on the amount of precipitation in inches comparing days when R&Rs were observed and those when they were not observed. Again, the amount of rain was almost equal when R&Rs were observed or not observed. The mean precipitation when R&Rs were observed was .34th of

an inch, while the mean precipitation when R&Rs were not observed was .36th of an inch. The T-Test *p-value* was 0.939 (equal variances assumed). Therefore hypothesis 3 was rejected.

Hypothesis 4 states that a high amount of wild food eating is correlated to the amount of zoo food given (this hypothesis relates only to Quito). While the total amount of data available for assessing this hypothesis is low, when a chart was made of the relevant data it was not at all clear that Quito's wild food eating habits were correlated to the amount of food given to him by zoo staff (see Table 5). For example, on June 5th and 19th, Quito received high overall amounts of food than on any other date listed in Table 5 (and quite a bit of it in his outside paddock). On these days, he did not engage in heavy eating of wild foods within his paddock. Yet he was still observed engaging in light consumption of wild foods four and three times respectively on these two days. Tentatively, hypothesis 4 can be rejected, though clearly more data is necessary to more completely evaluate this hypothesis.

Table 5

Day	Total Food (in lbs)	Food Outside (in lbs)	Number of "Eat Wild Food – Light"	Number of "Eat Wild Food – Heavy"
5-June	10	2	4	0
10- June	9	1.5	1	3
15-June	11.5	0	5	1
19-June	11	2.5	3	0

Hypothesis 5 states that R&Rs are correlated with pull/eat hair activities as well as knock on door and door hang activities. This hypothesis relates only to Rumples. Table 6 presents a chart of the relevant data. While again the total number of days for which data is available is small, it seems clear that he was doing a greater amount of door hangs and knock on doors as well as pull/eat hair activities on days when he was observed performing R&Rs. Therefore, hypothesis 5 cannot be rejected at this point.

Table 6

Date	Number of "Door Hangs"	Number of "Pull/eat hair"	Number of "Knock on door"	Number of RR
5-Jun	11	3	3	11
10-Jun	24	12	2	4
19-Jun	7	0	0	0

Conclusions

Keeping the relatively small data set in mind, a few conclusions can be drawn. The amount of R&Rs may not be related to when the gorillas are let out to and in from their outdoor enclosures. The amount of R&Rs may not be related to temperature either. In Quito's case, the amount of zoo food given on any given day does not seem to affect the amount of wild food that he eats. Regarding Rumples, his knock on door, door hang, and pull and eat hair activities, do seem to correlate to the amount of R&Rs he performs.

To accurately gauge what is causing the gorillas to perform R&Rs a longer more in depth study is required. Even though almost all of the hypotheses were rejected, it does not necessarily mean that they do not explicate some aspect of R&R performance. To get at more accurate and precise conclusions, there need to be a longer, controlled period that specifically tests each of the hypotheses separately. For instance, to better test hypothesis 1, that R&Rs are correlated to a variance of change times greater than thirty minutes, a test period where the gorillas are changed out at almost the exact same time every day need to be set up to compare with a normal, more sporadically scheduled change time.

Other factors may have also been involved that prevented appropriate data collection and statistical testing (beyond simple sample size issues). It was unsurprising that the statistical tests showed that there was no correlation between the amount of precipitation and R&Rs as there was no place for me to watch Ben and Lash without getting myself and my equipment wet, making observations impossible on days experiencing heavy rainfall. On one occasion it started to rain very heavily. Of course, all equipment had to be immediately packed up. However, the author stayed to informally (i.e., off-the-record) watch how Ben would react to the rain. What he did was rather amusing. First he huddled in a corner trying to stay as dry as possible, then he started running around his enclosure on his back legs only while swinging his arms in circles. He also performed several R&Rs that were not recorded in the database because formal data collection had been stopped. When it was time for him to go inside and Lash to come out, Lash would not leave the interior paddock. The keepers eventually used some method to get him to exit the door. Immediately he did several R&Rs and a few minutes later did several more R&Rs. He then also proceeded to run around his enclosure (he did it on all fours) until finding a relatively dry place near the visitor windows.

The observations made during this study suggest that the amount of R&Rs seems to be related to stress. The stress that the gorillas are under could be due to any number of factors including the ones suggested in the hypotheses tested: change times, heat, rain, and amount of food given. In Rumples case, his R&Rs are related to other activities that are probably indicators of stress such as when he pulls out his hair and eats it. An additional focus of a follow up study would need to be what causes this stress in the gorillas and what can be done to eliminate as much stress from their lives as possible. This might lead to management plans that would decrease the overall amount of R&Rs.

The Gorillas at the Jacksonville zoo need to have longer and more in-depth study with specific control periods

that relate to each of the hypothesis presented in this preliminary study. With a longer study, the root of the problem with their R&Rs (and heavy food eating for Quito) may be found and alleviated.

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