

# **Anticipatory Behavior in Male Western Lowland Gorillas**

## **(*Gorilla gorilla gorilla*)**

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### **Abstract**

Previous research has shown that animals may exhibit anticipatory behavior leading up to an event. The primary goal of this study was to explore behaviors considered undesirable in captive populations of western lowland gorillas (*Gorilla gorilla gorilla*), particularly those related to the anticipation of entry to the back-bedroom area at the end of the day. Additionally, this study investigated the effect of this anticipation on social proximity and spatial selectivity. Subjects were 3 male gorillas (two silverbacks, one blackback) in a bachelor troop at the San Diego Zoo and 2 blackback males in a breeding troop at the San Diego Zoo Safari Park. 124.5 hours of live behavioral observations were conducted over a six-week period between June 11 and July 20, 2018 using Behavioral Observation Research Interactive Software (BORIS) Application. We used continuous sampling, recording the gorilla's behavior, proximity to the nearest gorilla, and location within the exhibit. Two of the focal males increased their frequency of self-grooming throughout the day (F-test=7.59,  $p<0.01$ ; F-test=8.26,  $p<0.01$ ), three of the focal animals showed increased spatial selectivity (F-test=84.97,  $p<0.0001$ ; F-test=12.79,  $p<0.001$ ; F-test=10.58,  $p<0.01$ ), and one male increased his rate of aggressive events as the day went on (F-test=8.38,  $p<0.01$ ). Overall, all five focal animals demonstrate a significant change in undesirable behavior as time until bedroom access decreases. Further research is needed on the use of auditory cues in signaled predictability in primates, but this may be an effective option to alleviate these anticipatory behaviors in captive animals.

## **Introduction**

The captive environment inherently influences animal behavior and imposes physical limitations on their habitat. Additionally, captive animals experience daily predictable routines contingent on the keeper's schedule. As such, animals become sensitive to environmental and/or temporal cues that indicate the onset of the event, and may exhibit anticipatory behavior leading up to the event (Watters 2014). Previous studies have found higher levels of aggression and self-directed behaviors in primates during periods prior to feeding (Wasserman and Cruikshank 1983; Waitt and Smith 2001). The primary goal of this study was to improve welfare through investigating undesirable behaviors in gorillas in relation to the anticipation of entry to the back bedroom area at the end of the day, as well as the effect of anticipation on social proximity and spatial selectivity. Furthermore, little is known about the daily activity budget of captive gorillas, so the secondary goal of this study was to determine how much time is allotted for these behaviors.

An ancillary project we undertook was piloting two new behavioral observation recording applications for the Institution of Conservation Research, Population Sustainability Team. Traditional pen-and-paper data collection during live observations inherently limits the type of data observers are able to record; however digital technology allows for faster recording and more accurate durations. These advancements have alleviated some of the difficulties of continuous live observations. The Population Sustainability team plans to use our expertise on these applications for future research on giant panda bears, polar bears, and other animals. Additionally, our research on anticipatory behaviors in gorillas will be continued by the Population Sustainability Team.

## **Methods**

Subjects were 5 male western lowland gorillas. Monroe, age 7, and Frank, 9, are blackback males in a breeding troop of 8 individuals at the San Diego Zoo Safari Park in Escondido, CA. Monroe has hair loss on his arms and back from hair pulling. Ekuba, 12, Mandazzi, 15, and Maka, 23, are three brothers housed in a bachelor troop at the San Diego Zoo in San Diego, CA. They share their habitat with a breeding troop of three individuals, so the three brothers are on exhibit half the day on a rotating basis.

Live behavioral observations were conducted over a six-week period between June 11 and July 20, 2018 using Behavioral Observation Research Interactive Software (BORIS) Application. We used continuous sampling, recording the gorilla's behavior, proximity to the nearest gorilla, and location within the exhibit.

Preliminary observations were conducted using both the BORIS Application and Zoomonitor, a web-based application. After testing both, we decided to use BORIS because we wanted to do a continuous study, and ZooMonitor's interface caused logistical issues for continuous observations.

Four 30-minute observations took place per individual per day of observation. These occurred between 9:00-19:00 Monday-Friday and were conducted by two observers. Observation times were systematically distributed over the study period to equally represent behaviors at each time of day.

ANOVAs tested differences in behavioral rates between individuals or frequencies of events. Regressions tested for correlations between factors of interest.

## Results

### *Activity Budget for Each Subject*

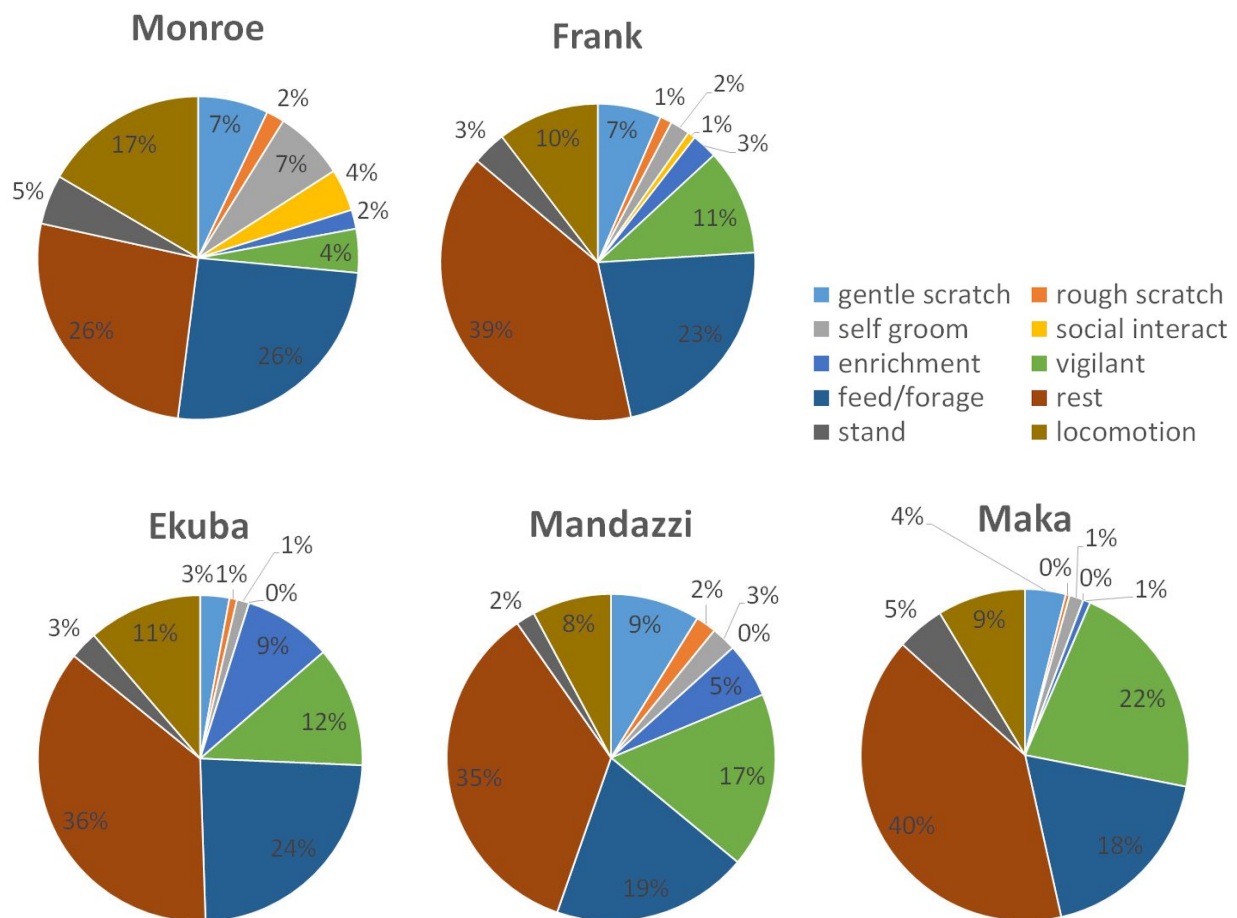


Figure 1. The activity budget of each of the 5 male gorillas demonstrating individual behavioral variation.

### *Self-directed behavior*

Monroe self grooms more than any of the other focal subjects (F-test=6.53, p-value<0.0001). The proportion of time he spends self grooming and frequency of hair pulling both increase with time (F-test=15.86, p-value<0.0001, and F-test=7.59, p-value<0.01 respectively) and self grooming increases with temperature (F-test=4.37, p-value<0.001). Mandazzi increases his rate of self grooming as time progresses (F-test=8.26, p-value<0.01).

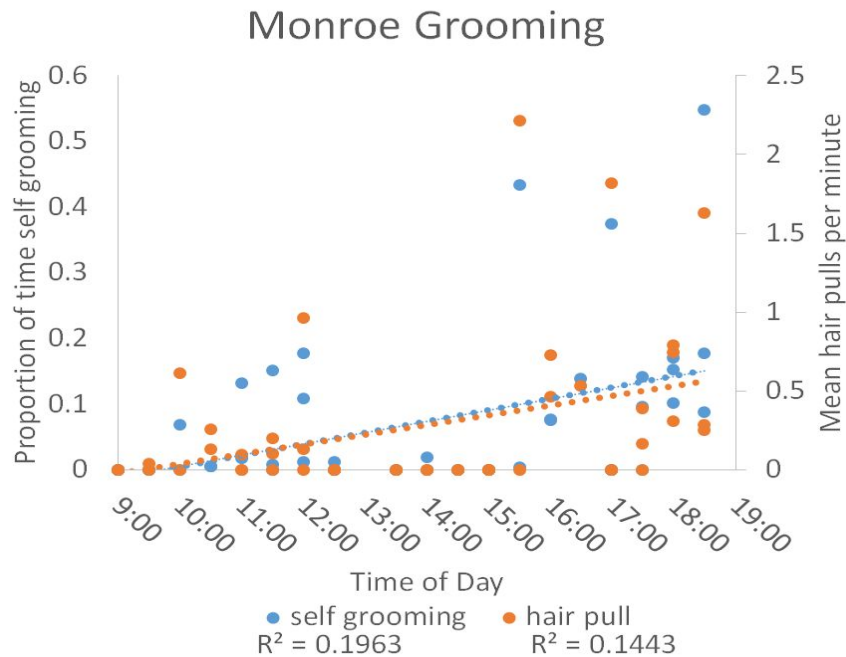
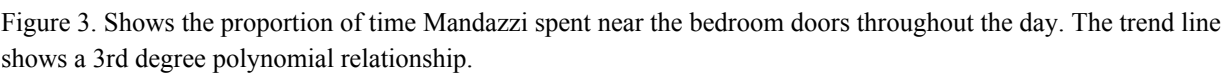


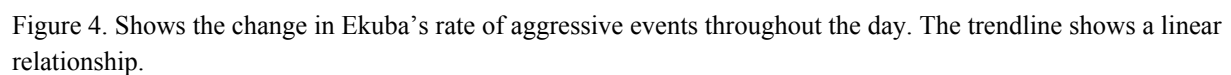
Figure 2. Displays the proportion of time self grooming (blue) and the frequency of hair pulling (orange) throughout the day for Monroe.

### *Spatial Selectivity*

Mandazzi spends more time near the bedroom door later in the day (F-test=84.97, p-test<0.0001) and Maka spends more time between the glass and elevated portion of the exhibit (F-test=12.79, p-value<0.001). Frank spends more time outside the right cave entrance as bedroom access gets closer (F-test=10.58, p-value<0.01). Frank and Mandazzi spend significantly more time distant or far distant from the nearest individual than Monroe, Maka, or Ekuba (F-test=11.58, P-test<0.001).



Ekuba increases his frequency of aggressive events (F-test=8.38, p-test=0.006) throughout the day. Maka and Mandazzi exhibit a higher rate of vigilance (F-test=4.58, p-value=0.035, F-test=8.08, p-test=0.006 respectively)



## Discussion

Consistent with previous studies of activity budgets of wild gorillas (Masi et al. 2009), the foraging time and resting time of the captive gorillas studied tended to decrease and increase with age, respectively. Also, vigilance tended to increase with age, which may be related to the general life history of male silverbacks. However, the captive gorillas spent less time foraging (21.8% vs. 67.1%) and more time resting (35.5% vs. 21.0%) compared to wild gorillas (Masi et al. 2009).

All five focal animals demonstrated an increase in certain behaviors leading up to the end of the day, although the behaviors themselves differed between individuals. Self-directed behavior increased in Maka, Mandazzi, and, most dramatically, Monroe. Ekuba also engaged more frequently in aggressive events. The increasing trend over time of these behaviors may indicate that these behaviors increase in frequency in anticipation of bedroom access. However, temperature is a confounding variable with time of day, so it is difficult to determine how much temperature plays a role in these behaviors. Future studies are needed on the effects of temperature on anticipatory behaviors.

Maka, Mandazzi, and Frank both demonstrated an increase in spatial selectivity, spending more time near the bedroom doors in their respective exhibits as time progressed. Although previous studies have found that captive gorillas spend the majority of time in a small percentage of their available space (Ross et al. 2001), increase of this spatial selectivity, as well as an increase in vigilance over time (for Maka and Mandazzi), suggest that they are altering their location in order to better tune into environmental cues that might indicate entry into the bedroom doors. This is in accordance with definitions of anticipatory behavior in the literature (Watters 2014). Additionally, Frank and Mandazzi spent significantly more time away from other individuals than the other three gorillas. Previous research has demonstrated that a lack of socialization may increase anticipatory behaviors (Watters 2014).

Overall, all five focal animals demonstrate a significant change in behavior as the day progresses. While each behavior varies in its individual implications, the anticipation of bedroom access can potentially influence socialization, self-directed behaviors, and spatial selection. Making bedroom access as predictable as possible may help them cope with the lack of control over this intensely stimulating event. On a variable schedule, captive animals depend on semi-reliable external cues that accompany keeper routines to indicate the onset of certain events (Waitt and Smith 2001). Previous studies show that the use of more reliable audio signals decreased stress-related and anticipatory behaviors by making the events more predictable (Gottlieb et al. 2013). Disney's Animal Kingdom applies this work by using an audio cue with their tigers for nightly recall in addition to one for emergency recalls (Papadopoulos 2016). Although further research is needed on the use of auditory cues in signaled predictability in primates, this may be an effective option to alleviate anticipatory behavior in captive animals. As these

animals are ambassador animals for their wild counterparts, encouraging natural behaviors and eliminating sources of stress, such as unpredictability in their daily routines, will improve their welfare and allow them to do what they do best: inspire guests to support conservation efforts.

## References

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