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The Behaviors of a Captive Father-Daughter Pair of *Ateles geoffroyi geoffroyi*

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ABSTRACT: The Central Florida Zoo and Botanical Gardens intends to introduce new members to the black-handed spider monkeys (*Ateles geoffroyi geoffroyi*) enclosure. The behavioral analysis of captive animals within their human-made zoo environments is pertinent information for zookeepers before such an introduction can be made. To contribute to that goal, this study observed the behaviors of a father-daughter pair of black-handed spider monkeys. This study observed their vocalizations, habitat utilization, enrichment utilization, conspecific interactions, and interactions with humans to better understand how they interact with their environment as well as their group dynamics. This behavioral baseline can then be utilized to assess the pair's readiness for new members and allow for post-introduction comparisons. The manifestation of these behaviors and the lack of stereotypic behaviors throughout the study suggests high well-being and a healthy dynamic between the pair. The introduction of new individuals to the current troop would not be advisable if the pair had shown signs of stress and aggressive conspecific behaviors. As a continued collaborative effort between the University of Central Florida and the Central Florida Zoo and Botanical Gardens, this study will allow zookeepers to make informed decisions on the expansion of the spider monkey troop.

KEYWORDS: black-handed spider monkey; ateles geoffroyi; behavior; vocalizations; central florida zoo and botanical gardens; habitat utilization; captive; allogrooming

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Introduction

Zoo environments provide an abundance of stimuli for the resident animals within their walls. These ‘animal ambassadors’ living in captivity are subject to visitation by unfamiliar humans, regular interaction with familiar zookeepers and staff members, ambient sounds relative to the zoo’s location within an urban context, and, on occasion, the noise generated by construction on the zoo’s property. The well-being of species living in this type of environment has been studied for years, and what constitutes welfare for each species remains a contentious topic among welfare researchers and zoo management systems (Maple & Finlay, 1989; Maple & Segura, 2014). Hosey (2005) argued that zoo environments may not be detrimental to the well-being of animals, considering threats, such as predation, are non-existent in captivity, while the regularity that management provides is non-existent in the wild. Predictions of how a species may behave in a captive environment may be somewhat based on the behavior in a wild environment. However, keeping the aforementioned considerations in mind, research in the wild cannot be used as a proxy for understanding behavior in the context of captivity. Therefore, it is of the utmost importance that research is conducted within zoo environments, as well as in the field (Hosey, 2005). Individuals of the same species may vary in well-being within the same enclosure due to factors such as age and sex (Maple and Finlay, 1989). The level of chronic exposure to a human audience (familiar and unfamiliar), the size and naturalistic qualities of the enclosure, and the level of management can also impact the well-being of animals in a captive setting (Hosey, 2005). Stereotypies can manifest in different etiologies through different causes and motivational states (Swaisgood & Shepherdson 2005).

This study was a continuation of long-term efforts and collaboration between the Central Florida Zoo and Botanical Gardens (CFZ), located in Sanford, Florida, and the University of Central Florida to gain a better understanding of the activity budgets and the habitat utilization of the CFZ’s resident *Ateles geoffroyi*. The current home of the resident monkeys, father-daughter pair Big Guy and Zsa-Zsa, is a large, recently renovated enclosure with many different structures throughout, such as live plants, log branches, ropes that can be moved, a stone archway, and two wooden buildings which are identified within this study as the ‘house’ and ‘gazebo’. Spider monkeys are primarily arboreal;

therefore, many elements of the enclosure allow the residents to climb, hang, and brachiate. The center of the enclosure is viewed through a window panel which allows guests to closely view the monkeys. Guests can view the monkeys from a greater distance by the far left and right of the enclosure. Spider monkeys in the wild tend to form large groups that can range anywhere from 30 to 100 animals (Gorog, 2002). Considering Big Guy’s age and spider monkey group dynamics in the wild, the CFZ is interested in expanding its black-handed spider monkey troop. Behavioral analysis of the Central Florida Zoo pair will enable their keepers to prepare and alter the enclosure as needed.

This study lays the groundwork necessary to aid in the transition process of adding new individuals to this troop, and there is a large focus on conspecific and human-spider monkey interactions to understand how these interactions influence their welfare. This study examines the pair’s use of food enrichment and habitat utilization to assess welfare status. In addition, there is a focus on the frequency of their vocalizations with respect to their potential motivations. Vocalizations of these primates range from whining to barking sounds; these sounds respectively may function as distress calls when separated from each other and when feeling threatened (Gorog, 2002). In the wild, low-frequency vocalizations may be utilized to decrease social uncertainty between callers outside of a particular subgroup when the separation between members spans a large distance; these vocalizations provide the listener with contextual information that allows them to adjust their behavior and respond accordingly (Ordóñez-Gómez et. al., 2019). The frequency and motivation of vocalizations differ between the sexes, as females appear to vocalize more frequently during feeding, potentially reducing competition over food between individuals. Alternatively, males may not experience the same anxiety response to the presence of conspecifics and may be using the calls to maintain contact with close associates, rather than practicing avoidance as females may (Dubreuil et. al., 2015). The dynamics among female *Ateles* in the wild may be an indication of how Zsa-Zsa and potential new females may interact.

Methods

The CFZ’s resident *Ateles* are a 37-year-old male named Big Guy and his 19-year-old daughter, Zsa-Zsa. Although they are currently the only *Ateles*

geoffroyi living onsite, their troop previously included two other females, Blondie and Red, who have since passed away. Zsa-Zsa and Big Guy were observed from the front of the enclosure, which offers the widest vantage point, and allowed for the recording of the interactions between the monkeys, the visitors, and the employees. The observation period took place from May 19, 2019 through July 26, 2019.

The first week of the study included four days of pilot-observations, which are not included in the results graphics. Each subsequent week consisted of two to three days of observations, with each session lasting for around two to three hours. Each session began by documenting environmental conditions, such as temperature, cloud cover, percentage of precipitation, and humidity. The time of day was recorded as behaviors occurred, such as moving around the enclosure or performance of social behaviors. For ease of interpretation these behaviors are separated into Personal, Conspecific, and Human-Related categories (See Table 1 in Appendix A). Any breaks in the observation periods were recorded. The observations totaled approximately 61.3 hours. Considering Big Guy's tendency for patrolling behaviors, the enclosure was broken down into "Zones" (see Table 2 in Appendix A), and the number of instances in each zone was averaged for each zone (see Figures 2 and 3 in Appendix B). "Instances" are the presence of the individual in a particular zone, excluding when the individual passed through a "Zone" without stopping. The vocalizations of both monkeys were recorded continuously throughout the observation periods indicating the motivation whenever possible. Testimonials from zoo employees and volunteers were noted and are discussed in this paper where relevant.

Results

Vocalizations

As depicted in Figure 1 (see Appendix B), Zsa-Zsa vocalized more frequently than Big Guy, and she was generally more vocal. On average, Zsa-Zsa vocalized approximately 17 times per session, Big Guy vocalized approximately 6.09 times per session, and instances in which the subject was unclear occurred approximately 1.77 times per day. Zsa-Zsa vocalized repeatedly during feeding periods and upon entering the enclosure when the keepers had just placed food. Both Zsa-Zsa and Big Guy vocalized at the sight

of familiar staff members and volunteers; however, Big Guy tended to vocalize in the presence of these humans using a series of coos and grunts rather than high-pitched whinnies. Zsa-Zsa and Big Guy also engaged in a call-and-response behavior, in which Big Guy would vocalize and Zsa-Zsa would echo him in a similar tone.

Conspecific Behaviors

The three most displayed conspecific interactions between Zsa-Zsa and Big Guy were allogrooming, proximity behaviors while resting, and a 'follow-the-leader' behavior. Aggression and avoidance behaviors were observed, albeit less frequently.

Allogrooming

Allogrooming was observed 10 times. 60% percent of these bouts were performed by Zsa-Zsa grooming Big Guy, and in the remaining 40%, Big Guy groomed Zsa-Zsa. The spider monkeys were seated on the platform in Zone 1 for 90% of observed bouts, and 10% of the bouts were performed on the front platform in Zone 9 of the enclosure. In one bout, Big Guy was observed 'ignoring' Zsa-Zsa's gestures to solicit allogrooming; Zsa-Zsa groomed Big Guy for a few minutes, only stopping to self-groom momentarily before continuing. Zsa-Zsa then lay down and gestured to Big Guy to groom her by reaching out her hand to touch him. After he stopped grooming her, she reached out soliciting grooming once more, to which he did not respond. Contrary to a testimony received from one of the keepers, only one instance of pectoral sniffing and embracing was observed during the study.

Resting-in-Proximity Behaviors

When lying or seated together on the Zone 1 platform or on the Zone 9 platform, Zsa-Zsa and Big Guy would either lie next to each other with physical contact, or they would rest on the opposite sides of the platform from one another. Avoidance behaviors were observed 10 times. In these displays, Big Guy would be seated and Zsa-Zsa would approach as if to sit near him; however, he would not stay there with her but, instead, find a new spot to sit or simply roam around the enclosure. The motivation for this behavior was unclear.

Follow-The-Leader

The follow-the-leader behavior consisted of Zsa-Zsa following Big Guy around the enclosure. If the shift door was open, the monkeys were free to move between the enclosure and the holding area as they pleased. If this behavior occurred when the shift door was open, Big Guy would emerge from the holding area first and begin to roam around the enclosure. Zsa-Zsa would follow behind him, tracing his path with slight deviations. Similar instances of this behavior occurred when the monkeys were not moving between the enclosure and the holding area. This 'follow-the-leader' behavior was observed 24 times, 58.33% occurred before noon, 37.5% occurred in the morning and afternoon, and 4.17% occurred after noon. There was one outlying instance in which Big Guy was observed following Zsa-Zsa.

Human-Animal Interactions

The human-animal interactions observed varied between Zsa-Zsa and Big Guy. In some observations they exhibited similar behaviors; however, their behaviors differed depending on the specific people present around them.

Zoo Personnel

The only zoo staff Zsa-Zsa interacted with were the keepers. She watched as keepers of her own or those belonging to the neighboring enclosure roamed behind and between the enclosures. She paid little attention to those moving along the guest pathways. If a keeper approached the back wall of the enclosure, she approached them as closely as the enclosure permitted, depending on the individual. A veterinary technician confirmed this pattern of behavior, claiming that Zsa-Zsa preferred only a few keepers. (Zoo Personnel, personal communication). This claim is substantiated by the increase in her activity when they are near, and by her vocalizing a short chuckle in their presence.

Big Guy displayed more affiliative behaviors towards humans. Because of his tenure at the zoo, many of the long-term staff members have formed a rapport with him (Zoo Personnel, personal communication). Staff members such as the Public Safety Officers were observed stopping by the enclosure to see him. They would often call out to him, addressing him by name to get his attention. Big Guy would often approach the front of the enclosure to meet them. His behaviors consisted of a

series of different facial expressions, such as eye contact, sticking out his tongue, vocalizations, and playing a sort of 'mouth game' with them. In this game, he would open and close his mouth repeatedly, and the humans would mirror the action back to him. Two of the 14 performances of the mouth game were directed towards zoo personnel. Big Guy also performed a sort of bobbing motion, either from a seated or standing position. Throughout the study, 14 human-animal interactions involving the researcher occurred, including eye contact or performing the bobbing motion, coupled with sticking out his tongue. Anecdotal evidence from zoo staff suggests that Big Guy also recognizes zoo staff and volunteers outside of their uniforms. He exhibits the same affiliative behaviors towards them without the uniforms. The zoo staff likely reinforced this behavior because they would stop by the enclosure outside of work hours to visit him and see if he would interact with them. One zoo volunteer who stopped by the enclosure once said she has known Big Guy since she started volunteering at the age of 13 and has been volunteering for 22 years. She said she has probably been around the zoo for longer than most of the keepers. According to her testimony, Big Guy is very protective of his favorite female humans from around the zoo. Any physical contact between her and any other human, even someone he knows, will make him irate, screech, and gesture violently (Zoo Personnel, personal communication). She said there are a few other females with whom these human-animal interactions occur.

The docents¹ and camp counselors who walked around the zoo with large summer camp groups caught Big Guy's attention. In this case, he watched as they walked past or stopped to allow the children a chance to see the enclosure. Similarly, Big Guy would rapidly approach the front wall of the enclosure as the white-shirted volunteers or staff members walked by pushing a cart or rolling cooler. The motivation behind this behavior was unclear. Big Guy, like Zsa-Zsa, also watched as staff members moved around the exterior of the enclosure.

Big Guy displayed aggressive behaviors which appeared to be motivated by the construction work around the zoo that took place during the pilot observations and subsequent sessions. Zsa-Zsa, while she typically reacted to the presence of zoo employees and construction workers near the enclosure, did not display any obvious signs of aggression in these instances.

¹Docents are zoo volunteers who lead educational efforts and educate visitors about wildlife.

Guests

Zsa-Zsa was rarely seen interacting with the guests. She was observed watching as guests walked past the enclosure only twice, once on Week 8 and once on Week 9. When guests approached the enclosure, she exhibited no change in behavior and didn't display any recognition of their presence. Big Guy, in contrast, was frequently observed directly interacting with the guests. As he played the 'mouth game' with familiar staff and volunteers, he also played with children, occurring 7 out of the 14 instances of this behavior. Big Guy also played this game with adult guests in 8 of the 14 instances. Big Guy engaged in this sort of play with the guests and staff members seated on the front platform in Zone 1, directly facing the person of interest. Big Guy often watched guests as they moved through the pathways, unlike his daughter, and enabled nearby guests to view him more closely, and for longer periods than Zsa-Zsa, by moving towards zones where they could easily see him.

Overall, no aggressive behaviors towards guests were observed except for a couple of outlying instances. In the most striking occurrence, a guest told another that Big Guy did "not like hats" as he removed his wide-brimmed hat and proceeded to wave the hat in Big Guy's direction. In response, Big Guy moved aggressively and rapidly in the direction of the guest, baring his teeth and actively shaking the wire wall of the enclosure. Other nearby guests mimicked the behavior of the first to elicit a reaction from Big Guy.

Habitat Utilization

When resting, Big Guy was observed on the front platform, the platform on the back wall, the branch on the far right of the enclosure, the corner of perpendicular branches on the far left, the top of the house at the back, or between a rope and a branch towards the back left; these are zones 9, 1, 10, 2, and 6 respectively. While active, he made use of the entire enclosure, including the floor, particularly when searching for food. He exhibited patrolling behaviors and took brief pauses on his path before moving on to the next destination. Based on their average instances per week, Zsa-Zsa was 33.7 % less active than Big Guy, finding a spot and keeping it for extended periods. Although Zsa-Zsa typically has fewer occurrences in each Zone of the enclosure than Big Guy, she spent relatively more time in the areas in which she was present than Big Guy in the areas in which his instances occurred. Zsa-Zsa frequently hung

from the enclosure walls and from the ceiling while hovering above a branch or a platform. She preferred the platform on the back wall, the high branch at the back left, or the branch on the front right for times when she was resting; these are zones 1 and 10 respectively. As shown in Figures 2 and 3 (see Appendix B), both Big Guy and Zsa-Zsa tended to favor Zones 1 and 9, which respectively represent the area in the back left of the enclosure and the area around the right-hand portion of the viewing window. Both individuals also traveled to Zone 4 the least, which represents the left-hand portion of the viewing window.

Enrichment Utilization

In a brief testimony, one of the keepers stated that Zsa-Zsa is Big Guy's "little princess" and he will let her eat more of the sweet foods during feeding time, identifying this as the reason why she appears to have a larger abdomen than he does. This testimony is consistent with their feeding patterns relative to enrichment utilization. Both monkeys were observed interacting with the enrichment items placed in the enclosure. All the interactions appeared to be motivated by food, as neither monkey interacted with the items if they were not in search of food. These items included paper bags filled with treats, a Jolly Egg toy, KONG toys of various sizes, slotted boxes, palm fronds, balls, buckets, wire baskets, maze bowls, blocks of ice, and corn husks. The observation of these interactions occurred after the keepers cleaned and placed new food onto the exhibit. On Weeks 6 and 9 of the observations, no interactions with enrichment items were observed for either Big Guy or Zsa-Zsa, as shown in Figure 4 (see Appendix B). Data for enrichment utilization is limited due to the limited number of total observations and the timing of enrichment placement on the enclosure relative to the time frame of the observation sessions.

Discussion

Zsa-Zsa's repetitive vocalization during feeding times is consistent with the literature (Dubreuil et al., 2015) which suggests that although she was born and raised in captivity, she still shares behavioral traits with wild *Ateles geoffroyi*. Previous research at the Central Florida zoo observed this pattern of behavior (Hargrave, 2019), indicating that her state of well-being has not altered between the studies. Her use of whinny vocalizations during feeding may serve as a claim to food resources (Dubreuil et al., 2015) and would likely serve to reduce

food competition if any new ‘immigrant’ conspecifics are introduced (Riveros et al., 2017). The presence of call-and-response behaviors between Zsa-Zsa and Big Guy suggests that they maintain healthy group dynamics and are not in a state of distress. Any changes in the vocalizations of either monkey over time could serve as an indicator of well-being to the zoo’s keepers and staff. The overall lack of aggressive behaviors between Zsa-Zsa and Big Guy demonstrates the quality of their dynamic and is reminiscent of the male-female dynamics of wild *Ateles geoffroyi* (Slater et al., 2009). Although instances of aggression were limited in this study, understanding the drivers of aggression within this species will be crucial if new conspecifics are introduced. As females in the wild can be more aggressive to newly immigrated females, Zsa-Zsa may engage aggressively with newly introduced females. However, this would likely decrease over time as the newer members become fully assimilated into the troop (Slater et al., 2009). Since the keepers regularly provide food, would the spider monkeys display similar tactics to wild *Ateles* to reduce food competition and cope with aggression risks?

Additionally, understanding Big Guy and Zsa-Zsa’s relationship in the parent-offspring context is important for ensuring not only their well-being, but also to ensure a smooth introduction when and if new conspecifics are introduced. Their feeding behaviors and their keeper’s testimony are consistent with the mother-offspring separation during feeding as a way of avoiding competition (Sukiennik, 2016). Unfortunately, a lack of information in the literature concerning father-daughter relationships exists, as the focus tends to be on mother-infant relationships. Likewise, preference of females for grooming opposite-sex individuals (Slater et al., 2009) and the grooming-reciprocation practices of male spider monkeys (Shaffner et al., 2011) could elucidate Big Guy’s ‘refusal’ to groom Zsa-Zsa. Although allogrooming has not been widely reported in captivity or the wild, intentional communication techniques, such as arm-raising, may be used to solicit allogrooming; this has been observed in captive spider monkeys in other research (Scheel & Edwards, 2012). Unlike the monkeys in the 2012 Scheel and Edwards study, neither Zsa-Zsa nor Big Guy made frequent use of arm-raising gestures to solicit allogrooming. While pectoral sniffing and embracing were only observed once in this study, the first iteration noted several instances of such initiated by Zsa-Zsa; this took place when the CFZ troop included Blondie and Red, and Zsa-Zsa’s behaviors could be attributed to her age and her position in the group

dynamics. In this regard, group dynamics may also have been linked to her genetic relationship to Big Guy, as father-daughter pair did not share genetic linkage to either Blondie or Red (Pitchford, 2016).

Although the motivation behind the avoidance behaviors was unclear, continued research on the subject may reveal insights regarding affiliative behaviors and group dynamics of spider monkeys. In these scenarios, Zsa-Zsa’s movement towards Big Guy could be affiliative, rather than a tactic for displacement, as observed between Zsa-Zsa, Blondie, and Red previously (Pitchford, 2016). The follow-the-leader behaviors exhibited by Zsa-Zsa and Big Guy during this study are consistent with the behaviors observed by Pitchford (2016), despite the current absence of other conspecifics in the troop, which may serve as an indicator of maintained well-being. Interestingly, this behavior was not noted in a previous iteration of this study (Hargrave, 2019), and should be investigated in greater detail in future iterations. Should new conspecifics be introduced, they may uptake subordinate positions to Big Guy and Zsa-Zsa, as Blondie and Red would, when the troop engages in this behavior. Understanding this behavior in depth will aid keepers in ensuring the successful fusion of new conspecifics into the troop by illuminating what this can reveal about group dynamics.

The habitat utilization and engagement with enrichment in this study did not indicate ill-health or contraindications of the practices of enrichment, but changes in related behaviors of either monkey or the behaviors exhibited by newly introduced conspecifics can be used as an indicator for changes in welfare. The display of patrolling behaviors by Big Guy and the differences in activity level between Big Guy and Zsa-Zsa are consistent with previous observations (Pitchford, 2016; Hargrave 2019) despite the loss of Blondie and Red from the group dynamics.

The human-animal interactions observed in this study, particularly with Big Guy, provide insight into the welfare conditions of animals in captivity. Zsa-Zsa did not appear to be impacted by the presence of humans other than the keepers. The results indicate that the human-animal interactions serve as enrichment and stimulation for Big Guy, considering the display of affiliative behaviors towards most visitors and familiar personnel (vocalizations, mouth game, etc.). However, the “hat incident” is evidence of the negative potential impact on behavior and well-being. While this particular

interaction between Big Guy and the guest was an isolated incident, there are important elements to consider: (1) the welfare of the animals is relative to the quality of their interactions with the guests, and (2) the behavior of the guests must be regulated to ensure the well-being of the animals is maintained or improved. To better gauge how human behavior impacts the spider monkey's behaviors, future studies should develop a human behavior ethogram. Analysis of human behaviors simultaneous with the analysis of animal behavior can provide an in-depth view of the correlations between welfare and the quality of the interactions between the respective parties.

Conclusion

This study's findings are crucial for understanding and interpreting the behaviors and the needs of both captive and wild *Ateles* spp. The data collected through studies on captive animals, particularly those of endangered species, can allow us to better understand what measures could be taken to ensure that individual's well-being in captivity. With a greater understanding of group dynamics, the keepers can ensure the smooth integration of new conspecifics into the zoo's established troops.

Collaborative long-term observational case studies such as this increase the body of behavior analysis literature (Maple & Segura, 2014), particularly our understanding of behavior within captivity as it changes over time. In this case, each iteration is a snapshot in time of the behaviors of Big Guy and Zsa-Zsa, offering their keepers the opportunity to spot behavioral changes between seasons and years.

If the goal of future research is to understand just how Big Guy and Zsa-Zsa make use of the enrichment placed within their enclosure, the observations should be perfectly timed with the placement of enrichment in the enclosure, which was not always the case in this study, and would help to reduce variables associated with the timing of the observations (shifting of the monkeys on and off enclosure, distractions caused by the presence of visitors, keepers, the researcher, etc.). Furthermore, it may benefit future researchers to classify the soft architecture elements of the enclosure as a form of enrichment, since these features are regularly altered by the keepers.

Significant improvements to this research could be provided by keeping the methodology consistent across each iteration. For example, the iteration of this study conducted by Hargrave utilized BORIS software for recording observations and would have benefitted this

study. Inconsistencies between the structure of each iteration may add unnecessary difficulty for the keepers' understanding and interpretation of the results. Future iterations of this study could be optimized utilizing technology to help monitor behaviors. This may help to limit the researcher as a stimulus in the animals' environment, as appeared to have become the case in this study. Using an accelerometer to detect changes in locomotion and bioacoustics to detect vocalizations can help to create a more detailed picture of the spider monkeys' behaviors; the combination of different devices, coupled with in-person monitoring can aid in determining their welfare status, based not only on behavioral but also physiological changes (Whitham & Miller, 2016). This newfound perspective would equip keepers with the in-depth knowledge to provide high-quality care to the residents and enable them to make any necessary changes before the introduction of new individuals. Thereafter, improvements within the habitat could increase the well-being of the current residents and ensure the successful introduction of any future troop members.

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Appendix A: Tables

Category	Behavior	Definitions
Personal Behaviors	Feeding	Consuming food placed on the enclosure by the keepers, or naturally occurring throughout
	Patrolling	Specific to Big Guy: continuous movement throughout the enclosure, with brief pauses in one location
	Self-Grooming	Combing through one's fur, licking oneself, scratching
	Vocalizing	Including coos, grunts, whinnies, and barks
Conspecific Behaviors	Aggression	Baring teeth, loud vocalizations, and striking directed towards conspecific
	Allogrooming	Grooming which takes place between the pair can be mutual or one-sided
	Avoidance	Moving away from conspecific within proximity
	Follow-The-Leader	Zsa-Zsa following Big Guy around the enclosure
	Pectoral Sniffing and Embracing	An individual placing its nose at the chest or armpit region of another individual (Riveros et al., 2017) coupled with an arm wrapping embrace
	Resting in Proximity	Resting for an extended duration within proximity of one another
Human-Related Behaviors	Aggression	Baring teeth, loud vocalizations, and rapid movements directed towards humans
	Bobbing	Moving the torso up and down repeatedly, from either an upright seated position or standing
	Mouth Game	Opening and closing of mouth mimicry of humans
	Sticking Out Tongue	Protrusion of the tongue (can be involuntary)
	Following / Observing	Visually tracking or traversing the enclosure to observe humans who pass the enclosure

Table 1. Ethogram of Observed Behaviors of Big Guy and Zsa-Zsa

1	6	7	12
2	5	8	11
3	4	9	10

Table 2. The enclosure was broken down into twelve zones; however, this table is not meant to be an exact representation of the enclosure. The numbers in the top row with the lightest coloration represent the areas at the back of the enclosure, the middle row with the medium shades represent the central areas of the enclosure, and the bottom row with the darkest coloration represents the front of the enclosure. Each zone encompasses multiple landmarks. For example: Zone 1 is representative of the back-left corner of the enclosure and the holding area and is where the back platform and the shift door are located.

Appendix B: Figures

Figure 1. Average Number of Vocalizations

Blue = Zsa-Zsa, Red = Big Guy, Yellow = Unsure

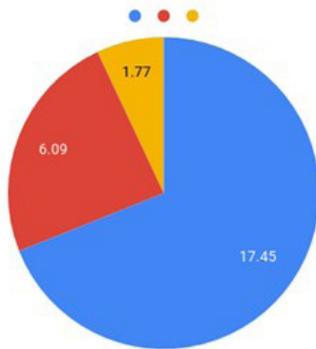


Figure 1. Average number of vocalizations made by each individual throughout a typical observation session, which lasted two to four hours in length. The region identified as "unsure" represents the instances in which it was unclear which individual produced the vocalizations that were heard.

Big Guy's Average Instances in the Enclosure "Zones" Per Session

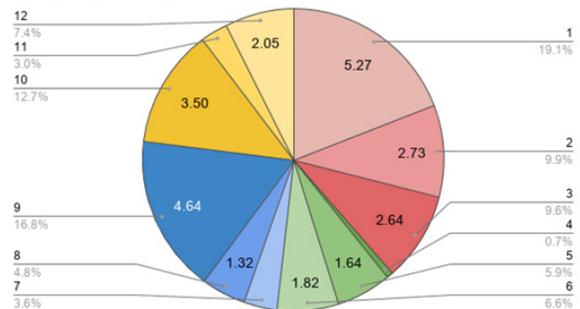


Figure 2. This figure represents the average number of instances that Big Guy was in a particular "Zone" of the enclosure. The Zones are shown 1 through 12 respectively, and the color of each slice coordinates with the color in Table 2 grid depiction of the enclosure. The percentage associated with each Zone indicates the instances of that Zone relative to the other areas of the enclosure.

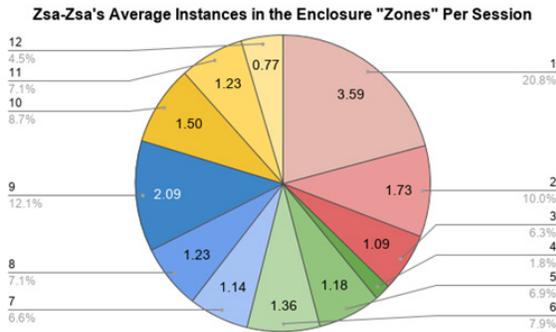


Figure 3. This figure represents the average number of instances that Zsa-Zsa was in a particular "Zone" of the enclosure. The Zones are shown 1 through 12 respectively, and the color of each slice coordinates with the color in Table 2 grid depiction of the enclosure. The percentage associated with each Zone indicates the instances of that Zone relative to the other areas of the enclosure.

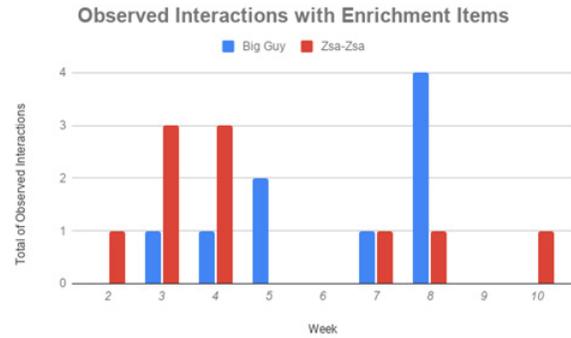
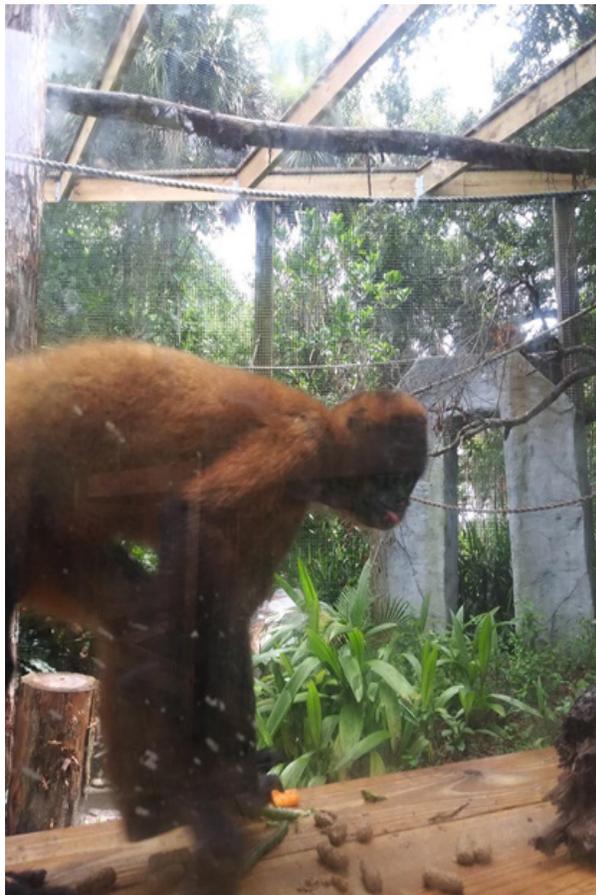
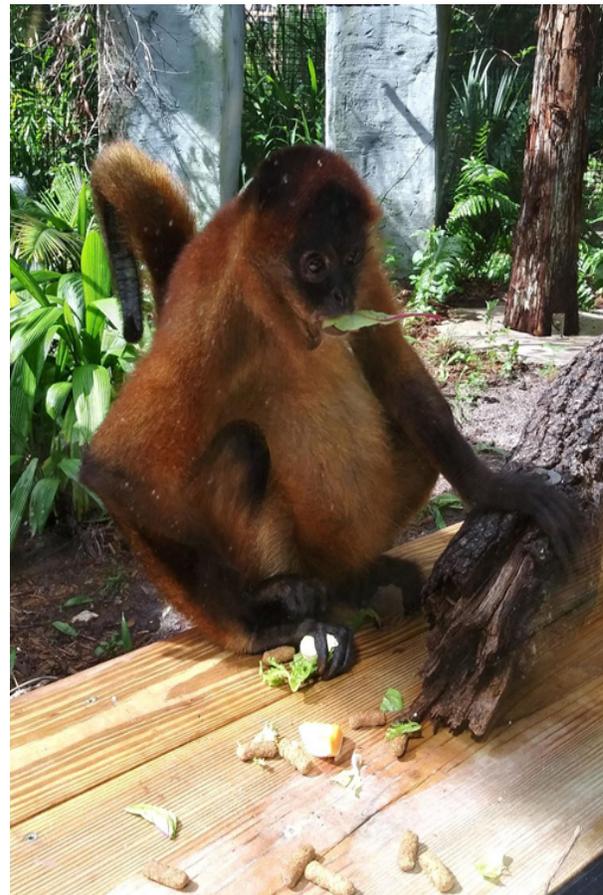


Figure 4. This figure displays the total observed interactions with enrichment items of both Big Guy and Zsa-Zsa per week. No observations related to enrichment items were made on either Week 6 or 9 of the observations.

Appendix C: Pictures



Picture 1. Big Guy during feeding time



Picture 2. Zsa-Zsa during feeding time