



PSYCHOLOGY AND PSYCHIATRY

NOVEL-RESULT

The effect of a nighttime zoo event on spider monkey (*Ateles geoffroyi*) behavior

Darby Proctor^{1,2}  and Michelle Smurl²

¹Florida Institute of Technology, and ²Brevard Zoo
Correspondence. Email: dproctor@fit.edu

(Received 23 March 2020; Revised 30 September 2020; Accepted 01 October 2020)

Abstract

The relationship between zoo animals, particularly nonhuman primates, and visitors is complex and varies by species. Adding complexity to this relationship is the trend for zoos to host events outside of normal operating hours. Here, we explored whether a late-night haunted-house style event influenced the behavior of spider monkeys. We conducted behavioral observations both on event nights and nights without the event. The spider monkeys were active and outside more frequently on event nights compared to the control nights indicating that their typical nighttime behavior was altered. However, it is difficult to definitively conclude whether the behavioral changes were a result of the event being aversive or enriching. Our findings suggest that zoos should conduct behavioral observations of and collect physiological data from their animals, especially if they are sensitive to environmental changes, when implementing new events, including those occurring outside of normal operating hours to ensure high levels of animal welfare.

Keywords: zoo animal welfare; behavioral observations; zoo visitors; nonhuman primates; zoo events

Introduction

The relationship between zoo visitors and animals, particularly nonhuman primates, is a complicated one and there is little consensus in the literature on whether visitors cause stress, provide enrichment or do not affect the animals (for a review see: Hosey, 2000). In primates, this relationship seems to be dependent on the species and sometimes the individual.

To further complicate this issue, modern zoos focus on providing visitor experiences that go beyond passively observing animals (Anderson et al., 2003). These experiences include activities such as interactions with keepers, animal training, and special events that occur outside of normal operating hours. While these extra activities/events enhance the zoo visitors' experience, there has been little empirical research into how zoo events, aside from standard visitation, affect the welfare of the animals.

Objective

To begin to address the lack of information on zoo animal welfare during special events, we opportunistically studied how a new, late-night, haunted-house style event affected zoo animal behavior. During the event, visitors walked through the woods behind the animal exhibits and actors startled the visitors which often resulted in screaming and yelling. To explore whether this impacted the animals, we conducted a quasi-experiment on the behavior of spider monkeys (*Ateles geoffroyi*) comparing their

behavior on event nights to control nights surrounding the event. As spider monkeys are typically diurnal, we believed they would be a good representative animal species to study.

Methods

We tracked the behavior of the spider monkeys ($n = 4$) during the two years the event ran (Friday and Saturday nights during October 2015 and 2016, the only time this event ever occurred) using night-vision goggles (Eyeclops Spy Gear 15 m Night Vision). We conducted scan samples (Altmann, 1974; every 10 minutes in 2015 and every 90 seconds in 2016) and recorded whether each monkey was active (any movement or eyes visible), resting (no visible movement) or inside (in their night building and not visible to the observers; the monkeys always had unrestricted access to the building). The difference in sampling frequency between the years was due to increased visibility in 2016 as we added an infrared home security light (LTIR50 DC12V 170 ft IR Night Vision Illuminator). The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional guides on the care and use of laboratory animals.

Results

We compared the monkey's behavior on baseline nights (8:30 pm – midnight; Thursdays and Sundays; $n = 9$) to event nights (8:30 pm – midnight; Fridays and Saturdays; $n = 11$). Because we had different numbers of scan samples in 2015 and 2016 and different numbers of baseline and event nights (due to an unrelated maintenance issue that resulted in the monkeys being kept in their night house during two of our planned baseline nights), we first converted our data into proportions of scans for each of our three behavioral categories for both event and baseline nights. We then ran z-tests for two proportions for each behavior, all of which were significant (see Table 1). The monkeys were more active, rested outside more frequently and spent less time inside during the event than during baseline observations. However, our data were not normally distributed, nor were they independent since the same individuals were used in both conditions, suggesting those results may be inaccurate.

Therefore, we created a weighted average of scans and used an alternative statistical technique that does not require normality or independence (See Table 2). We calculated Hedges' g , a measure of effect size for comparing means, to determine if there was a meaningful difference between event and baseline nights for each behavioral category (Hedges, 1981). All effect sizes were large ($>.8$; Cohen, 1988; See Table 2). As we found above, during the event the monkeys were more active and spent more time resting outside than on baseline nights, suggesting the event disrupted their typical nighttime behavior.

Table 1. Percentages of Scans by Behavioral Category.

	Baseline	Event	z	p
Active	4%	12%	10.01	<.001
Resting Outside	49%	77%	18.65	<.001
Inside	47%	11%	26.53	<.001

Table 2. Weighted Percentage of Scans by Behavioral Category.

	Baseline	Event	Hedges' g
Active	1.25%	10.22%	0.99
Resting Outside	49.64%	81.79%	4.16
Inside	49.10%	7.99%	7.80

We also conducted a Wilcoxon signed-rank test to determine whether there were any lasting effects of the event by comparing our baseline measures before (Thursday nights) and after (Sunday nights) the event. No differences were found in any of our behavioral categories (all $p > .05$). This suggests there were no longer-term effects of the event for the behaviors we measured.

Discussion

This late-night event changed the nighttime behavioral patterns of the spider monkeys. They spent more time outside and were more active during the event. However, the answer to what effect this event had on the animal's welfare is much less clear, just as is the relationship between visitors and primate welfare during standard zoo hours (Hosey, 2000). As we can rule out no effect, we are left with the possibilities that the event was either aversive or enriching.

Even though we did not systematically take data on the monkeys getting startled, we often observed rapid head movements and scanning behavior immediately following the actors and visitors yelling and screaming. The startle reflex is widely considered an aversive reflex (see the following reviews: Davis et al., 2008; Lang et al., 1990), so it is possible the event was aversive to the monkeys.

However, it is also possible that the event was enriching. Moodie & Chamove (2005), concluded that brief threatening events can cause some of the same positive side effects as enrichment in cotton-top tamarins (*Saguinus oedipus*). It is possible that the screaming and yelling by visitors promoted similar positive responses in our monkeys. However, as the aversive nature of the startle reflex is well-established, we favor the explanation that the event may have been aversive, although future research should explore both of these possibilities. Specifically, physiological measures, such as fecal cortisol levels would be helpful in distinguishing between the competing explanations for the change we observed in the monkeys.

To limit any potential confounding effects of weather/season/month, we chose to use different days of the week, Thursday and Sunday, to obtain baseline measures while the event ran only on Friday and Saturday. As a result, there is a potential confound of the day of the week. Thus, it is possible that there is some other variable, perhaps crowd size, that influenced their nightly behaviors. We think this is unlikely as these individuals grew up in zoos and are well habituated to crowds. Therefore, a more parsimonious explanation would be that the novel event changed their behavior. Nonetheless, the question of whether crowd density during the day influences the nighttime behavior of the animals is certainly worth exploring in the future.

Conclusion

As zoos continue to seek more avenues for revenue, such as after-hours events, there should be an associated increase in monitoring animal welfare. It seems likely these events will affect the animals in some way, but more research should be conducted to determine how this affects the animal's short and long-term welfare. Zoos should be particularly aware of the effect of events when they have animals that are more sensitive to environmental changes.

Author Contributions. DP and MS conceived the study. DP conducted the data collection and analyses. DP and MS wrote the article.

Funding Information. This research received no specific grant from any funding agency, commercial or not-for-profit sectors.

Data Availability. Readers may contact DP if they want to access the data.

Conflicts of Interest. The authors have no conflicts of interest.

References

- Altmann, J. (1974). Observational study of behavior: Sampling methods. *Behaviour*, **49**, 227–267.
- Anderson, U. S., Kelling, A. S., Pressley-Keough, R., Bloomsmith, M. A., & Maple, T. L. (2003). Enhancing the zoo visitor's experience by public animal training and oral interpretation at an otter exhibit. *Environment and Behavior*, **35**, 826–841. <https://doi.org/10.1177/0013916503254746>.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Routledge Academic.
- Davis, M., Antoniadis, E. A., Amaral, D. G., & Winslow, J. T. (2008). Acoustic startle reflex in rhesus monkeys: A review. *Reviews in the Neurosciences*, **19**, 171–186. <https://doi.org/10.1515/REVNEURO.2008.19.2-3.171>.
- Hedges, L. V. (1981). Distribution theory for glass's estimator of effect size and related estimators. *Journal of Educational Statistics*, **6**, 107–128. <https://doi.org/10.2307/1164588>.
- Hosey, G. R. (2000). Zoo animals and their human audiences: What is the visitor effect?. *Animal Welfare*, **9**, 343–357.
- Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1990). Emotion, attention, and the startle reflex. *Psychological Review*, **97**, 377.
- Moodie, E. M., & Chamove, A. S. (2005). Brief threatening events beneficial for captive tamarins?. *Zoo Biology*, **9**, 275–286. <https://doi.org/10.1002/zoo.1430090403>.

Peer Reviews

Reviewing editor: Dr. Melissa Birkett

Southern Oregon University, Psychology, 1250 Siskiyou Blvd, Ashland, Oregon, United States, 97520-5010

This article has been accepted because it is deemed to be scientifically sound, has the correct controls, has appropriate methodology and is statistically valid, and met required revisions.

doi:10.1017/exp.2020.56.pr1

Review 1: The effect of a nighttime zoo event on spider monkey (*Ateles geoffroyi*) behavior

Reviewer: Marieke Gartner

Atlanta Fulton County Zoo Inc

Date of review: 04 June 2020

© The Author(s), 2020. Published by Cambridge University Press This is an Open Access article, distributed under the terms of the Creative Commons Attribution licence (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted re-use, distribution, and reproduction in any medium, provided the original work is properly cited.

Conflict of interest statement. Reviewer declares none.

Comments to the Author: Overall this is an interesting and important subject for research, but some points need to be addressed before I would recommend publication.

Even though the authors state that the event was new, there is no data on the monkeys behavior before the event. This is compounded by the fact that the event took place on the same days each week, so it is unknown what effect day is having on the data. This needs to be mentioned at least as a limitation. Other limitations should also be included.

The literature cited is quite old—there are newer articles on primates available.

As I don't have experience with Hedge's g I'm sure the statistical reviewer will comment, but I believe confidence intervals should be included.

The wording of the Conclusion needs to be changed as there is no scientific evidence that the event was aversive to the monkeys. In addition, it is overreaching to say, in the Discussion, that the event was "likely...aversive" and instead should just suggest that it might be.

Because the results are so few, there is no reason not to include them in the text for easier accessibility, rather than in a table.

Score Card

Presentation



Is the article written in clear and proper English? (30%)

5/5

Is the data presented in the most useful manner? (40%)

4/5

Does the paper cite relevant and related articles appropriately? (30%)

4/5

Context



Does the title suitably represent the article? (25%)

5/5

Does the abstract correctly embody the content of the article? (25%)

5/5

Does the introduction give appropriate context? (25%)

4/5

Is the objective of the experiment clearly defined? (25%)

5/5

Analysis



Does the discussion adequately interpret the results presented? (40%)

4/5


Is the conclusion consistent with the results and discussion? (40%)

1/5

Are the limitations of the experiment as well as the contributions of the experiment clearly outlined? (20%)

1/5

Review 2: The effect of a nighttime zoo event on spider monkey (*Ateles geoffroyi*) behavior

Reviewer: Dr. Amanda Dettmer 

Date of review: 30 June 2020

© The Author(s), 2020. Published by Cambridge University Press This is an Open Access article, distributed under the terms of the Creative Commons Attribution licence (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted re-use, distribution, and reproduction in any medium, provided the original work is properly cited.

Conflict of interest statement. Reviewer declares none.

Comments to the Author: Several questions remain after reading this submission: Was this event "new" in 2015 (I.e., was that the first year it was held, or had the monkeys experienced it in years prior)? How many weekends per year was it held? Was it held on other days of the week as well? How did the hurricane impact data collection? Please provide a reference(s) for scan sampling. Were there differences between Sunday nights and Thursday nights? (the event may have continued to impact behavior after it ended). What is the cutoff for a "large" effect size? Since there was no data collection on aversion, please consider toning down the conclusion, "it is likely the event was aversive" – it's simply impossible to tell with the present data whether the monkeys were responding to novelty or auditory stimuli, or actually feeling aversive. As well, one reference on aversion (Lang et al.) does not support, "The startle reflex is widely considered an aversive reflex" (and you have plenty of room for more references. Similarly, in the conclusion – we cannot determine the event was aversive (yes, it resulted in reactions, but not necessarily aversion, given the data). Conversely, given the data, we cannot determine the event was NOT detrimental to welfare. You may be able to conclude something about long-term welfare, but we don't know about short-term welfare. Related to this, in the conclusion or discussion, can you add ideas for what other measures to include to get at welfare? This would also address limitations as well.

Score Card

Presentation



Is the article written in clear and proper English? (30%)

5/5

Is the data presented in the most useful manner? (40%)

4/5

Does the paper cite relevant and related articles appropriately? (30%)

2/5

Context



Does the title suitably represent the article? (25%)

5/5

Does the abstract correctly embody the content of the article? (25%)

4/5

Does the introduction give appropriate context? (25%)

4/5

Is the objective of the experiment clearly defined? (25%)

4/5

Analysis



Does the discussion adequately interpret the results presented? (40%)

3/5

Is the conclusion consistent with the results and discussion? (40%)

3/5

Are the limitations of the experiment as well as the contributions of the experiment clearly outlined? (20%)

2/5