Tails in Context: Implications for Laterality in the Colombian Spider Monkey

E.R. Boeving, G.A. Kendall and E.L. Nelson
Department of Psychology, Florida International University, Miami, FL

INTRODUCTION

- The Atelinae tail has a dense accumulation of receptors at the pad, and its sensitivity is distinctive among primates.
- Spider monkeys use their fully prehensile tail across a variety of contexts including postural support, social interaction, and object manipulation.
- Previous studies have emphasized laterality of paired organs (e.g., hands). However, unpaired organs may provide a unique test of laterality.
- We hypothesized that tail use is affected by context. We predicted tail use preferences when monkeys engaged in complex object manipulation, but not when monkeys were at rest.

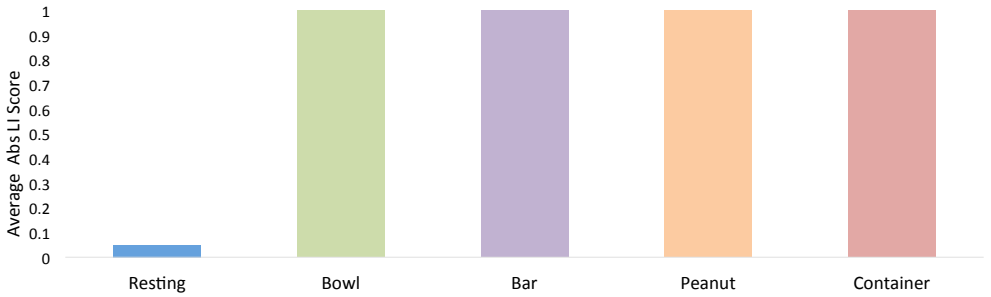
METHOD AND ANALYSIS

- Observational tail use data were collected by trained observers on a group of 14 adult Colombian spider monkeys *(Ateles fusciceps rufiventris)* at Monkey Jungle in Miami, FL. One observation was taken per day until 30 data points were obtained for each monkey. Data were recorded while at **rest** as tail wrapped to the left or right of the body.
- Experimental tail use data were collected on a subset of 5 monkeys who spontaneously use the tail to manipulate objects on a battery of four complex tasks: **bowl, peanut, bar,** and **container** (**Table 1**). Monkeys complete no more than 10 trials per day on each task until 30 data points are obtained. Data collection is in progress for 1 of the tasks.
- A *Laterality Index* was calculated for each monkey on each measure using the formula *LI = (R-L)/(R+L)*, where R is the number of right tail responses and L is the number of left tail responses. Negative values indicate a left bias, and positive values a right bias. We also computed absolute values of LI scores to facilitate comparisons across tasks.

Table 1. Experimental tail tasks.

Task	Description
Bowl Task	Tail used to obtain a grape from inside a suspended bowl placed outside enclosure out of reach of the hands.
Peanut Task	Tail used to obtain a peanut placed on a table at floor level outside enclosure out of reach of the hands.
Bar Task	Tail used to obtain a baited PVC tube placed on bookends outside enclosure out of reach of the hands.
Container Task	Tail used to obtain a grape from inside a container inclined at a 22.5° angle placed on a table at floor level outside enclosure out of reach of the hands. *Data collection still in progress*

Figure 1. Average strength of tail use preference by task.



RESULTS

- A one-sample t-test on tail wrapping LI scores found no population-level bias, $t(13)=-1.83$, $p=.09$ ($M=-0.05$, $SD=0.10$).
- On the experimental tasks, there was no variability in tail use. Monkeys were 100% lateralized. Four monkeys had LI scores of -1.00 on the bowl, peanut and bar tasks, indicating exclusive left tail use. One monkey had LI scores of 1.00 on the bowl, peanut, and bar tasks, indicting exclusive right tail use. Although the container task is still in progress, data collected so far match the pattern found on the other experimental tasks.
- Group level data comparing the average strength of tail use preference for resting versus object manipulation is given in **Figure 1.**

DISCUSSION

- Our results confirm our prediction that the complexity of object manipulation elicits a lateralized response in tail use, whereas there was no tail preference at rest.
- We build upon previous work in unpaired organs where subjects were 100% lateralized in the use of the prehensile tail (*Ateles geoffroyi*) during manipulation[3] , and during skillful feeding movements in trunk use (*Elephas maximus*)[2,4].
- While the mechanics of the elephant trunk are commonly replicated in the robotics field[1], the spider monkey tail is not currently utilized as a model. However, the elephant trunk consists of soft tissue muscles and lacks the skeletal structure of the spider monkey tail that is often built into robots.
- Further examining the precision, structure, and capacity of the spider monkey tail through experimental tasks may advance multiple disciplines currently utilizing biological models for continuum style robots.
- Understanding why some monkeys do not use the tail for manipulation is also a goal of future work.

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CONTACT INFO:
Emily R. Boeving
eboev001@fiu.edu