

2018

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Recommended Citation

Palmer, Emily P. (2018) "Play behavior varies by age class in wild African elephants (*Loxodonta africana*)," *Papers & Publications: Interdisciplinary Journal of Undergraduate Research*: Vol. 7 , Article 3.

Available at: <https://digitalcommons.northgeorgia.edu/papersandpubs/vol7/iss1/3>

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Acknowledgments

This research was made possible by the Randolph-Macon College biology department as I have completed many biology courses that have laid the foundation for this project including how to properly write a scientific paper, conduct research, and draw bigger implications based off data. Dr. Stephanie Coster assisted me in choosing a proper research topic, method of observation, and appropriate writing techniques. Dr. Coster served as a professor, and a mentor by providing helpful feedback and insight. This experience was influenced by photographer Joseph Andy Dyson and wife Dr. Alisa Dyson, of Reflections of Nature. Safari guides George Wajuje Wachira and Nick Njuguna were the main persons involved with obtaining data in the wild during game drives due to their professional expertise in safari wildlife.

Play Behavior Varies by Age Class in Wild African Elephants (*Loxodonta africana*)

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ABSTRACT: Many environmental factors effect the behaviors of African elephants, *Loxodonta africana*, such as, health, drought, and dominance. The purpose of this research was to observe play behaviors within the different age classes (calf, juvenile, and adult) of wild elephants during recent drought conditions in Amboseli National Park, Ol Pejeta Conservancy, and Samburu National Reserve in Kenya. Scan sampling every 15 minutes was used to record play behavior. The results from this study indicated that there are differences in the types of play behavior among the age classes. Adults displayed the most play frequencies for environmental, alone locomotion, and tactile play. Calves exhibited the most play frequencies for object and calm play. Calves were also the only age class to display nursing attempts, with juveniles displaying zero attempts. Research was conducted at the David Sheldrick Wildlife Trust, an elephant orphanage, as a comparison to the wild data. The findings indicated similarities between wild and captive data. Similar to the results in the wild, juveniles had the highest play frequencies for environmental play. Calves also had similar behavior in the orphanage and in the wild, where the highest play frequencies were object and calm play. Observing play behavior across the different age classes can be beneficial in order to understand the impact play behavior has on social development.



The African elephant (*Loxodonta africana*) is an endangered species that is experiencing declines due to poaching and habitat destruction (Blanc, 2008). Many behaviors of African elephant's mimic that of other individuals in their cohort through emotional expression; this is important when understanding the impact emotion has on play behavior (Soltis, 2013). Play behavior offers psychological and physiological benefits, as elephants use play behavior as a method to alleviate distress, anxiety, and grief (Lee and Moss, 2014). In the wild there are various factors that influence the different types of play behaviors, including environmental conditions such as drought, social exchanges that reflect personality types, and early maternal investment. The combination of these factors influences the social development of elephants.

Drought conditions can influence maternal investment and play behavior, potentially altering social development. More specifically, drought decreases water availability, which limits food resources and affects the amount of nutrition lactating mothers have access to. Nursing calves, therefore, experience less nourishment (Lee and Moss, 2014). Early maternal investment is critical for understanding social development later in life. Calves experience a tradeoff between nutritional development and social development (Lee and Moss, 2014). Time spent nursing provides more nutrients for growth and survival but is also time less spent on social development through play with other individuals and herds. It is the balance between development payoffs now or

later in life. Males and females display different behavior with regards to nursing and social development. Males attempt to suckle more and are more successful, which provides them with a greater intake (Lee and Moss, 1986). Mothers show equal tolerances of both male and female suckling attempts (Lee and Moss, 1986). These early suckling behaviors are thought to influence social development. Males are believed to need more nutrients for future mating success, whereas females need social success to develop future maternal instincts (Lee and Moss, 1986).

Along with environmental conditions, gender, personality types, age, and hierarchy of herds all influence the types of play behavior in African elephants. As an individual becomes more dominant, it engages in less play behavior. Dominant bulls are less tolerant of play, whereas dominant females are more tolerant (Jeffery, 2017). Different personality types also influence play behavior, similar to humans (Jeffery, 2017). Sheldrick (1992) notes each elephant displays its own distinct personality and can display a range of emotions from happy or sad or envious.

Various types of play include environmental play, tactile play, object play, alone locomotion, and calm play (Lee and Moss, 2014; Table 1). Distinct body movements reflect the type of play behavior. Poole and Granli (2011) found larger juveniles or adults displaying submission to smaller calves, which demonstrates calm play. When older individuals instigate play, calves often respond by climbing, leaning, or rubbing (Poole and Granli, 2011). Object play is when calves, juveniles, or adults use an environmental or artificial object such as a stick or ball to play (Lee and Moss, 2014). Alone locomotion and tactile play consist of ear flapping, head swinging, and the tossing of water or mud on one's self or others (Lee and Moss, 2014). Lastly, Lee (1987) defines environmental play as when the elephant uses the head or trunk in an abnormal behavior to express play, along with trumpeting vocalizations (Lee, 1987). Elephants held in captivity also demonstrate play behaviors that invoke physical activity and social competency despite artificial conditions. In calf and juvenile elephants, play behaviors increase when water is present (Vicino and Marcacci, 2015),

indicating that the presence of water may predict the amount of play behaviors shown. Play is also shown in times of death or grief as elephants use play to relieve stress (Mertel et al., 2009). When nurturing calves and juveniles back to mental and physical health following abandonment or the death of their mothers, Ndume and Malaika (2017) also found similar behavioral patterns in Nairobi, Kenya. Studying play behavior in African elephants is important in order to understand the trade off between social development and nursing. These patterns are expressed long term under various circumstances throughout an individual's life such as poaching, drought, etc. Therefore, looking at play behaviors across all age classes is beneficial because we expect there to be a difference between social and nutritional needs in African elephants.

This study aims to compare the types of play behavior in calves, juveniles, and adults, under the current drought conditions in Amboseli, Ol Pejeta, and Samburu, Kenya. We predicted a significant difference in play between age classes, with younger calves playing more frequently than older individuals, and the same expectation of calves displaying more play behavior than juveniles as found in Ndume and Malaika (2017). Within each age class, we also expect play frequency to vary by type of play with a significant difference. With a goal of seeing 3 scans per hour, under each duration of scan sampling, we hypothesized that calves display more calm play, and juveniles display more tactile play (Lee and Moss, 2014). We predicted that in adults environmental play will predominate. Lastly, we also expect nursing frequencies between calves and juveniles to differ, with calves attempting to nurse more frequently. Documenting maternal investments can provide insight in social development, in light of the survival-social trade off. Understanding the social interactions within play behaviors in African elephants may help in times of environmental stress, poaching, or habitat destruction.

Methods

Observational Methods

Data was collected in various parks throughout Kenya. In Amboseli National Park, 25

observation scans took place from January 8-11, 2018. On January 13 and 14, 2018, 8 observation scans were taken in Ol Pejeta Conservancy. In Samburu National Reserve, 11 observation scans took place January 15-18, 2018. Scan sampling was used to investigate play behavior among different age classes of wild elephants. The time intervals for recorded observations began every 15 minutes for 1-3-minute intervals, or until elephants left the field of view. A wrist watch was used to ensure that all times were precise, as well as a set of binoculars that kept elephants in sight for as long as possible. An ethogram was created to outline the different types of play behaviors based on Lee and Moss

(2014) (see Table 1). Play behaviors were operationalized based on the unique characteristics that each behavior displayed, such as body movements, vocalizations, and interactions with others. These play behaviors included: environmental play, alone locomotion play, object play, tactile play, and calm play (Table 1). The nursing frequencies of calves were determined using the same method (Table 1).

A tally system was implemented to record the frequency of each play behavior. For instance, if a juvenile depicted object play, one tally for the age class of juvenile was recorded under the object play behavior type: one tally per bout. The tally system displayed the frequencies of each play behavior, in each age class, for statistical testing. The play behaviors were observed under the set time intervals and recorded based on which age class (Calf, Juvenile, or Adult), and which type of play behavior was shown. Each age class was abbreviated as C (calf), J (juvenile), or A (adult). Having the corresponding letter with each tally mark showed which age class was displaying what behavior.

Table 1: Play Behavior Types.

The different types of play behaviors are defined with the distinct characteristics (Lee and Moss, 2014).

Behavior Type	Definition
Nursing Behaviors	Attempting to suck the mother's breast milk. Indicates level of energy, play's costs and consequences.
Environmental Play	Approach, chase, or vocalize at objects (other species) in the environment typically with movements of: A. Head B. Trunk C. Trumpeting vocalizations.
Object Play	Discovering objects with: A. Trunk B. Mouth C. Tusks D. Feet E. Body tossing F. Body movement
Alone Locomotion Play	A. Running B. Head swinging or head in charge position. C. "Ear Flopping" D. Kicking E. Spinning pattern F. Vocalization sounds
Tactile Play	A. Rolling B. Tossing of mud, water, or dust C. Other actions shown such as swimming, head dumping in water, & submergence of body.
Calm Play	A. Climbing B. Leaning C. Rubbing D. Rolling on behaviors E. Trunk twining and play.

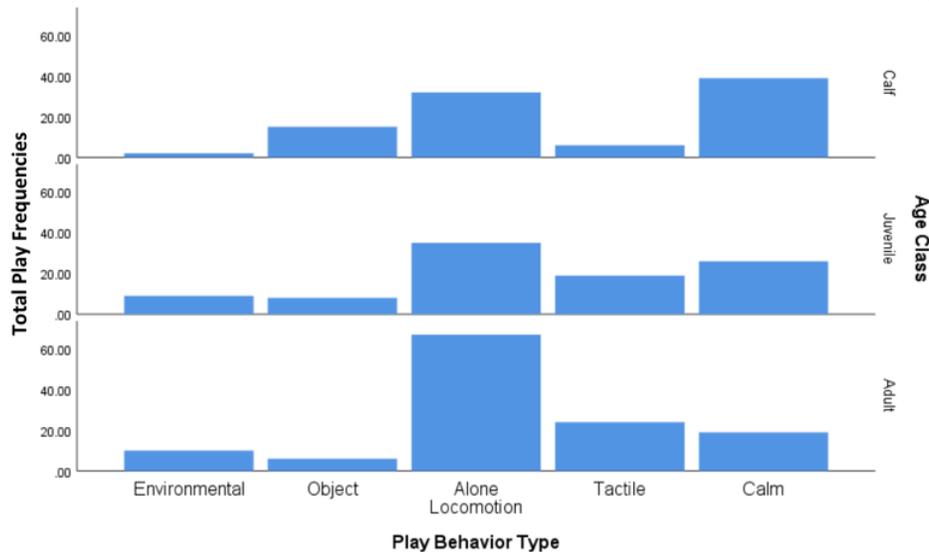
David Sheldrick Wildlife Trust

The David Sheldrick Wildlife Trust (DSWT) in Nairobi, Kenya is an elephant orphanage designed to nurse elephants back to mental and physical health following abandonment or the death of their mothers. In this location, the play behaviors of the elephants were observed in the orphanage as a comparison to the play behaviors of the elephants in the wild. It was expected to see calves displaying more play behavior, as it is likely they were still coping with emotional trauma. A total of 4 observation scans took place at the DSWT on January 7, 2018.

Analytical Methods

SPSS version 25.0 (2017) was used to calculate summary statistics, including the average number of bouts of each play behavior in both the wild and

Figure 1. The total play frequencies for each play behavior type is listed, per age class, from the wild data collection.



captive populations. Wild observations were then pooled, and a statistical analysis was run to investigate whether play frequency varied by age class, and by play type within each age class. A chi-squared non-parametric test ($\alpha = 0.05$) was implemented in SPSS. Statistical tests on the captive population were not run due to a small sample size.

Results

In the wild, adults exhibited the most play frequencies for environmental, alone locomotion, and tactile play. Calves generally exhibited the most play frequencies for object and calm play. Calves were also the only age class to display nursing attempts, with juveniles displaying zero attempts. In the DSWT, the results were similar regarding which type of play was expressed the most. The oldest individuals at the DSWT were juveniles, who displayed the most play frequencies for environmental, similar to the results found in the wild. In addition, calves had similar behavior in the orphanage and in the wild, where the highest play frequencies were object and calm play. Nursing frequencies were not observed at the DSWT because all elephants were held in captivity without mothers; and were, therefore, bottle-fed.

Out of 40 total wild observation scan

periods, there were 317 play bouts across all age classes and play behavior types. From the pooled data from all of the parks, a significant difference in play frequencies was found across all age classes and play behavior types ($\chi^2 (2) = 5.91$, $p < 0.05$; Figure 1). Adults displayed more play bouts in environmental, alone locomotion, and tactile play; whereas calves displayed more play bouts in object and calm play (Table 2). Also, the frequency by play type was significantly different within each age class. For calves, play frequency varied by type of play ($\chi^2 (4) = 55.5$, $p < 0.0005$), and calves displayed the greatest number of bouts in calm play. For juveniles, play frequency varied by type of play ($\chi^2 (4) = 27.1$,

Table 2: The total number of play behavior occurrences, per age class and play type.

The average frequency of each type of play behavior is displayed.

	Environmental	Alone Locomotion	Object	Tactile	Calm
Age Class					
Calf	2	32	15	6	39
Juvenile	9	35	8	19	26
Adult	10	67	6	24	19
Average	7.00	44.66	9.66	16.33	28.00

$p < 0.0005$), and juveniles displayed the greatest number of bouts in alone locomotion play. Lastly, in adults play frequency varied by type of play ($\chi^2(4) = 96.7, p < 0.0005$) and adults also displayed the greatest number of bouts in alone locomotion play. Calves displayed more nursing attempts than juveniles ($N = 21$ for calves; $N = 0$ for juveniles). The greatest number of scans were taken in Amboseli National Park, with the least number of scans observed in Ol Pejeta Conservancy (Amboseli = 21; Ol Pejeta = 8; Samburu = 11).

In DSWT there were a total of 4 observation scans, with 30 play bouts, and the DSWT results also showed a difference in play behaviors between calves and juveniles, with calves displaying more total play frequencies (Table 3). Also, the same findings from the various parks were found in the DSWT results as well. Although the number of play frequencies were much less, juveniles displayed higher play frequencies in environmental play; while calves displayed higher play frequencies in object and calm play (Table 3).

Discussion

This study supports the hypothesis of calves displaying more calm play, with adults exhibiting more environmental play. Calves displayed the greatest nursing attempts and calm play frequencies, and adults demonstrated the most environmental play frequencies. However, juveniles did not exhibit the most play frequencies for tactile play, as predicted; instead, adult

elephants displayed the highest frequencies.

In Asian elephants (*Elephas maximus*), tactile play is recognized as a form of social behavior, as well as a form of play behavior in specific circumstances (Vanitha et al., 2011). The details of the behavior include trunk twining in a ‘S’ or ‘U’ shape, as well as using the trunk to touch lips (Vanitha et al., 2011). These specific characteristics can be found at various times such as, disturbance, threatening situations, grooming practices, or for reassurance in partner relationships (Vanitha et al., 2011). Tactile play in Asian elephants is primarily expressed by adults, which corresponds to the findings of this study as adult African elephants displayed the most frequencies for tactile play. Both instances of tactile play in the Asian and African elephant potentially involve other individuals by touching lips, trunk twining, and the tossing of mud or water on one’s self or others. These similarities suggest that tactile play could be used less as a method of play behavior, but rather more as a method of social behavior.

In addition to using tactile play in a social context, both African and Asian elephants display similarities in communication methods. The two-different species use the same four categories of communication techniques: trumpets, chirps, roars, and rumbles (Nair et al., 2009). In Asian elephants, Nair et al. (2009) found adults primarily demonstrate the use of trumpets and roars in times of play, distress, and aggression. Juveniles use trumpets, roars, and rumbles in times of play and distress as well (Nair et al., 2009). The findings from Nair et al. (2009) are similar to the findings of this study as adult and juvenile African elephants displayed the highest frequencies regarding alone locomotion and environmental play: the two play behaviors that include vocalization sounds and trumpeting. Notably, these play behaviors involving vocalizations are exhibited by individuals in the more mature age classes. Juveniles and adults are responsible for learning the behaviors of the matriarch with age progression and are therefore likely to vocalize their learning behaviors as a method of social communication (Lee and Moss, 2014).

Table 3: The total number of play behavior occurrences for calves and juveniles with respect to each play type at the DSWT.

The average frequency of each type of play behavior, for calves and juveniles, is displayed.

Age Class	Environmental	Alone Locomotion	Object	Tactile	Calm
Calf	1	5	7	6	7
Juvenile	3	3	1	5	2
Average	2.0	4.0	4.0	5.5	4.5

One of the limitations of this study was that elephants often left the field of view. It became troublesome to keep a continuous scan of the same herd over time due to landscape attributes. Elephants were often covered by bushes, or other members of the herd, which inhibited the ability to observe all members equally. Scans conducted in Amboseli were more continuous because the landscape was open plains as compared to shrubland habitat present in the other parks. Another limitation of this study was the comparison of nursing frequencies between calves and juveniles. We expected that juveniles and calves would have an equal opportunity to nurse and would feel pressure to nurse due to the drought conditions. However, calves were the only age class to attempt nursing. Despite the limitations, the data still relate closely with other findings of nursing behaviors (Lee and Moss, 1986).

This study illustrates that observing play and nursing behavior can help illuminate the social interactions of African elephants. More specifically, as poaching rates and habitat destruction continue to rise, understanding play behavior among age classes can help researchers interpret the meaning behind play behavior. Adults and juveniles used play behaviors as methods of social communication when interacting with other individuals. Calves, however, demonstrated play that included mimicking the behavior of other individuals; potentially indicating play is used as a training tool to enhance survival (Lee and Moss, 2014). Similarities in the results between the wild and orphaned elephants also suggest that the different age classes have similar interactions. From the findings of this study we suggest that play behaviors and nursing attempts may inform the future social success of the individuals in both wild and captive populations.

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Contributor Bio

Emily Palmer is intrigued in the study of animal behavior and has researched play behavior in wild African elephants (*Loxodonta africana*) in Kenya, Africa. She is receiving her B.S. from Randolph-Macon College with a major in Biology and minor in Psychology. After undergraduate education, she will attend nursing school to receive her B.S.N. Her studies and interests are focused around animal and human behavior, as she enjoys learning more about the functions of the brain and the purpose of behavior: both human and animal.

Acknowledgements

This research was made possible by the Randolph-Macon College biology department as I have completed many biology courses that have laid the foundation for this project including how to properly write a scientific paper, conduct research, and draw bigger implications based off data. Dr. Stephanie Coster assisted me in choosing a proper research topic, method of observation, and appropriate writing techniques. Dr. Coster served as a professor, and a mentor by providing helpful feedback and insight. This experience was influenced by photographer Joseph Andy Dyson and wife Dr. Alisa Dyson, of Reflections of Nature. Safari guides George Wajuje Wachira and Nick Njuguna were the main persons involved with obtaining data in the wild during game drives due to their professional expertise in safari wildlife.