

# Social Behavior in a Herd of Captive Male Giraffes

By: Patrick Ziarnowski and Kaidi Fenrich

Faculty Mentor: Frank Logiudice

UCF Department of Biology

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**ABSTRACT:** Giraffes (*Giraffa spp.*) are a common feature of zoological institutions, where conditions differ from those of the wild, a reality that may cause behavioral changes. A recent management technique has been to house all-male herds in zoos that have not been selected for giraffe breeding, with breeding confined to certain zoos. To date, no studies have looked at social behavior in captive herds comprised exclusively of males. In a herd of one adult (named Emba) and two subadult male giraffes (named Rafiki and Gage), the dominant adult giraffe, Emba, demonstrated sociosexual behavior—apparent courtship, investigation, and flehmen responses—almost exclusively toward one of the subadult giraffes, Rafiki, and agonistic behavior towards both subadult giraffes. Often in combination with sociosexual behavior directed towards Rafiki, Emba displayed aggressive behavior in the form of hitting, which Rafiki rarely reciprocated. In response to Emba standing tall behind him, a dominance display, Rafiki frequently assumed a snout high posture, possibly indicating submission. In addition, behaviors regarded as affiliative, such as social rubbing and social exams, occurred between all giraffes. These behaviors varied in frequency between dyads and potentially may indicate social preferences. All giraffes attempted to mount at least once, though the two oldest conducted the majority of the mountings, and the recipient of the action was nonrandom. Ultimately, no statistical relationship was apparent between mounting and dominance.

**KEYWORDS:** giraffe, social behavior, zoo, captivity

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## INTRODUCTION

Conditions in captivity typically vary greatly from conditions in the wild. As a consequence, behaviors observed in captive animals may diverge considerably from those of wild animals (Maple, 2007). In the wild, male giraffes only loosely associate with one another and become increasingly solitary as they grow older (Bercovitch et al., 2006; Dagg and Foster, 1976). Bulls adopt a roaming male tactic, traveling and evaluating females they encounter for sexual receptivity, as females are in estrous one day of about every two weeks and are frequently in gestation (Bercovitch et al., 2006).

To date, little research has been conducted on groups of all-male captive giraffes, since such grouping is a more recent trend in zoos affiliated with the American Zoological Association, which manages the giraffe populations of all zoos to ensure their survival through control of reproduction. Male giraffes are increasingly placed in long-term single-sex herds in captivity, whereas similar all-male herds are short-lasting in the wild (Bercovitch and Berry, 2015). As a result, it is possible to observe the appearance of less common behaviors occurring in herds of captive males. Due to the low degree of association between males in the wild, different social behaviors may only occur at low frequency in that setting. If social interactions are not altered by captive conditions, frequency would be increased only due to the proximity inherent to captive conditions and the resulting greater potential for interactions, allowing the observation of otherwise rare behaviors without lengthy field studies (Bashaw, 2004). Alternatively, these behaviors may be due to the conditions imposed by captivity.

This study aims to examine giraffe social behaviors present in an all-male population at the Central Florida Zoo and Botanical Gardens. This population is comprised of one adult and two subadult giraffes, all of varying species. Because all-male groups are short-lasting in the wild and because these species do not occupy ranges that typically overlap in the wild, behaviors that occur at low frequencies in the wild, which are typically missed in observational studies, may be more clearly observed in captivity. It is also possible that some of the behaviors seen may be due to the unique circumstance of these three giraffes (being held in close quarters for prolonged periods of time).

Specifically, we hypothesize that there will be a clear dominance hierarchy: the eldest giraffe is most likely

the most dominant member of the group, and the two subadult giraffes are either equal within the hierarchy, due to their similar age, or there would be a clear pattern of behaviors to indicate which one is dominant to the other. Based on this prediction, we further hypothesize that the eldest would perform most, if not all, dominance and sociosexual behaviors. Furthermore, due to the short-lasting nature of wild all-male groups, we predict that there would be a lack of apparent social preferences through random affiliative behaviors. Specifically, we predict that the two subadult giraffes would avoid the most dominant giraffe and we further predict that hitting between the eldest and the others would appear more aggressive, while hitting between the two subadults would be gentler and a form of sparring.

## MATERIALS AND METHODS

Central Florida Zoo houses one adult giraffe and two subadult male giraffes, all of known pedigree and of different species in the same genus: Emba, a twenty-year-old Rothschild's giraffe (*G. camelopardalis rothschildi*); Rafiki, a four-year-old reticulated giraffe (*G. reticulata*); and Gage, a three-year-old Masai giraffe (*G. tippelskirchi*)<sup>1</sup>. Each giraffe can be readily distinguished by its pelage and ossicones.

During business hours (09:00–17:00), the giraffes are located in the outdoor exhibit (approximately 800 m<sup>2</sup>) replenished daily and given access to *ad libitum* ("at one's pleasure") alfalfa hay that is located in three feeders spread throughout the enclosure, while water is available from two different containers. Around 16:30, the giraffes are brought into the holding yard with access to their barn.

We conducted fieldwork from January 11, 2016 to April 15, 2016 (PZ) and from May 16, 2016 to July 26, 2016 (KF) at the Central Florida Zoo from public walkways during business hours. In total, we made 198.3 h of observations over 62 days and recorded social behaviors using a combination of *all-occurrence* and *ad libitum* sampling, by which the observer records all occurrences of the behaviors of interest, as well as the context in which they occur. Due to the nature of this study, affiliative gestures, courtship and mate guarding, sparring and hitting, dominance behaviors, and attempted mounting were specifically observed. Based on the dominance hier-

<sup>1</sup> Zoo giraffes reach sexual maturity by age 3 or 4, and they live approximately 20–25 years (Dagg, 1976).

archy, we expected to observe a certain distribution of the actors and recipients involved in these social behaviors.

To investigate the distribution of affiliative behavior, our study looked at social exams and social rubbing, as both behaviors can be clearly identified and recorded. Due to the limited size of the enclosure, it was difficult to determine with great certainty whether a giraffe was truly following another or if they were walking in the same direction. Co-browsing and co-feeding were also recorded, as they are also considered affiliative in nature and can be recorded with little ambiguity.

Due to the extensiveness of anogenital exams performed by one giraffe, the study chose to measure flehmen responses. The flehmen response, from the German word for “curl the upper lip,” is a behavior where an animal curls its upper lip and inhales through the mouth, holding that position for several seconds. It is an easily recognizable and observable behavior. In giraffes, it is generally accepted that the examiner attempts to stimulate the usually female recipient to urinate, after which the examiner samples the urine and performs the flehmen response. Anogenital exams and flehmen responses are both sociosexual in nature and commonly occur between a male giraffe and female giraffe pair.

We also recorded and observed sparring matches, a form of play, and hitting, a form of agonistic behavior, since both relate to the dominance hierarchy. We expected that sparring would be limited to giraffes equal in the dominance hierarchy, while hitting would be performed by a dominant giraffe toward a giraffe lower in the dominance hierarchy. Similarly, mounting may also provide clues, as it is a sociosexual behavior that is typically also related to the dominance hierarchy, with only an adult giraffe mounting a subadult giraffe and not conversely.

An ethogram is included in the appendix defining the above behaviors.

## RESULTS

### 1.1 *Affiliative Gestures*

Affiliative gestures in the giraffe are comprised of behaviors including social exams, rubbing, following, co-feeding, and co-browsing (Bashaw, 2004). The giraffes in our study were sometimes observed placing their

snouts close to the body of another giraffe, not including the anogenital region, to presumably sniff, a behavior constituting a social exam. Rubbing also sometimes occurred, with one giraffe rubbing his head or neck against the neck or torso of another. For example, Emba, the adult giraffe, sometimes rubbed his head against the body or neck of Rafiki, and Gage typically rubbed against Rafiki before initiating sparring.

All three male giraffes in our study were observed socially examining the others (Table 1). Gage primarily sniffed Rafiki, and Emba also primarily sniffed Rafiki. Rafiki preferentially sniffed Gage. In contrast, not all giraffes socially rubbed against the other giraffes (Table 2): Emba only rubbed against Rafiki, and Gage only rubbed against Rafiki. In five instances, Rafiki rubbed against Gage, but was never observed to rub against Emba. The data suggests that the eldest giraffe possessed social preferences, as his behavior was nonrandomly distributed between the two subadult giraffes. Meanwhile, the observations of social rubbing and social exams by the two subadult giraffes conformed to our expectation that affiliative behavior by subadult giraffes would be more commonly directed to a giraffe equal in dominance ranking.

In ten instances, Rafiki and Gage co-fed, and in forty-six instances, Rafiki and Gage co-browsed. Either Gage or Rafiki would typically walk away after less than one minute, although they had been observed co-browsing for as long as five minutes. These observations confirm our expectation that co-browsing and co-feeding would be limited to giraffes close in the dominance hierarchy.

### 1.2 *Courtship and Mate Guarding*

Emba frequently sniffed the anogenital region of Rafiki, after which he would typically stand tall, following Rafiki whenever he walked away. This behavior is consistent with courtship by male giraffes in the wild (Pratt and Anderson, 1985). More recently, the aforementioned behavior has been explained as mate guarding when it accompanies mounting attempts, enabling the male to restrict access to the female at the expense of browsing time (Bercovitch et al., 2006). On all of the days this behavior was observed, Emba investigated Rafiki on multiple occasions. These periods of close following sometimes lasted over 20 minutes, and, frequently, less than 5–10 minutes of browsing separated sessions before Emba resumed investigating Rafiki. Sometimes after being investigated, Rafiki urinated, which Emba typically

sampled and then flehmened. Additionally, Emba was sometimes observed with his penis unsheathed as he stood tall behind Rafiki; his erections were only observed during periods of persistent following and during attempts to mount.

In response to Emba standing tall behind him, Rafiki often pointed his snout upwards, consistent with Dagg's (1976) description of submissive gestures where one giraffe adopts a posture as if to browse with the neck exposed. Pointing the snout up is also a behavior observed in juvenile males and young bulls during sparring. Pratt and Anderson (1985), who found no evidence that it was a threat display or submissive gesture, also observed the snout up behavior in juvenile females when a mature bull passed by them, which they interpreted as a sign of sexual arousal, as it often accompanied urinating. The context in which Rafiki assumed a snout up posture appeared consistent with the behavior being an indication of submission, as suggested by Dagg. However, Rafiki often elevated his snout such that it was nearly touching Emba's snout, and in multiple instances Rafiki made snout–snout contact with Emba. On more than one occasion, Emba hit Rafiki immediately after Rafiki made contact with his snout.

We recorded over one hundred fifteen instances of flehmen responses (Table 3). Emba, being the oldest and the dominant animal in the herd, was typically the one investigating and flehmening, as expected; however, Rafiki has also demonstrated investigating behavior. There were no instances of Gage conducting the flehmen response, though we observed him conducting anogenital exams.

Gage was rarely investigated by either of the other two, and Emba was never seen following Gage for any significant length of time. When Rafiki investigated Gage, it was occasional and was never followed or preceded by an extended period of following. In eight instances, Rafiki conducted the flehmen response after investigating Gage.

A giraffe husbandry manual published online in 2003 noted similar sociosexual behaviors as above between males, specifically urine testing and mounting, occurring in retired bulls and in bulls that have not yet mated (Jolly, 2003). The literature lacks other examples of such behavior in captivity. Due to the lack of females, and the motivation to perform these sociosexual behaviors, the bull performs these behaviors with other male giraffes.

Our study did not expect to find the degree of sociosexual behaviors as was performed by the dominant giraffe. Specifically, while male–male mounting was expected, the courtship-like behaviors, including anogenital exams with extensive following, was not expected.

Surprisingly, Emba demonstrated sociosexual behaviors—specifically anogenital exams and flehmen responses—most often performed by male giraffes towards female giraffes. In addition, he preferentially performed such behavior on one giraffe, as he did with affiliative gestures. As expected, the oldest and most dominant giraffe conducted the majority of flehmen responses, and the youngest, still maturing giraffe performed none.

### *1.3 Sparring and Hitting*

Rafiki and Gage engaged in a total of 24 sparring matches, each generally exchanging an equal number of gentle blows. One giraffe would swing his neck toward the other's neck or torso, typically twisting his head and landing his ossicones against the torso or neck of the other. They frequently also pressed their bodies sideways into one another at the hindquarters, as well as at the shoulder region. Rafiki and Gage were sometimes observed swinging gently almost simultaneously. More often than not, Gage initiated the sparring and on some days hit Rafiki much more often than conversely. Sparring was noted to occur for as long as twenty minutes in this study, although the majority of matches observed lasted less than ten minutes. Emba sometimes approached Rafiki and Gage while they were sparring, which appeared to have the effect of concluding the match. In one instance, Emba joined a sparring match between Rafiki and Gage by standing next to Rafiki and beginning to swing gently.

On multiple occasions, Emba was seen swinging his neck at Rafiki, typically gently but sometimes hitting with force much greater than that witnessed during Gage and Rafiki's sparring sessions. In total, Emba hit Rafiki 352 times. No instances of Emba hitting Gage occurred. Rafiki generally did not reciprocate the hits and typically attempted to walk away, although Emba often followed him and sometimes continued to occasionally hit him. On four occasions between May and July, Rafiki reciprocated hits delivered by Emba. In the moments preceding hitting, Emba was typically following Rafiki, investigating frequently and standing tall directly behind. Ostensibly, these are courtship and

mate guarding behaviors. Typically, these behaviors were observed to resume immediately after hitting.

There was a single instance of Rafiki pawing in response to Emba hitting him, a response putatively regarded as a displacement activity in anxiety-causing situations (Innis, 1958; Seeber et al., 2012). Seeber, et al. (2012) note that pawing occurs relatively rarely, but Dagg née Innis (1958) stated that she observed pawing frequently in wild giraffes.

Sparring was generally limited to the giraffe equal in dominance ranking, while most of the hitting, an agonistic behavior, was performed by the eldest and most dominant giraffe, with the less dominant giraffes almost never reciprocating, instead walking away. The behavior of the giraffes thus confirmed our expectations.

#### 1.4 Dominance

Emba has clearly displaced Rafiki and Gage on multiple occasions. No evidence of a difference in rank between Rafiki and Gage was observed during the course of this study. In some instances, Emba simply looked at another giraffe with his head held low and approximately parallel to the ground, leading the other individual to walk away or change directions. On one occasion, Gage approached Emba while he was drinking. Emba paused and looked up at him, causing Gage to stop walking. Gage approached again when Emba resumed drinking but promptly walked away when Emba raised his head from the water and held it low a second time. Further examples include Emba chasing off Rafiki or Gage and Emba, walking as if to intercept Rafiki, in response to which Rafiki cantered. In some instances, Emba cantered after Rafiki, causing him to canter, and as both giraffes passed Gage, he also began cantering.

Gage also made active efforts to avoid Emba, the eldest giraffe, when Emba was following Rafiki and passed in close proximity. Gage frequently stood up if laying down when Emba passed in close proximity, or he would otherwise walk away, or sometimes canter, if Rafiki and Emba were both approaching. In these cases, the dominant giraffe, Emba, effectively displaced Gage.

Their dominance and submissive behaviors, specifically displacement and yielding, were as expected, based on size and the large age difference between the eldest and the two subadult giraffes. Although a slight size and age difference exists between the two subadult giraffes,

there was no discernible difference in their rank based on dominance behaviors.

#### 1.5 Mounting

All of the giraffes have been observed mounting, as was expected due to the prevalence of male-male mounting in the wild. In total, 78 mountings were witnessed (Table 4). Emba exclusively mounted Rafiki. It was expected that the non-dominant giraffes would not mount the dominant giraffe, but our results did not strictly support this. Gage exclusively mounted Rafiki, as expected given their closeness in age. Rafiki mounted Emba preferentially, which was not expected, although he also mounted Gage. Given Rafiki's approaching sexual maturity, his mountings of the dominant giraffe may represent a challenge to the dominance hierarchy. Conversely, Gage's mounting of Rafiki appear more analogous to play (see Discussion). Generally, all giraffes were noted to be erect while mounting; however, it could not be determined in all instances whether the mounted giraffe was erect. Erections were only observed in association with mounting or courtship behavior. In one instance, Emba mounted Rafiki after urine testing and flehmening.

Mounting was another behavior where social preferences were implied by nonrandom actor and recipient distributions unrelated to the dominance hierarchy. Based on the dominance hierarchy, it would be expected that Rafiki would preferentially mount Gage, a giraffe equal in rank, but instead he mounted the most dominant giraffe significantly more often. Interestingly, as seen with affiliative and other sociosexual behaviors, Emba appears to display a preference for Rafiki over Gage. Bashaw (2004) studied affiliative interactions between individual female giraffes that supported the existence of social preferences. Our results suggest that male giraffes can also develop social preferences despite the relatively solitary nature of male giraffes. Rafiki and Emba both arrived at the Central Florida Zoo around the same time, while Gage arrived eight months later, potentially resulting in the pattern of interactions we have observed. Similar long-term associations between male giraffes over a period of months have not been observed in the wild. Additionally, the literature lacks examples of apparent social preferences in captive male giraffes.

## DISCUSSION

In the wild, adult male giraffes rarely associate with

the same individual on multiple occasions (Dagg and Foster, 1976). Thus the conditions of a zoo habitat may allow for types of social encounters in all-male groups to be studied where all individuals are in the same herd for months or even years. With resources such as food and water clustered in specific locations and with giraffes in forced proximity to one another, it is possible to document a multitude of agonistic behaviors in the zoological environment (Horová et al., 2015)

In giraffes, agonistic behavior, consisting of behaviors relating to conflict and dominance, includes aggressive behavior such as hitting and necking, as well as behaviors that may not include any physical contact but that serve as indicators of dominance or of submission, including dominance gestures, submissive gestures, threat displays, displacement, and yielding. The principal benefit derived from dominance is access to limited resources (Goodenough et al., 2010). Members of the same social group exist in the same geographic area and have physical access to the same resources, such as food, water, mates, and territory. The primarily disputed resource in giraffes is female mates, though in captive giraffes, agonistic behavior may be seen in regards to clustered resources such as food and water. The submissive individual yields to the dominant individual over these resources.

The establishment of a dominance hierarchy determines in advance an individual's level of access to a resource, allowing overt conflict to be minimized. In captive giraffes, the dominance hierarchy is linear (Horová et al., 2015). Asymmetries in size, strength, and experience favor one individual winning in a fight against another, and these factors impact one's position within the dominance hierarchy (Goodenough et al., 2010). Larger size, greater strength, and increased experience in fighting enable an individual to win conflicts and may lead to harm or death in the other individual. Through the expression of dominance gestures by the dominant individual, the submissive individual may evaluate asymmetries in size and strength. These asymmetries can serve as predictors of the outcome of a conflict, and may determine whether the risk of losing a fight outweighs the benefits gained by the contested resource. As a result, the submissive individual must either challenge the dominance gesture through a threat display or accept the other individual's dominance, often by expressing a submissive gesture. Agonistic behavior that is not inclusive of aggressive behavior allows for the outcome of a fight to be agreed upon in advance, with the dominant individual gaining access to resources without physical harm occurring to

either individual.

Sparring occurs frequently in subadult male giraffes but occurs rarely in mature bulls (Pratt and Anderson, 1982). Early explanations of the behavior have included establishing a dominance hierarchy and fostering social cohesion (Coe, 1967). However, a later study found little evidence to support a relationship between sparring and dominance; instead the study posited it to be a form of play, providing benefit to the giraffe later in life as it allows him to practice his fighting skills in a harmless manner (Pratt and Anderson, 1985).

Play incorporates fragments of other behavior in complete or incomplete sequence, serves no immediate purpose, and is often of exaggerated form (Goodenough et al., 2010). It typically resembles crucial behavior seen in adults, serving the purpose of discovering the best combination of actions and reinforcing them so that they can be firmly established and competently performed as an adult (Wilson, 1980). For example, a giraffe that has had sufficient experience in sparring may be more likely to later succeed in necking matches against other bulls, and in turn is more likely to gain access to estrous females and increasing reproductive success.

Seeber, et al. (2012) noted that the widely accepted function of investigating behavior is to stimulate the female giraffe to urinate. Dagg (1958) stated that in her observations in the wild, she observed males exclusively urinate on females. However, flehmen responses have been observed in captive environments between males in mixed-sex exhibits, although at lower frequency than between bulls and cows (Meredith J. Bashaw, personal communication, February 2016). Additionally investigating behavior has been observed being directed toward either sex, by bulls as well as by cows (Seeber et al., 2012). Male-male mounting among younger giraffes has been well-documented in wild giraffes (Dagg and Foster, 1976; Innis, 1958; Pratt and Anderson, 1985; Seeber et al., 2012).

Among the most compelling explanation for male-male mounting is that it is a harmless by-product of other adaptations, namely high sexual motivation. It may potentially serve in social functions such as fostering social bonds, displaying dominance, and practice for copulation (Sommer and Vasey, 2006). A study on male-male mounting in American bison (*Bison bison*) found no correlation with social rank and contended that it may play a role in social bonding, and in acquiring

experience, although crucial steps including penetration were missing (Vervaecke and Roden, 2006).

In this study, we did not find any association between mounting and dominance: Emba and Rafiki mounted each other at similar frequencies, in spite of a difference in rank. Meanwhile, no mountings occurred between Gage and Emba, even though the same rank relationship exists between Gage–Emba as it does for Rafiki–Emba. There may be evidence of reciprocity, as dyad mounting frequencies were comparable, suggesting mounting plays a social role: Rafiki mounted Emba at a similar frequency to the inverse relationship, while no mountings occurred between Gage and Emba, and mountings between Gage and Rafiki occurred at low but comparable frequencies. However, co-browsing and co-feeding occurred only between Rafiki and Gage, which was complemented by relative mounting frequencies. This pattern may suggest that co-browsing and male-male mounting serve different social functions. While co-browsing is found among giraffes of equivalent dominance ranking, mounting may serve as a means for challenging one's position in the dominance hierarchy. Rafiki's mountings of Emba may represent him testing his place in the hierarchy.

## **CONCLUSION**

As zoos segregate giraffes by sex to prevent unwanted breeding, specific patterns of agonistic behaviors and male-male sociosexual behavior may emerge even without the contentious resource of reproductive females. This study also illustrates the possibility of social preferences among male giraffes and potentially other artiodactyl species. Additionally, this study is the first to investigate agonistic and affiliative behaviors among individual male giraffes in the captive setting.

The frequency of ostensible sociosexual behaviors and agonistic behaviors appears to be greater among captive male giraffes than in their wild counterparts. This is partly on account of an increase in interactions due to the size to the enclosure available relative to the vastness of habitat in the wild. The frequency of Emba's behavior toward Rafiki—including anogenital sniffing, persistent following, and standing tall behind—appears to be a result of the conditions of captivity, including the lack of cows, and may be a novel expression of dominance, as it frequently accompanied hitting, to which Rafiki commonly responded by avoiding Emba. Our observations suggest male giraffes may have

social preferences not strictly related to the dominance hierarchy. These preferences may be due in part to familiarity, as it may differ among zoo animals due to variable arrival times. Other undetermined factors may contribute to social preferences and consequently impact interactions among giraffes.

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**Table 1.** Frequency of social exams.

<b>Actor</b>	<b>Recipient</b>		
	<b>Emba</b>	<b>Gage</b>	<b>Rafiki</b>
Emba	–	3	10
Gage	3	–	23
Rafiki	8	13	–

**Table 2.** Frequency of social rubbing.

<b>Actor</b>	<b>Recipient</b>		
	<b>Emba</b>	<b>Gage</b>	<b>Rafiki</b>
Emba	–	0	28
Gage	0	–	12
Rafiki	1	5	–

**Table 3.** Frequency of flehmen responses.

<b>Actor</b>	<b>Recipient</b>		
	<b>Emba</b>	<b>Gage</b>	<b>Rafiki</b>
Emba	–	22	85
Gage	0	–	0
Rafiki	0	8	–

**Table 4.** Frequency of attempted mountings.

<b>Actor</b>	<b>Recipient</b>		
	<b>Emba</b>	<b>Gage</b>	<b>Rafiki</b>
Emba	–	0	28
Gage	0	–	17
Rafiki	31	2	–



**Ethogram**

Category	Behavior	Description
Affiliative	Social exam	One giraffe brings its nose in close proximity to the body of another giraffe, not including the anogenital region, which would be considered an anogenital exam.
	Social rubbing	The giraffe rubs its head or neck against another giraffe's body. It is sometimes followed by sparring.
	Co-browsing	Two giraffe simultaneously ingest browse from the same source, using their tongue and lips.
	Co-feeding	Two giraffe simultaneously ingest food from the same hay feeder.
	Following	One giraffe maintains close proximity to another, standing alongside and walking as necessary.
Sociosexual	Anogenital exam	One animal sniffs near the anus or genital region or the flanks of another animal. It is also referred to as investigating. In doing so, the bull attempts to stimulate the female to urinate, allowing for urine sampling.
	Urine sample	The bull catches urine with his mouth from another giraffe as it urinates, often followed by a flehmen response.
	Flehmen	The giraffe lifts its head up, curling the upper lip and inhaling deeply. It is often preceded by urine sampling.
	Mounting	One giraffe standing behind another animal lifts its front legs onto the other's body. The other animal may tolerate it or may walk or canter away.
	Mate guarding	The bull maintains a distance of less than one body length from another individual, often accompanied by investigating and mounting attempts.
Agonistic	Displacement	One giraffe drives away another by staring, walking, or cantering.
	Yielding	The giraffe changes direction to avoid another giraffe.
	Hitting	One giraffe swings its ossicones or neck into the neck or both of another giraffe, with greater force than is seen during sparring matches.
Play	Sparring	One giraffe swings its ossicones or neck into the neck or body of another giraffe. Sparring is typically gentler than necking or hitting.
Other	Pawing	Stomping with one foreleg once or repeatedly, possibly an alarm signal in threatening situations or a displacement activity in threatening or uncertain situations.

Adapted from Seeber, et al. (2012) supplemental material

Emba, the twenty-year-old Rothschild's giraffe (left) and Rafiki, the four-year-old reticulated giraffe (right). Image provided by Central Florida Zoo & Botanical Gardens. Used with permission.



## REFERENCES

1. Bashaw MJ. 2004. Social behavior and communication in a herd of captive giraffe (*Giraffa camelopardalis*). US: ProQuest Information & Learning.
2. Bercovitch FB, Bashaw MJ, del Castillo SM. 2006. Sociosexual behavior, male mating tactics, and the reproductive cycle of giraffe (*Giraffa camelopardalis*). *Hormones and Behavior*. 50:314–321.
3. Bercovitch FB, Berry PSM. 2015. The composition and function of all-male herds of Thornicroft's giraffe, *Giraffa camelopardalis thornicrofti*, in Zambia. *African Journal of Ecology*. 53(2):167–174.
4. Coe M. 1967. "Necking" behaviour in the giraffe. *Journal of Zoology*. 151(1):313–321.
5. Dagg AI. 1984. Homosexual behaviour and female-male mounting in mammals—a first survey. *Mammal Review*. 14(4):155–185.
6. Dagg AI, Foster JB. 1976. *The giraffe: its biology, behavior, and ecology*. Malabar, Florida: Robert E. Krieger Publishing Company.
7. Goodenough J, McGuire B, Jakob E. 2010. *Perspectives on animal behavior*. 3rd ed. Hoboken, NJ: John Wiley & Sons.
8. Horová E, Brandlová K, Gloneková M. 2015. The first description of dominance hierarchy in captive giraffe: not loose and egalitarian, but clear and linear. *PLoS ONE*. 10(5):1–13.
9. Innis A. 1958. The behavior of the giraffe, *Giraffa camelopardalis*, in the Eastern Transvaal. *Proceedings of the Zoological Society of London*. 131(2):245–278.
10. Jolly L. 2003. Giraffe husbandry manual. Available from <http://www.australasianzookeeping.org/Husbandry%20Manuals/Husbandry%20manual%20Giraffe.pdf>
11. Maple TL. 2007. Toward a science of welfare for animals in the zoo. *Journal of Applied Animal Welfare Science*. 10(1):63–70.
12. Pratt DM, Anderson VH. 1982. Population, distribution, and behaviour of giraffe in the Arusha National Park, Tanzania. *Journal of Natural History*. 16(4):481–489.
13. Pratt DM, Anderson VH. 1985. Giraffe social behaviour. *Journal of Natural History*. 19(4):771–781.
14. Seeber PA, Ciofolo I, Ganswindt A. 2012. Behavioural inventory of the giraffe (*Giraffa camelopardalis*). *BMC Research Notes*. Supplemental material: Table 3, General Interactions.
15. Sommer V, Vasey PL. 2006. *Homosexual behaviour in animals: an evolutionary perspective*. Cambridge; New York: Cambridge University Press, 2006.
16. Vervaecke H, Roden C. 2006. Going with the herd: same-sex interaction and competition in American bison. In: Sommer V, Vasey PL, editors. *Homosexual behaviour in animals*. Cambridge, UK: Cambridge University Press.
17. Wilson EO. 1980. *Sociobiology*. Cambridge, Mass.: Belknap Press of Harvard University Press, 1980.