EFFECTS OF GUEST FEEDING PROGRAMS ON CAPTIVE GIRAFFE BEHAVIOR

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ABSTRACT

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Zoological institutions develop human-animal interaction opportunities for visitors to advance missions of conservation, education, and recreation; however, the animal welfare implications have yet to be evaluated. This behavioral study was the first to quantify impacts of guest feeding programs on captive giraffe behavior and welfare, by documenting giraffe time budgets that included both normal and stereotypic behaviors. Thirty giraffes from nine zoos (six zoos with varying guest feeding programs and three without) were observed for three days each, using both instantaneous scan sampling and continuous behavioral sampling techniques. All data were collected during summer 2012 and analyzed using generalized linear mixed models. The degree of individual giraffe participation in guest feeding programs was positively correlated with increased time spent idle and marginally correlated to reduced time spent ruminating. When time spent eating routine diets was combined with time spent participating in guest feeding programs, individuals that spent more time engaged in total feeding behaviors performed less oral stereotypic behavior such as object-licking and tongue-rolling. By extending foraging time and complexity, guest feeding programs have the potential to act as environmental enrichment and alleviate unfulfilled foraging motivations that may underlie oral stereotypic behaviors observed in many captive giraffes. Additionally, management strategies can be adjusted to mitigate idleness and other program consequences. Further studies, especially pre-and-post comparisons, are needed to better understand the influence of human-animal interactions on zoo animal behavior and welfare.

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KEY TO SYMBOLS OR ABBREVIATIONS

AZA – Association of Zoos & Aquariums

ANOVA – Analysis of Variance

GFP – Guest Feeding Program

GLMM – Generalized Linear Mixed Model

INTRODUCTION

The mission of many zoological institutions includes the advancement of conservation, education, and recreation (Anderson et al., 2003; Fernandez et al., 2009; Kreger and Mench, 1995; Patrick et al., 2007; Reade and Waran, 1996). To accomplish these goals, many zoological institutions (hereafter referred to as zoos) have developed human-animal interaction opportunities for visitors to directly engage with wildlife. Although some educational benefits of human-animal interactions have been documented, these interactions have yet to be evaluated from the animal welfare perspective.

Animals that express natural behaviors or are in close proximity to visitors are more interesting than inactive or hidden animals (Altman, 1998; Bitgood et al., 1988; Margulis et al., 2003) and enhance the interpretive and entertainment experience (Anderson et al., 2003; Swanagan, 2000; Woods, 2002). Therefore, an increasing number of zoos offer visitors an opportunity to directly interact with selected species as a way of complementing educational messages. Interaction with animals is the most direct form of engagement, because visitors perceive animals through their own senses and can establish an emotional connection (Beardsworth and Bryman, 2001). These interactions occur in a variety of formats such as petting zoos, touch tanks, public feedings, animal rides, and live entertainment shows (Kreger and Mench, 1995). Physical contact with live animals, combined with educational messaging, has been found to improve cognitive learning and attitudinal empathy (Kidd et al., 1995; Morgan and Gramann, 1989; Sherwood et al., 1989); therefore, zoos have the potential to significantly advance their conservation education mission by providing human-animal interactions (Kreger and Mench, 1995).

Now recognized by most zoos as a critical objective and responsibility, animal welfare has been incorporated into the accreditation standards of the Association of Zoos & Aquariums

(AZA). The AZA defines animal welfare as "an animal's collective physical, mental, and emotional states over a period of time, and is measured on a continuum from good to poor" (AZA Animal Welfare Committee, 2013). The study of animal welfare is relatively new in the zoo and aquarium industry, with comprehensive information still lacking for many exotic species (Melfi, 2009; Wickens-Dražilová, 2006). Current welfare studies have primarily focused on animal husbandry and environments (Melfi, 2009) with substantially less attention given to welfare impacts of human-animal interactions within a zoo setting.

Zoo visitors can have three potential effects on animals: 1) stress, 2) enrichment, or 3) none or neutral (reviewed by Hosey, 2000). Various species in zoos respond negatively to the presence of guests (evidenced behaviorally and physiologically), with responses influenced by visitor behavior, visitor group size, animal personality, and exhibit design (reviewed by: Davey, 2007; Fernandez et al., 2009; Hosey, 2000, 2008). For example, clouded leopards (*Neofelis nebulosa*) placed on visitor display expressed higher levels of fecal corticoids than conspecifics held off-exhibit (Wielebnowski et al., 2002). Other studies suggest that the experience is enriching for other zoo animals, as evidenced by reciprocal behaviors or a desire for interaction (reviewed by Claxton, 2011). Chimpanzees (*Pan troglodytes*) at Chester Zoo, for instance, were found to elicit begging behavior and change locations within the exhibit to gain attention from zoo visitors and solicit food (Cook and Hosey, 1995), while a Long-billed Corella (*Cacatua tenuirostris*) spent more time at the front of its cage performing active behaviors when visitors were nearby at Adelaide Zoo (Nimon and Dalziel, 1992). Additional research is needed to clarify the true welfare implications of visitor effects (Davey, 2007), while also explicitly considering species and individual variation.

According to the AZA, a program animal is described as "an animal whose role includes handling and/or training by staff or volunteers for interaction with the public and in support of institutional education and conservation goals" (AZA Program Animal Policy, 2011). Beyond what is experienced by a normal exhibit animal, program animals are presented with novel stimuli through changing environments, dynamic routines, and interactions with unfamiliar people. The consequences of these specific interactive programs to animal welfare are relatively unknown at this time, but are important to consider before continued emulation.

Charismatic megavertebrates such as the giraffe (*Giraffa camelopardalis*) are prime candidates for human-animal interaction programs in zoos, largely due to their popularity and prevalence. Additionally, their physical and behavioral attributes make them a relatively safe species for guests to interact with. Over the last decade, many zoos have developed guest feeding programs (GFPs) that offer visitors the opportunity to feed giraffes from platforms adjacent to exhibits. An estimated 57% of AZA-accredited zoos exhibiting giraffes currently offer GFPs to zoo guests (determined from zoos' websites), but programs vary in schedule, platform structure, food types, and regulations (Burgess, 2004). As more GFPs are developed, it becomes essential to document their effects on giraffe behavior and welfare to not only justify their implementation, but to also identify what modifications to programs may be necessary to maximize benefits or minimize harm to giraffe welfare.

Wild giraffes spend about 70% of their day engaged in feeding and ruminating activity (Ginnett and Demment, 1997; Leuthold and Leuthold, 1978a; Pellew, 1984), yet in captivity these behaviors may comprise no more than half of the giraffe daily time budget (Koene, 1999, Veasey et al., 1996). Captive giraffes also have less complex foraging patterns because, unlike in the wild, diets do not contain ants or thorns that may require extensive oral manipulation (Koene

and Visser, 1996). Simple diets and a relatively large amount of unoccupied time may cause distress for captive giraffes, leading them to develop replacement activities in the form of stereotypies (Baxter and Plowman, 2001; Dittrich, 1976; Koene, 1999; Mason, 1991a; Mason and Rushen, 2006).

Stereotypic behaviors are repetitive behavioral patterns that remain invariant and serve no recognizable goal or function (Mason, 1991a). Their presence is often considered an indication that the animal may not be appropriately adapting to its captive environment and is experiencing suboptimal welfare (Broom, 1991a; Lawrence and Rushen, 1993; reviewed by Mason, 1991a; reviewed in Mason and Latham, 2004). Captive giraffes perform multiple oral stereotypic behaviors such as excessive object-licking and tongue-rolling, and locomotor stereotypic behaviors such as pacing (Bashaw et al., 2001). A survey of AZA-accredited institutions found that 79.7% of giraffes and okapis in the population performed stereotypies, 72.4% of which were object-licking (Bashaw et al., 2001). In that study, giraffe subspecies, diet, type of feeder, and feeding schedule were associated with stereotypic licking behavior, while giraffe subspecies, diet, exhibit size, and environmental change were associated with the presence of stereotypic pacing.

There is no fool-proof method for reducing prevalence of stereotypic behavior in giraffes, and various attempts by zoos only hold a success rate of 51.9% (Bashaw et al., 2001). Claxton (2011) argues that positive human-animal interactions could provide some necessary environmental enrichment to decrease stereotypic behavior. Limited evidence shows that giraffes fed by zoo visitors tend to express less stereotypic licking, however these conclusions were drawn without quantification of behaviors (Bashaw et al. 2001). Other suggestions for decreasing stereotypic behaviors in captive animals are to increase foraging time through environmental

enrichment programs (Newberry, 1995; Swaisgood and Shepherdson, 2006; Young, 1997) and increase feeding duration by increasing food quantity, processing, or dispersal over larger areas (Tarou et al., 2003). The implementation of GFPs may effectively encompass all of these strategies and therefore contribute to creating a positive welfare state for giraffes.

Despite the critical gap in understanding effects of human-animal interactions on species-specific animal welfare, zoos have moved forward with implementation of guest feeding programs. The primary goal of this behavioral observation study was to assess the impacts of GFPs on captive giraffe behavior, and thus implications for welfare. The objective was to quantify how daily time budgets of captive giraffes changed according to extent of individual participation in a GFP, with emphasis on changes to stereotypic behaviors. We expected that an increased time spent participating in GFPs by an individual giraffe would positively correlate to increased active behaviors such as locomotion, rumination and social behavior, and negatively correlate to prevalence of stereotypic behavior in that individual.

METHODS

Behavioral Observations

From June 22 to August 3, 2012, observations were conducted at nine Midwestern US, AZA-accredited zoos (coded A through I in Table 1). Group size and animal demographics are detailed in Table 1. At each zoo, behavioral data were collected for 3 days from 09:00 to 17:00, with the exception of Zoo B and Zoo I where animals were observed from 10:00 to 18:00 to comply with zoo operating hours. A single observer collected all data, with an intra-observer reliability score of 87.24% as determined by comparison of 3 hours of live and video recordings. The observer was positioned on a feeding platform or visitor pathway to blend in with visitors. Giraffes were only observed while on public display.

Table 1. Giraffe populations observed at nine zoos.

Zoo	GFP Presence*	Number of Individuals	Sex (male.female)	Age Average (years: mean ± SEM)	Age Range (years: min. – max.)
A	all-day	4	1.3	9.1 ± 3.4	3.0 – 15.1
B	none	5	1.4	11.9 ± 4.0	3.7 – 22.2
C	part-day	2	1.1	4.1 ± 0.0	4.1 – 4.1
D	part-day	5	1.4	8.8 ± 4.7	1.0 – 27.4
E	part-day	2	1.1	3.9 ± 0.8	3.1 – 4.6
F	all-day	5	0.5	11.5 ± 4.9	2.1 – 23.6
G	part-day	3	1.2	10.0 ± 4.4	1.3 – 15.0
H	none	2	0.2	18.6 ± 4.6	14.0 – 23.1
I	none	2	1.1	5.3 ± 0.6	4.7 – 5.9

* Ordinal variables defined in *Analysis* section

An ethogram (Table 2) was constructed by combining information obtained through preliminary observations and published ethograms for giraffes (del Castillo et al., 2005; Ginnett and Demment, 1997; Hosie and Turner, 2000; Kinahan and Marples, 2002; Seeber et al., 2012;

Veasey et al., 2006). Not all behaviors were mutually exclusive; for instance, rumination and locomotion could occur simultaneously.

Table 2. Ethogram of giraffe behaviors used to collect live observational data.

Behavior	Description
Idle:	stationary position with no oral or locomotive activity, typically standing or lying down (includes urination and defecation)
Locomoting:	walking or running
Eating:	tongue/mouth is in contact with non-cud food items for purpose of consumption, includes mastication of non-cud
Ruminating:	lower jaw moves horizontally to upper jaw and back to starting position in succession of five or more occurrences resulting in the mastication of cud. Also includes regurgitation and swallowing of cud
Drinking:	tongue/mouth is in contact with water
Socializing:	physical contact with conspecific, includes necking, allogrooming and flehmen activities
Grooming:	rubbing of body against stationary object (e.g., wall, tree) or scraping of teeth/tongue across own body
Object-manipulating:	tongue/mouth/head is in physical contact with non-food item, typically movable enrichment items
Object-licking:	tongue is repetitively moved across non-food, stationary item, typically a structural component of exhibit such as wall, fence, or tree
Tongue-rolling:	tongue is continuously moved (or "rolled") in and out of mouth, most often involving a food item that is not actively involved in mastication or rumination
Aberrant oral behavior:	teeth or lips are repetitively moved across non-food, stationary item, typically a structural component of exhibit such as wall, fence, or tree
Pacing:	locomotion occurring in a repeated pattern between two locations
Time out:	animal or animal's head is hidden from observer

One stereotypic behavior not identified previously, but recorded in this study, is "aberrant oral behavior." This was a catch-all type behavioral category that was neither tongue-playing nor object-licking but still encompassed the repetitive, invariant nature of a stereotypic behavior and seemed to have no apparent goal or function (Mason, 1991a). Typically, aberrant oral behavior manifested as a grating of teeth or lips on some object such as rope fencing or a wooden wall.

Time budgets were calculated from data collected during 30-minute sessions of instantaneous scan sampling (one scan per minute; Altmann, 1974; Martin and Bateson, 2007) that took place over 3 days at each institution. Based on preliminary observations, 1 minute was sufficient for scanning up to six giraffes in the presence of maximum guest crowds. Five to six sampling sessions took place per day, staggered throughout the 3 recording days (Table 3). The time budget data sheet allowed recording of information from multiple giraffes simultaneously (Appendix A).

In addition to instantaneous scans, the frequency and duration of stereotypies were recorded by continuous behavioral sampling (Altmann, 1974; Martin and Bateson, 2007). Each giraffe group was continuously observed for 30 minutes, and the start and end times of stereotypic behaviors of individual giraffes were logged. A stereotypy was only recorded if its duration exceeded 5 seconds. Five to six sessions of continuous behavioral sampling took place per day, staggered throughout the 3 recording days (Table 3). Sessions were staggered to provide ample time for data collection by both sampling methods, to account for circadian rhythms of giraffes, and to record all management and GFP events. The stereotypic behavior data sheet allowed recording of multiple giraffes simultaneously (Appendix B).

Table 3. Sampling schedule for giraffe observations at all zoos (except Zoo B and Zoo I where all times were shifted later by one hour).

Day	Type of Sampling	Start Time					
1	Scan (Time Budget)	09:00	10:30	12:00	13:30	15:00	16:30
	Behavioral (Stereotypies)	09:30	11:00	12:30	14:00	15:30	-
2	Scan (Time Budget)	09:30	11:00	12:30	14:00	15:30	-
	Behavioral (Stereotypies)	10:00	11:30	13:00	14:30	16:00	-
3	Scan (Time Budget)	10:00	11:30	13:00	14:30	16:00	-
	Behavioral (Stereotypies)	09:00	10:30	12:00	13:30	15:00	16:30

Management Survey

To document differences among zoos, qualitative data were collected from giraffe care staff (keeper or curator) via a structured interview (Appendix C). Survey variables included environment (size, features, proximity to humans and other species), animal care (diet, feeding schedule, training, and enrichment), and animal demographics (sex, age, rearing, and health status). Details were also collected regarding various aspects of the GFPs including platform size, food type, and food price.

Analysis

Data collected from 30 giraffes were used for analysis. A total of 32 giraffes were observed throughout the study period, but two giraffes were excluded from analysis because of their age and physical limitations. Two behaviors, drinking and object-manipulating, were also excluded due to exhibit characteristics that prevented consistent, accurate sampling. One individual in the dataset was an outlier in its performance of aberrant oral behavior, as determined through a Grubbs test. The individual was a Reticulated/Masai/Rothschild's hybrid, separated early from its mother, aggressive to both keepers and conspecifics, and performed a head-rolling movement while at the feeding platform. Since we do not fully understand how these variables influence giraffe behavior, values with and without this outlying individual are presented where appropriate.

Generalized linear mixed models (GLMM) were used for analysis because data were non-independent (clustered) and unbalanced. Preliminary analysis tested influence of demographic and environmental variables on behavior, and the results were used to select random and fixed effects for the model. Specifically, analysis of variance (ANOVA) tests were

conducted to determine whether giraffe behaviors differed significantly between zoos. Each zoo housed a separate cluster of giraffes and was therefore used as a random effect in the model. No other random effects were necessary because "zoo" encompassed all other significant environmental and animal care factors (e.g., exhibit size, indoor housing size, and browse availability).

Behavioral data collected on each giraffe from the 3 observation days were compiled. Time spent participating in a GFP was converted to a percentage of total observation time to facilitate comparisons among giraffes with different total sampling times. Because not all zoos had GFPs, and because some giraffes did not participate when GFPs were available, time budget behavioral data were standardized across all zoos (those with GFPs and those without GFPs) by converting time spent engaged in behaviors to percentages of total observation time with the time spent participating in GFPs removed. Percentage of time spent participating in a GFP was used as the fixed effect, and behaviors from the time budget, including stereotypic behaviors, were analyzed separately as dependent variables. All percentages for all models were arcsine transformed prior to data analysis.

Sex (ordinal variable) and age (continuous variable) were separately entered into generalized linear mixed models as fixed effects because preliminary analysis showed that they independently influenced behavior. For these two models, "zoo" was the only random effect and behaviors were analyzed separately as the dependent variables.

One additional set of GLMM analyses was conducted to assess how duration of availability of GFPs, regardless of individual participation, affected giraffe behavior. Zoos were grouped by an ordinal variable based on GFP duration: "no GFP", "part-day GFP", and "all-day GFP" (Table 1). The designation of "all-day GFP" was indicative of a GFP being open during all

zoo operating hours, whereas a "part-day GFP" was a more limited program that only remained open for certain segments of the day, which in these cases extended no more than 2 hrs total. In this model, "zoo" was the only random effect, duration of GFPs was the fixed effect, and behaviors were analyzed separately as the dependent variables.

All statistical analyses were performed using the statistical software R v. 2.13.2011 (R Core Development Team, 2011), chiefly the "lme4" package for generalized linear mixed models (Bates et al., 2011). The outlier test was performed using the "outliers" package (Komsta, 2011).

Project Approval

Observational data were collected without manipulation of animals, humans, or environments occurring. Therefore, this study received an exemption from filing an Animal Use Form with the Michigan State University Institutional Animal Care and Use Committee or requiring human subject research approval from the Michigan State University Institutional Review Board. All zoos voluntarily participated in this study.

RESULTS

Results of the two sampling methods used to measure stereotypic behavior were highly correlated, indicating that despite the presumed "event" status (Altmann, 1974; Martin and Bateson, 2007) of stereotypic behavior, scan sampling was adequate for capturing the amount of time spent performing these behaviors. Observations between instantaneous scan sampling and continuous behavioral sampling were highly correlated for object-licking (Pearson's r = 0.957, $P < 0.001$), tongue-rolling (Pearson's r = 0.928, $P < 0.001$), and pacing (Pearson's r = 0.799, $P < 0.001$). A single outlier was apparent in the aberrant oral behavior category (Grubbs Test G = 5.166, $P < 0.001$); after removing this outlier, observations of this behavior were also highly correlated (Pearson's r = 0.927, $P < 0.001$). Because results derived from the two sampling techniques were correlated, data from only one method were analyzed further. The instantaneous scan sampling dataset was chosen because other behaviors used to calculate time budgets, as well as stereotypic behaviors, were included.

Several giraffe behaviors significantly differed between zoos including idleness, rumination, social, total oral stereotypies, and pacing (ANOVA, Table 4). A trend was observed for time spent eating, and no effect was found on locomotion and grooming behaviors. Because multiple behaviors were influenced by the zoo the giraffes resided in, zoo was included as a random effect in subsequent generalized linear mixed model analyses.

Table 4. "Zoo" effect on giraffe behavior observed in nine zoos (n = 30 giraffes).

Behavior	$\mathbf{F_{8,20}}$	***P*-value**
Idleness	4.441	0.003***
Locomotion	1.822	0.129
Eating	2.118	0.081*
Rumination	5.316	0.001***
Social	2.523	0.043**
Grooming	0.967	0.487
Total Oral Stereotypies	3.053	0.019**
Pacing	4.945	0.002***

* Indicates trend ($0.1 > P \geq 0.05$), ** Indicates significance ($0.05 > P \geq 0.01$),
*** Indicates high significance ($P < 0.01$)

The average time budget for giraffes at zoos without GFPs was comprised mostly of idleness and eating, but rumination, locomotion, and oral stereotypies also occupied a large portion of the observation period (Table 5a, Fig. 1a). At zoos with GFPs, the average time budget for giraffes was similarly distributed (Table 5b, Fig. 1b).

Table 5a. Average time budget (for total observation period) for giraffe sample population (n = 9) at three zoos without GFPs. Total time exceeds 100% because not all behaviors were mutually exclusive.

Behaviors	% of Observation Period ± SEM		
	Total (n=9)	Male (n=2)	Female (n=7)
Idleness	29.6 ± 3.6	30.1 ± 1.7	29.4 ± 4.7
Locomotion	11.5 ± 1.3	16.7 ± 1.1	10.0 ± 1.1
Eating	21.3 ± 3.4	33.1 ± 1.0	17.9 ± 3.4
Rumination	18.4 ± 3.0	12.0 ± 5.8	20.2 ± 3.4
Social	1.4 ± 0.6	3.0 ± 2.3	1.0 ± 0.4
Grooming	0.8 ± 0.2	0.8 ± 0.1	0.8 ± 0.3
Oral stereo.	17.0 ± 4.4	5.5 ± 5.0	20.2 ± 4.9
Pace stereo.	1.3 ± 0.7	0.0 ± 0	1.6 ± 0.9

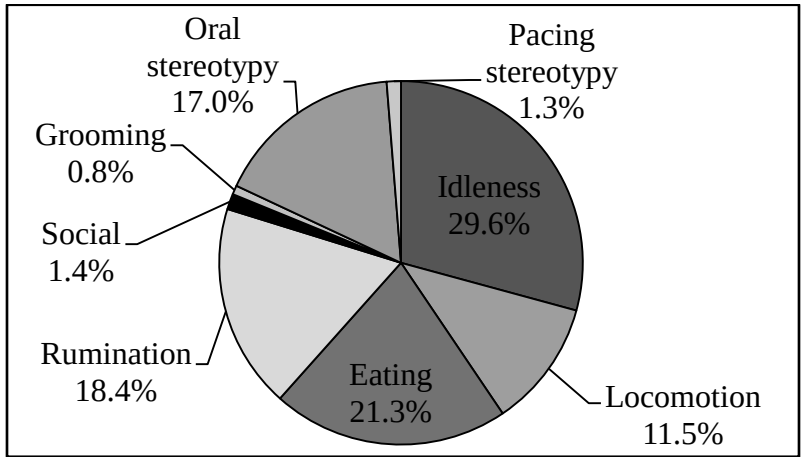

Figure 1a. Average time budget for giraffe sample population (n = 9) at three zoos without GFPs.

Table 5b. Average time budget (for total observation period) for giraffe sample population (n = 21) at six zoos with GFPs. Total time exceeds 100% because not all behaviors were mutually exclusive.

Behaviors	% of Observation Period ± SEM		
	Total (n=21)	Male (n=5)	Female (n=16)
Idleness	35.4 ± 3.8	28.9 ± 1.6	37.4 ± 4.9
Locomotion	11.6 ± 1.2	13.6 ± 2.7	10.9 ± 1.3
Eating	19.6 ± 1.8	27.6 ± 4.0	17.2 ± 1.6
Rumination	11.9 ± 1.7	15.9 ± 3.2	10.6 ± 2.0
Social	0.5 ± 0.2	0.5 ± 0.3	0.5 ± 0.2
Grooming	1.3 ± 0.4	2.6 ± 1.2	0.9 ± 0.4
Oral stereo.	12.5 ± 0.4	3.7 ± 2.2	15.2 ± 4.8
Pace stereo.	1.4 ± 0.5	1.8 ± 1.4	1.2 ± 0.6
Part. in GFP	7.8 ± 1.9	6.6 ± 1.8	8.2 ± 2.4

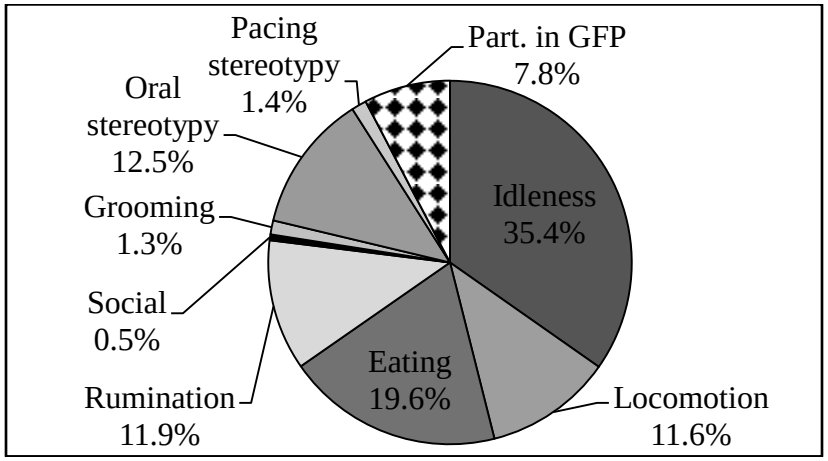

Figure 1b. Average time budget for giraffe sample population (n = 21) at six zoos with GFPs.

The amount of time spent participating in GFPs influenced rates of idleness and rumination (GLMM, Table 6). Idleness significantly increased and rumination tended to decrease as a function of participation in GFPs (Fig. 2, Fig. 3). Additional analysis of these two behaviors showed that both behaviors differed based on type of GFP. Idleness significantly increased for all-day feeding programs (GLMM, $t = 3.303$, $P = 0.003$) but was not influenced by part-day feeding programs (GLMM, $t = 0.239$, $P = 0.813$). Similarly, rumination significantly decreased for giraffes in all-day feeding programs (GLMM, $t = 2.206$, $P = 0.036$) but was not influenced by part-day feeding programs (GLMM, $t = 0.092$, $P = 0.927$). Locomotion, eating (routine diet), social and grooming behaviors were not affected by time spent participating in GFPs.

In contrast to the positive correlation between time spent participating in GFPs and idleness, there was a negative correlation between time spent eating (routine diet) and idleness (GLMM, Table 6). The combination of time spent eating (routine diet) and participating in GFPs tended to be positively correlated with increased time spent locomoting, and had no effect on idleness or rumination (GLMM, Table 6). Social and grooming behaviors were not influenced by total time spent feeding.

Table 6. Mixed model analysis results of feeding effects on giraffe behavior. Zoo was the random effect and times spent feeding in various formats were fixed effects in separately run models. Giraffe behaviors were the dependent variables. Data from nine zoos combined (n = 30 giraffes).

Fixed Effect	Dependent Variable (Behavior)	*t*-value	*P*-value
Participation in GFP	Idleness	2.902	0.007***
	Locomotion	1.067	0.295
	Eating (routine diet)	-1.272	0.214
	Rumination	-1.756	0.090*
	Social	-0.845	0.405
	Grooming	-1.678	0.104
	Tongue-rolling	-1.561	0.130
	Object-licking	-0.735	0.468
	Aberrant oral behavior (outlier removed)	-1.387	0.177
	Aberrant oral behavior (with outlier)	2.755	0.010**
	Pacing	-0.764	0.451
	Total oral stereotypy (outlier removed)	-0.981	0.335
	Total oral stereotypy (with outlier)	-0.678	0.503
Eating (routine diet)	Idleness	-2.427	0.022**
	Total oral stereotypy	-2.816	0.009***
Total feeding (routine diet + participation in GFP)	Idleness	-0.203	0.841
	Locomotion	1.817	0.080*
	Rumination	0.137	0.892
	Social	1.207	0.237
	Grooming	-0.698	0.491
	Tongue-rolling	-2.667	0.013**
	Object-licking	-1.958	0.060*
	Aberrant oral behavior (outlier removed)	-0.804	0.429
	Aberrant oral behavior (with outlier)	1.735	0.094*
	Pacing	-0.113	0.911
	Total oral stereotypy (outlier removed)	-3.228	0.003***
	Total oral stereotypy (with outlier)	-3.043	0.005***

* Indicates trend ($0.1 > P \geq 0.05$), ** Indicates significance ($0.05 > P \geq 0.01$),
*** Indicates high significance ($P < 0.01$)

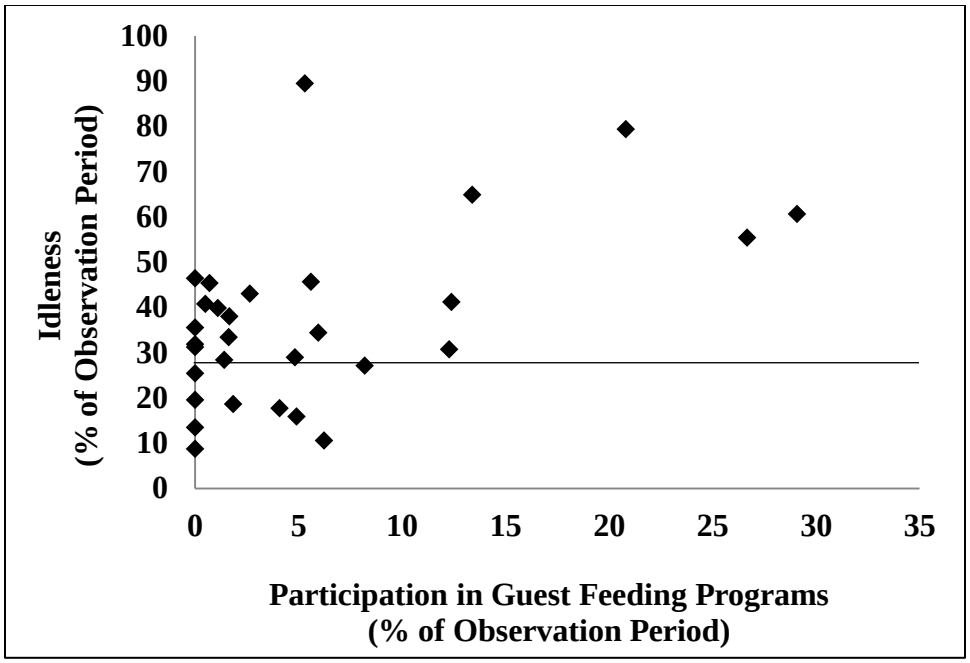

Figure 2. Correlation (*P* = 0.007) between time spent idle and time spent participating in guest feeding programs in giraffes (n = 30) from nine zoos. Horizontal line indicates average for giraffes at zoos without guest feeding programs.

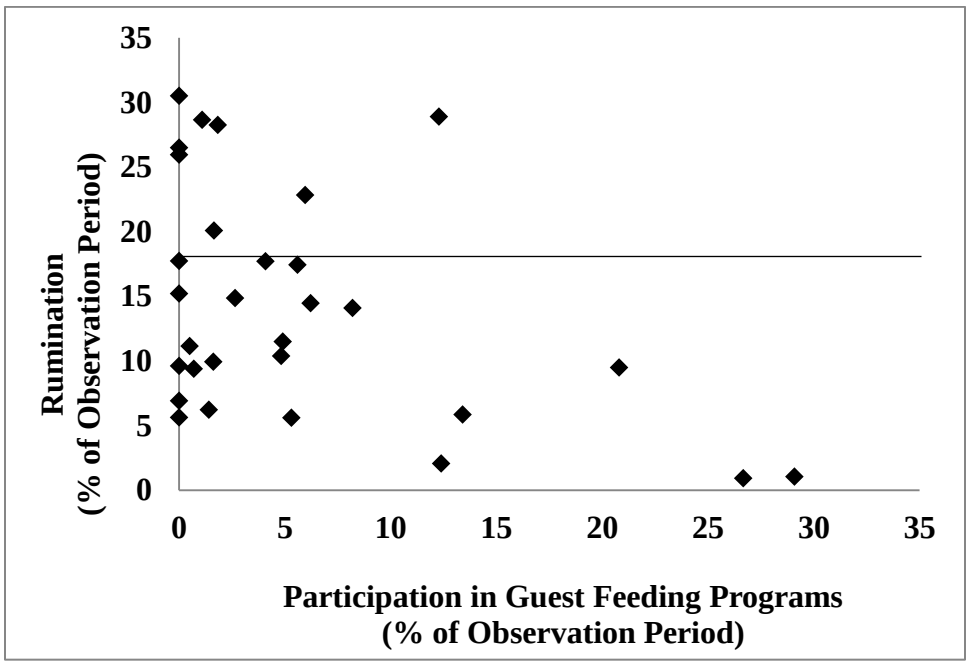

Figure 3. Correlation (*P* = 0.09) between time spent ruminating and time spent participating in guest feeding programs in giraffes (n = 30) from nine zoos. Horizontal line indicates average for giraffes at zoos without guest feeding programs.

Twenty-eight of the 30 giraffes expressed one or more stereotypic behavior (19 performed tongue-rolling, 24 performed object-licking, 8 performed aberrant oral behavior, and 10 performed pacing). Performance of stereotypies varied in frequency and duration between giraffes (Table 7).

Table 7. Frequency and duration of giraffe stereotypic behavior bouts observed during the total observation period using continuous behavioral sampling. For duration, only stereotypic behavior bouts that began and ended within a 30-min sample session were analyzed. The number of giraffes from nine zoos that performed the specific behavior is denoted by "n".

Stereotypic Behavior	Frequency			Duration (mm:ss)		
	Average ± SEM	Min.	Max.	Average ± SEM	Min.	Max.
Tongue-rolling (n = 16)	17.5 ± 4.9	1	59	03:43 ± 02:06	00:07	16:46
Object-licking (n = 20)	15.5 ± 3.1	1	45	04:35 ± 01:31	00:06	21:30
Aberrant oral behavior (n = 6)	8.7 ± 3.3	1	23	00:49 ± 00:47	00:05	05:38
Pacing (n = 10)	6.3 ± 1.0	1	11	02:07 ± 00:22	00:13	16:29

Time spent participating in GFPs had no effect on time spent engaged in stereotypies: tongue-rolling, object-licking, aberrant oral behavior, or pacing (GLMM, Table 6). When all oral stereotypies were combined, analysis continued to show no significant correlation with participation in GFPs (Fig. 4, Table 6). Time spent eating (routine diet) was negatively correlated to time spent engaged in total oral stereotypies (GLMM, Table 6). When time spent eating (routine diets) and participating in GFPs were combined, total oral stereotypies significantly decreased further (Fig. 5), and particularly significant negative correlations between total time spent feeding and tongue-rolling and object-licking were observed (GLMM, Table 6).

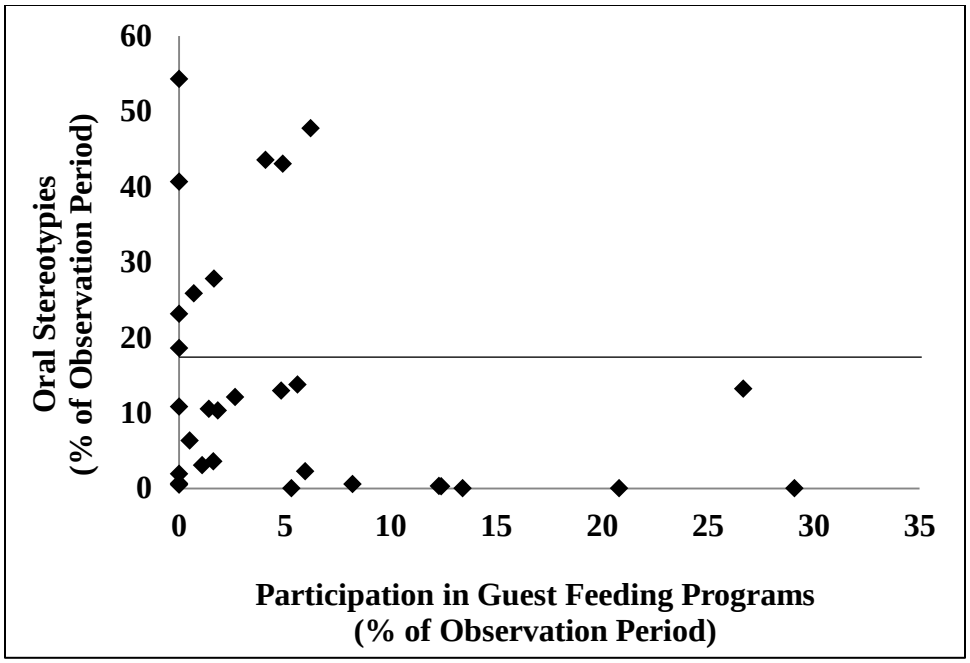

Figure 4. Correlation (*P* = 0.503) between time spent performing oral stereotypies and time spent participating in guest feeding programs in giraffes (n = 30) from nine zoos. Horizontal line indicates average performance of stereotypic behavior by giraffes at zoos without guest feeding programs.

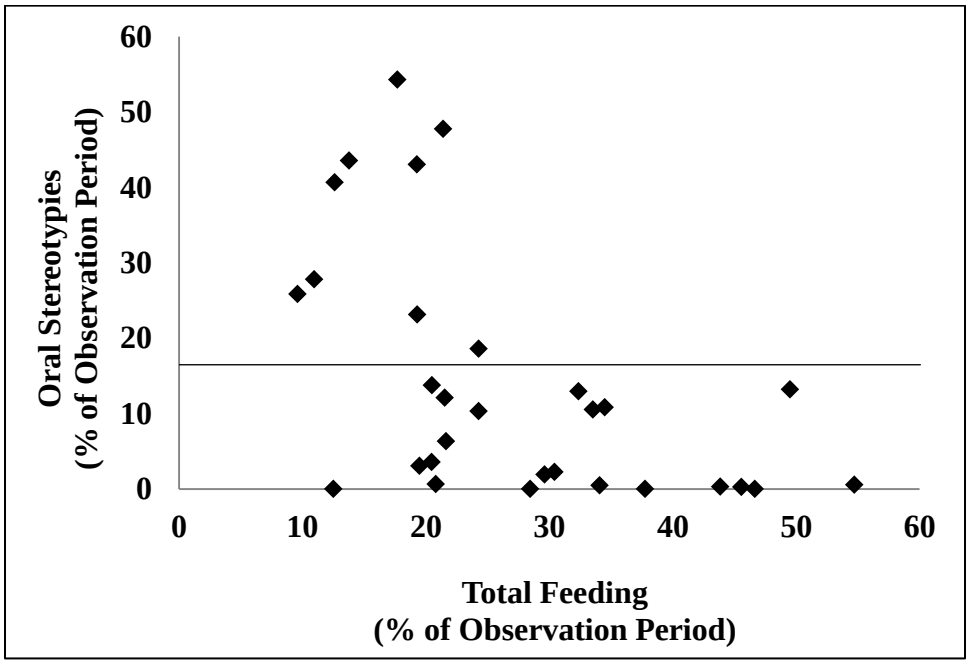

Figure 5. Correlation (*P* = 0.005) between time spent performing oral stereotypies and combined time spent eating (routine diet) and participating in guest feeding programs in giraffes (n = 30) from nine zoos. Horizontal line indicates average performance of stereotypic behavior by giraffes at zoos without guest feeding programs.

Sex and age were significantly correlated with several behaviors (GLMM, Table 8). Male giraffes spent more time eating (routine diet) throughout the observation period than females. There were also trends for increased locomotion and grooming among male giraffes. With regard to stereotypic behaviors, female giraffes performed oral stereotypies more frequently than males. Among older giraffes, idleness increased, while time spent engaged in locomotion, eating (routine diet), and grooming decreased. Performance of oral stereotypies was not affected by age, but pacing, the only locomotor stereotypy measured, was observed significantly more often in younger giraffes (Fig. 6). Rumination and social behavior were affected by neither sex nor age.

Table 8. Mixed model analysis results of demographic effects on giraffe behavior. Zoo was the random effect and each demographic was a fixed effect in separately run models. Giraffe behaviors were the dependent variables. Data from nine zoos combined (n = 30 giraffes).

Fixed Effect	Dependent Variable (Behavior)	*t*-value	*P*-value
Sex	Idleness	-0.347	0.731
	Locomotion	1.766	0.088*
	Eating (routine diet)	3.72	0.001***
	Rumination	-0.163	0.872
	Social	1.392	0.175
	Grooming	1.987	0.057*
	Total oral stereotypy	-2.868	0.008***
	Pacing	0.233	0.818
Age	Idleness	2.118	0.043**
	Locomotion	-2.404	0.023**
	Eating (routine diet)	-3.282	0.003***
	Rumination	-0.247	0.807
	Social	-0.603	0.551
	Grooming	-2.826	0.009***
	Total oral stereotypy	1.533	0.137
	Pacing	-2.549	0.017**

* Indicates trend ($0.1 > P \geq 0.05$), ** Indicates significance ($0.05 > P \geq 0.01$),
*** Indicates high significance ($P < 0.01$)

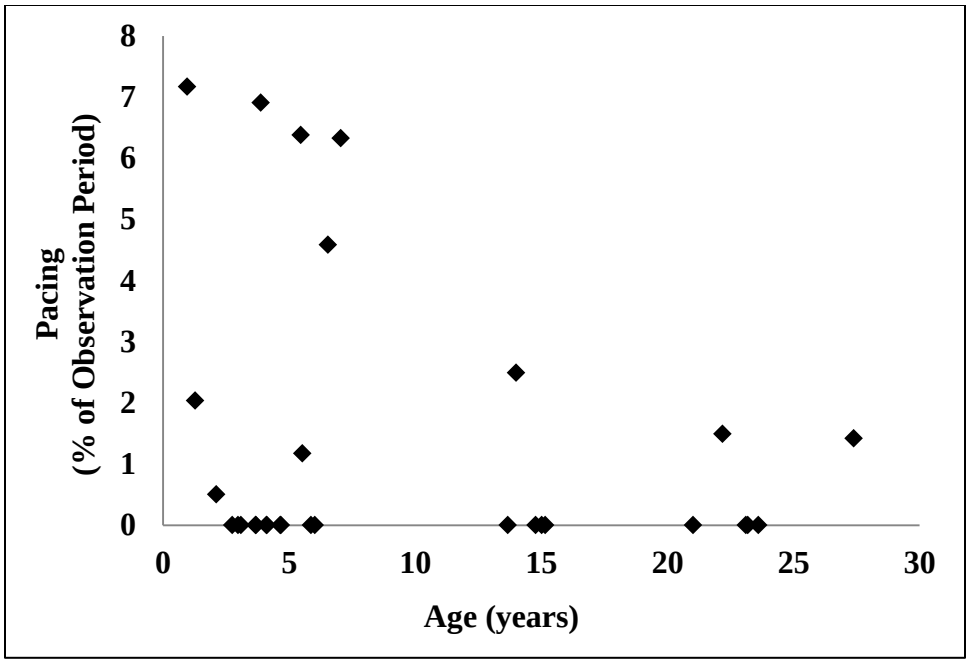

Figure 6. Correlation (*P* = 0.017) between time spent pacing and age in giraffes (n = 30) from nine zoos.

DISCUSSION

Human-animal interactions can influence the behavior and welfare of program animals in zoological institutions and must be closely evaluated to ensure a positive experience for both program animals and human participants. Welfare can be assessed through behavioral, physiological, and health measures, and is unique to species, individuals, and contexts. Poor welfare is associated with reduced fitness and is usually brought about by stress or an inability to cope with environmental conditions (Broom, 1991b). In this research, stereotypies were used as indicators of sub-optimal welfare, assuming that they arose from frustration of not being able to appropriately perform a desired, natural behavior – foraging. A guest feeding program (GFP) may help to restore some aspects of natural giraffe foraging by extending time spent feeding throughout the day, increasing food acquisition complexity, expanding distributional range of food, and providing additional food quantities. This was the first study to document quantification of behavioral changes (stereotypic and non-stereotypic) as a function of individual giraffe participation in GFPs, and results may indicate whether GFPs can be considered a form of environmental enrichment for captive giraffes.

Effects of GFPs on Non-stereotypic Behaviors

Idleness comprised the largest portion of the average giraffe time budget in this study, regardless of whether giraffes were housed at a GFP or non-GFP institution, and observed levels of idleness were higher than those reported for wild giraffes (Pellew, 1984; Veasey et al., 1996). Data indicated a strong positive correlation between idleness and degree of participation in GFPs; however when analyzed categorically, time spent idle was only significantly higher in

cases of all-day feeding programs, not in cases of part-day feeding programs. Locomotion levels were substantially lower than idleness and lower than those reported for wild giraffes (Pellew, 1984; Veasey et al., 1996). The elevated levels of idleness seem to be a consequence of open but not active feeding programs (often the case in all-day feeding programs) in which giraffes waited near platforms in anticipation of being fed. However, time spent engaged in GFPs may not impact overall activity levels, if time spent eating routine diets is accounted for. When time spent feeding from routine diets and GFPs were combined, total time spent feeding had no influence on idleness and tended to correlate to increased locomotion. Therefore idleness levels may be irrespective of total feeding activities, and may only potentially be problematic under all-day GFP situations.

Giraffes that spent more time engaged in GFPs had lower levels of rumination, which might be indicative of elevated stress because rumination is thought to transpire only when in a relaxed state (Trunkfield and Broom, 1990). Rumination is a very important part of the digestive process (Baxter and Plowman, 2001) and is the second most time-consuming activity in the daily time budget of wild giraffes (Pellew, 1984). Captive giraffes have been shown to increase rumination when fibrous food items (Baxter and Plowman, 2001) and an *ad-libitum* browse wild-like feeding regime (Veasey et al., 1996) were offered. Yet, giraffes exposed to a GFP did not exhibit the anticipated higher levels of rumination. Because giraffes still need to ruminate, it is plausible that rumination bouts may have shifted outside the observation period, specifically to night-time, indoor holding. Rumination has previously been found to occur more often at night in both captive and wild giraffes (Baxter and Plowman, 2001; Pellew, 1984). Furthermore, the time spent ruminating was only significantly reduced in giraffes in all-day GFPs, signifying that continuous feedings may have prevented initiation of rumination bouts (which were often

comprised of more than 20 continuous instantaneous scans in individuals with no or part-day GFPs). Without assessing the 24-hr time budget (see *Study Limitations*), it is difficult to ascertain whether time spent engaged in a GFP altered the total amount of rumination or simply the timing.

Effects of GFPs on Stereotypic Behaviors

Stereotypies can be defined as repetitive behavioral patterns that remain invariant and serve no recognizable goal or function (Mason, 1991a). Although the absence or reduction of stereotypic behaviors does not necessarily guarantee good welfare (Mason and Latham, 2004; Melfi, 2009), these behaviors are often used as indicators of suboptimal welfare (Broom, 1991a; Lawrence and Rushen, 1993; reviewed by Mason, 1991a, Mason and Latham, 2004). Animal welfare can only be improved by mitigating the motivation that initiates stereotypic behavior – not merely reducing performance of the behavior (Mason and Latham, 2004).

Believed to stem from abnormal animal–environment interactions (Carlstead, 1998), stereotypic behavior does not appear in the same context or frequency as it would in nature (Fraser and Broom, 1990; Veasey et al., 1996). The behavior is typically elicited in captive situations where an animal experiences stress, conflict, and/or frustration from a lack of stimulation in or control over its environment (Mason, 1991a; Morgan and Tromberg, 2007). In response to suboptimal conditions, stereotypies may act as a coping mechanism (Broom, 1991a&b; Fraser and Broom, 1990), allowing the animal to express a behavioral need, receive some benefit (e.g. salivation), lower responsiveness (calming feeling), or establish predictability

in an unpredictable environment (Mason, 1991a). Thus through coping, stereotypic behavior may work to alleviate stressful conditions and rectify individual welfare (Mason and Latham, 2004).

Many have hypothesized that oral stereotypies form in captivity as a result of frustrated feeding (and ruminating) motivation that is unable to be fulfilled as it would in nature (reviewed in Bergeron et al., 2006; Baxter and Plowman, 2001; Dittrich, 1976). Oral stereotypic behavior is especially prevalent in ungulate species due to adaptations necessary for herbivory: extensive amount of time needed for foraging (to attain bulk and nutritional gain), need to search for and select specific nutrients, and ability to overcome physical and chemical plant defenses (Bergeron et al., 2006). In captivity, ungulate diets are often concentrated, relatively homogenous, and directly offered in a fixed delivery (time and location), and consequently reduce time spent searching for food, consuming food, and (for ruminants) ruminating food (Baxter and Plowman, 2001; Bergeron et al., 2006; Dittrich, 1976; Kinahan and Marples, 2000; Koene, 1999; Young, 1997). As the largest ruminant in the world, feeding activity is a major component of a giraffe's biology, comprising a majority of its time budget (Ginnett and Demment, 1997; Leuthold and Leuthold, 1978; Pellew, 1984); the amount of time captive giraffes dedicate to feeding and rumination may only comprise roughly half of what is performed in the wild (Koene, 1999; Veasey et al., 1996). Both quantity and quality of food in captivity may have significant impacts on giraffe behavior, with time not dedicated to feeding leading to inactivity or a replacement stereotypic behavior (Kinahan and Marples, 2000; Koene, 1999).

Captive ungulates exhibit oral stereotypies that often resemble normal mouth movements made when feeding (Bergeron et al., 2006; Dittrich, 1976) and for giraffes, these include object-licking, tongue-rolling/tongue-playing, and vacuum chewing (Baxter and Plowman, 2001; Seeber et al., 2012). In a survey of the AZA giraffe and okapi population, 79.7% of giraffids

surveyed performed stereotypies with 72.4% of these being some sort of oral stereotypy (Bashaw et al., 2001). In this study, 93.3% of giraffes surveyed performed oral stereotypies at some point during the observation period; 33.3% performed pacing stereotypies. This higher occurrence could indicate that managers were unaware and thus underreported the prevalence of stereotypic behavior among their giraffes.

We expected GFPs to decrease prevalence of stereotypic behavior because program qualities (i.e., extend time spent feeding, increase feeding complexity) would mimic natural foraging characteristics and reduce frustration. Tarou et al. (2003) suggested that extending foraging duration would ultimately fulfill the foraging motivation causing oral stereotypies, and limited reports have shown that captive giraffes that spent more time feeding were observed to perform less oral stereotypic behavior (Koene, 1999; Koene and Visser, 1996). Increasing complexity of attaining food (through feeder design) can reduce oral stereotypy (Fernandez et al., 2008; Bashaw et al., 2001), and adding extra portions of browse and fibrous food items to the diet decreases object-licking and tongue-playing (Baxter and Plowman, 2001; Bashaw et al., 2001; Kinahan and Marples, 2000; Koene, 1999; Koene and Visser, 1996). A survey study by Bashaw et al. (2001) indicated a tendency for giraffes fed by zoo visitors to display less stereotypic licking (although the study did not measure feeding duration or quantity of feed).

Individual time spent participating in GFPs had no significant effect on performance of stereotypic behaviors. Although each of the four stereotypic behaviors decreased among giraffes that increasingly participated in GFPs, these relationships were non-significant. However, the difficulty in abolishing stereotypic behaviors once established must be taken into consideration (Mason and Latham, 2004; Mason, 1991a). Furthermore, because stereotypies can become habits over time regardless of stimuli, or be a result of central nervous system dysfunction, the

performance of stereotypic behavior may not be directly linked to current environmental conditions and welfare (Mason and Latham, 2004; Mason 1991b). In zoo animals particularly, stereotypic behaviors may be a result of past exhibits or experiences. For these reasons, guest feeding programs may not be able to fully eliminate an engrained stereotypic behavior even if enriching. Yet, since GFPs were not found to correlate to increased stereotypic behavior, we can infer that this human-animal interaction is not an apparent cause of stress or frustration and does not negatively contribute to giraffe welfare.

Time spent eating routine diets significantly correlated to reduced performance of oral stereotypies, and this correlation was strengthened when combined with time spent participating in GFPs. This relationship supports the hypothesis that increased time spent feeding reduces time spent performing oral stereotypies (Fernandez et al., 2008; Koene, 1999; Tarou et al., 2003). Guest feeding programs, in combination with increased feeding duration of routine diets, can significantly reduce performance of oral stereotypic behavior, reinforcing the proposition that these programs can serve as environmental enrichment for captive giraffes.

Time spent engaged in GFPs had no effect on performance of stereotypic pacing, supporting the idea that locomotor stereotypies are more influenced by environmental variables than by feeding variables (Bashaw et al., 2001). However, neither exhibit size nor indoor holding size showed significant influence on time spent stereotypic pacing in this study. Pacing was most often observed at the end of the observation period, directly prior to giraffes being allowed entry into indoor holding for the night. This observation was similar to that made by Koene and Visser (1996). Food was frequently available to giraffes upon return indoors, indicating that in this case, food or routine moving may have contributed to the cause of anticipatory pacing. Another explanation for the pacing behavior could be that, at two zoos, pacing individuals were separated

from a conspecific(s) kept indoors. It has been previously reported that females separated from a male conspecific at Zoo Atlanta showed increases of object-licking and pacing stereotypies (Tarou et al., 2000), and so observations from this study may further indicate that social separation is a stressful experience that can influence prevalence of stereotypic behavior.

Demographic Differences

Giraffe age positively correlated to levels of idleness, likely because older individuals were larger and could more readily participate in GFPs (previously shown to correlate to idleness). Presumably, locomotion decreased in older giraffes for the same reason. Younger, subordinate giraffes moved around the platform to find available, non-competitive space, or were too small to participate and spent time moving around the rest of the exhibit. Locomotion differences were also found based on sex, with males tending to locomote more than females, which corroborates data from wild giraffes (Pellew, 1984).

In the wild, females typically spend more time feeding than males, about 50-70% compared to about 25-50% of 24-hr activity, respectively (Ginnett and Demment, 1997; Leuthold and Leuthold, 1978; Pellew, 1984), with differences attributed to reproductive costs (Leuthold and Leuthold, 1978). In this study, females spent significantly less time eating than males but this difference might be largely influenced by the significantly higher stereotypic behavior levels exhibited by females which took up a larger portion of the time budget. Baxter and Plowman (2001) also reported that two females spent less time eating and more time oral stereotyping than their male companion. Older giraffes spent significantly less time eating

routine diets than younger giraffes, likely because older giraffes spent a larger portion of their day idle and participating in GFPs.

Female giraffes in the study performed stereotypic behaviors significantly more often than male giraffes. This observation was similar to those of Baxter and Plowman (2001), Hosie and Turner (2000), and Fernandez et al. (2008), although these authors observed few individuals and presented no reason behind the difference. Because female giraffes spend more time engaged in feeding behaviors in the wild (Ginnett and Demment, 1997; Leuthold and Leuthold, 1978a Pellew, 1984), and a strong unfulfilled motivation to feed is believed to induce oral stereotypic behavior, we would expect higher levels of oral stereotypies among captive female giraffes.

In contrast to observations of Veasey et al. (1996), younger giraffes in the present study paced more often than older giraffes. It has been suggested that stereotypies develop and become more frequent as animals mature (reviewed in Mason, 1991a), so differences in pacing behavior between young and older giraffes is difficult to explain. Pacing often preluded reuniting with separated conspecifics in indoor housing, suggesting that younger individuals may experience more stress from social separation than older individuals. There is recent evidence to suggest giraffes do not randomly associate as previously believed (Estes, 1999; Leuthold, 1979) but form social relationships, with social preference for individuals differing most in age (Bashaw et al., 2007). Younger giraffes in this study may have preferred to associate with separated older individuals, and prevention from doing so elicited frustration which caused pacing behavior. Alternatively, feeding motivations may become more pronounced at different ages, and thus the corresponding types of stereotypic behavior expressed in the time budget will shift accordingly as giraffes age.

Study Limitations

The present study only analyzed the period of the day from 9:00 to 17:00, which leaves a significant portion of the 24-hr time budget undocumented. Especially because stereotypic behaviors have been recorded more at night and while in indoor housing (Bashaw et al., 2001; Baxter and Plowman, 2001; Hosie and Turner, 2000), additional observations need to be made during the remainder of the 24-hr day. Fernandez et al. (2008) found that changing the feeding habits indoors affected stereotypic behavior expressed outdoors; the opposite is also possible. Extending the observation period to 24 hrs would help to clarify effects on overall stereotypic behavior, as well as rumination rate and timing.

Behavioral studies on animals within zoological settings present unique challenges. For example, it is often difficult to attain sample sizes sufficient for meaningful statistical inferences and also to attain balance with regard to sex and age in a sample population. The sample population in this study consisted of 7 males and 23 females and had a median age of 5.7 years. Although the composition of a giraffe herd within zoo exhibits is typically female-biased, the sample population from this study may not adequately reflect the age structure of the whole giraffe population. Giraffes in captivity can live into their mid- to late-20s, therefore caution should used when drawing inferences from this study about age- or sex-based effects on giraffe behavior.

Cross-institutional analysis can also present problems when assessing behavior, as individual animals and their ability to express certain behaviors will likely differ depending on exhibit and management characteristics (e.g., Carlstead et al., 1999; Koene and Visser, 1996; Montaudouin and Pape, 2004; Perkins, 1992). In contrast to Veasey et al. (1996) and Bashaw

(2011), significant differences in multiple behaviors were found between zoos in this study. With high variation in exhibit size (ranging from 0.3 acres to 16 acres) and complexity (i.e., provision of foliage, browse, and enrichment), social composition (intra- and inter-specific), GFP characteristics, and other factors, this was expected. Because animal welfare is influenced by many factors, more research emphasis needs to be placed on understanding exhibit and management characteristics' effect on giraffe behavior.

The six GFPs observed in this study were also physically and temporally quite different. Platforms (railings included) reached as high as 5.3 m and had a functional length ranging from 1.7 to 25.9 m. Food items for sale included leaves of romaine lettuce, sweet potato pieces, rye-crisp crackers, carrots, and browse leaves. Some program sessions were as short as 20 min (but offered three times per day), while other programs operated throughout the entire business day. Diversity within GFPs likely offered different experiences for both guests and giraffes, so future studies should distinguish how specific aspects of GFPs influence the guest experience and giraffe behavior and welfare.

Management Recommendations

Guest feeding programs at giraffe exhibits are becoming increasingly common as reflected by their presence at approximately 57% of AZA-accredited zoos that exhibit giraffes (determined from zoos' websites and not including VIP tours). Aside from the presumed educational and recreational benefits of up-close human-animal interactions to the visitors (Beardsworth and Bryman, 2001; Kidd et al., 1995; Kreger and Mench, 1995; Woods, 2002), these programs also provide a financial incentive to the institution. Within this study alone, a

single food portion was sold for as much as $5.00 (although most sold for $1.00-$2.00), and one zoo reported a $1,600 income from their GFP during a single observation day. This easy-to-implement, lucrative program may provide extra funds to general zoo operations, animal care, or specific conservation programs.

One of the most significant effects of GFPs was increased idleness observed in participating giraffes. Inactivity, while not necessary harmful, may lead to health problems and development of replacement stereotypic behavior (Veasey et al., 1996); furthermore, idleness also does not instill interest among zoo guests (Altman, 1998; Bitgood et al., 1988; Margulis et al., 2003). Since results showed that idleness was only significantly higher at zoos that offered all-day GFPs, this problem can be avoided by structuring GFPs into multiple short sessions. Shorter sessions may also help to assure a steady crowd of visitors during the GFP, therefore limiting the opportunity for giraffes to remain idle.

Anecdotal problems cited by multiple animal managers during the survey portion of the study included feeding of undesirable items by visitors (non-approved foods such as poisonous plants and human snackfood), teasing by visitors, giraffe reluctance to participate in programs, and giraffe dominance over conspecifics at feeding platforms (also described by Burgess, 2004). While proximate zoo staff surveillance may help reduce guest-driven incidents, special station- or target-training may be necessary to encourage timid giraffes and control those more dominant. Two zoos were working to station-train their giraffes to stand at specific parts of the platform and were successful at keeping giraffes at their stations as long as there was a fairly continuous flow of food being offered. A quiet, calm atmosphere at the feeding platform was also observed to help maintain giraffe presence. Loudspeaker systems and whistles were not observed to be

effective at attracting and maintaining giraffe presence at feeding platforms; these only added to the disturbance brought about by visitor crowds.

Managers should recognize that animals (at the species and individual level) will react differently to contact and interaction contexts. Although this study suggests that no reduction of giraffe welfare resulted from GFPs, managers should not assume that all individuals will be affected in the same way or to the same degree, nor will other species in other human-animal interactive programs. Other interactive experiences, such as stingray touch pools, parakeet/lorikeet aviaries, and petting zoos, need to be considered as unique opportunities with each meriting scientific research to determine effects to animal welfare.

Future Studies

The next step in understanding effects of GFPs on giraffe welfare would be to perform pre-and-post comparisons of physiological and behavioral indicators of welfare. By evaluating the cause-and-effect relationship GFPs have on these parameters, further evidence will be gained for comparison to the correlations presented in this study. Specifically, one can determine whether GFPs cause a direct reduction in stereotypic behavior both short- and long-term after a new GFP is established. Physiological indicators of stress, such as fecal cortisol levels, should also be measured in connection with a newly established GFP.

More research also needs to be conducted on understanding the unfulfilled motivations that cause oral stereotypic behavior. Excess salivation was observed during many bouts of oral stereotypic behavior in this study; this has been one suggested purpose of stereotypic licking as the production of excess saliva may help to buffer gastrointestinal acidity (Baxter and Plowman,

2001; Bergeron et al., 2006; Nicol et al., 2002; Wiepkema et al., 1987). Some giraffes were also observed to involve a small volume of food, such as a single leaf or small portion of hay, in their oral stereotypy. The food items were not actively ingested or ruminated, only manipulated. This observation was also made by Koene and Visser (1996), and yet, the purpose of the food items' involvement in oral stereotypic behavior, specifically how it may relate to salivation, is not understood. These observations should be studied further with specific investigation to the relationship of captive diets and gastrointestinal health with performance of oral stereotypies in ungulates.

One interesting finding of this study was that grooming behavior significantly decreased with age, and had a tendency to be more frequent in male giraffes. Grooming has not been identified as a key behavior in a giraffe's behavioral repertoire, but it may be interesting to know how grooming affects fitness levels, especially for younger, male giraffes (e.g. mate attractivity).

CONCLUSION

Results from the present study suggest that guest feeding programs at zoos have no apparent detrimental impact on giraffe welfare, as indicated by behavioral time budgets encompassing observations of both normal and stereotypic behaviors. Giraffe participation in guest feeding programs does not significantly influence their performance of stereotypic behavior. However, increased time spent engaged in feeding did significantly correlate with decreased levels of oral stereotypic behavior, and these levels further decreased with increased individual participation in guest feeding programs. This indicates that managers can potentially reduce oral stereotypies, an indicator of sub-optimal welfare, by increasing opportunities for giraffes to fulfill feeding motivation. Giraffe idleness can be problematic at guest feeding platforms, but resolution may come from adjusted management and program scheduling. As zoos strive to enhance the educational and entertainment value of a guest's experience through human-animal interactions, they must also ensure optimal welfare of individual animals involved. If properly implemented, guest feeding programs can provide financial benefits to the institution and potential enrichment to giraffe welfare.

APPENDICES

APPENDIX A

Time Budget Data Sheet

Date:

Site:

Temp: _____ Humidity: _____ Start Time:

	Behavior														Platform		
Time	**Idle**	**Locomoting**	**Eating**	**Ruminating**	**Drinking**	**Socializing**	**Grooming**	**Object-manipulating**	**Object-licking**	**Tongue-rolling**	**Aberrant oral behavior**	**Pacing**	**Other**	**Time Out**	**< 3m of Platform**	**> 3m of Platform**	**Active Feeds at Platform (y/n)**
0:00																	
0:01																	
0:02																	
0:03																	
0:04																	
0:05																	
0:06																	
0:07																	
0:08																	
0:09																	
…																	
0:25																	
0:26																	
0:27																	
0:28																	
0:29																	

Comments:

APPENDIX B

Stereotypic Behaviors
Data Sheet

Date:
Site:
Start Time:

Temp: _____ Humidity: _____

Giraffe ID	Start Time	End Time	Type of Stereotypic Behavior	Comments

Legend:
T - Tongue-rolling
O - Object-licking
A - Aberrant oral behavior
P - Pacing

Additional Comments:

APPENDIX C

Management Survey

Institution: _____

1) Animals

Individual	Sex	Age (years)	Years at Zoo	Reproductive/Health Status	Hand-Reared *vs.* Mother-Reared
	□ M □ F				
	□ M □ F				
	□ M □ F				
	□ M □ F				
	□ M □ F				
	□ M □ F				
	□ M □ F				
	□ M □ F				

Individual	Personality Type (check all that apply):	Other Comments
	□ Docile □ Aggressive □ Playful □ Timid □ Investigative	
	□ Docile □ Aggressive □ Playful □ Timid □ Investigative	
	□ Docile □ Aggressive □ Playful □ Timid □ Investigative	
	□ Docile □ Aggressive □ Playful □ Timid □ Investigative	
	□ Docile □ Aggressive □ Playful □ Timid □ Investigative	
	□ Docile □ Aggressive □ Playful □ Timid □ Investigative	
	□ Docile □ Aggressive □ Playful □ Timid □ Investigative	
	□ Docile □ Aggressive □ Playful □ Timid □ Investigative	

2) Giraffe Keeper Staff

a. How many different keepers / managers directly care for giraffes?

b. Does keeper staff have tactile interaction with giraffes? If so, estimate the amount of time this occurs on a weekly basis.

3) Exhibit Characteristics

Outdoor	
Area size:	
Substrate (check all that apply):	□ Dirt □ Sand □ Concrete □ Grass □ Other:
Features (check all that apply):	□ Pool □ □ Running water □ □ Elevation changes □ □ Trees □ □ Fields □ Shade structure
Is the overall surface plane slanted?	□ Yes □ No
Are the animals able to hide from public view?	□ Yes □ No
Indoor/Holding	
Area size:	
Substrate (check all that apply):	□ Dirt □ Sand □ Concrete □ Wood □ Tile □ Hay/Straw □Other: _____
Features (check all that apply):	□ Hay/straw □ □ Separate stalls □ How many: _____
Is the floor slanted?	□ Yes □ No
Are the animals able to hide from public view?	□ Yes □ No
What form of lighting is used? How many hours of artificial lighting per day?	□ Sunlight □ Fluorescent □ Incandescent □ Wide Spectrum □ Other: _____
Containment	
Features (check all that apply):	□ Mesh or chain link fence □ Metal bars □ Moat □ Glass □ Hot wire □ Gunite □ Cable □ Other:
Surroundings	
Proximity to predator (y/n):	Visual:
Proximity to visitor conveniences (*e.g.*, food, retail, rides, shows) (y/n):	Visual:
Public-Animal Interface	
Minimum distance between public and animals at normal viewing area:	
% of exhibit under public view:	
Number of sides (max 4) that public surrounds exhibit:	
Animal Composition:	
Is this a mixed-species exhibit?	□ Yes □ No If so, what species:
How many hours per summer day are the animals put on exhibits:	

4) Diet & Feeding Schedule

Please list all components of the animals' normal diet:

Food (Type and/or Brand)	**Quantity per Day**	**What % of Food is Consumed**
Browse	**Quantity per Day**	**# Days given per week**
Vitamin Supplements	**# Days given per Week**	

Outside of any feeding program:

a. When and where do feedings take place?

b. In what sort of container is food presented?

c. In what sort of container is water presented?

d. Please list all "treats" given (and how often) to the animals:

5) Veterinary Care

Please list animals and the medical care they receive or have received that may alter behavior:

Individual	**List any medical care given to each giraffe: (*e.g.*, medications for disease, injury, parasite)**

6) <u>Training</u>

Please list animals and the behaviors trained:

Ind.	Frequency of training sessions	Amount of time per day being trained	Level of Desired Training (1-5)	Animal Response to Training (retention of trained behavior)
				□ Poor □ Fair □ Good □ Excellent
				□ Poor □ Fair □ Good □ Excellent
				□ Poor □ Fair □ Good □ Excellent
				□ Poor □ Fair □ Good □ Excellent
				□ Poor □ Fair □ Good □ Excellent
				□ Poor □ Fair □ Good □ Excellent
				□ Poor □ Fair □ Good □ Excellent
				□ Poor □ Fair □ Good □ Excellent

a. What key behaviors have been trained:

b. Number of personnel training animals:

c. What training techniques are used (Check all that apply)?
   - ☐ Target training
   - ☐ Clicker training
   - ☐ Positive reinforcement
   - ☐ Negative reinforcement
   - ☐
   - ☐

d. What type of reward is offered during training (Check all that apply)?
   - ☐ Vocal praise
   - ☐ Tactile praise (*e.g.*, pat or rub)
   - ☐ Food treat
   - ☐
   - ☐

e. Does any of the training have direct public education purposes?

7) Enrichment

Please list all enrichment items used (if applicable):

	Frequency Used	Duration Used	Animal Response (Interest)
			□ Poor □ Fair □ Good □ Excellent
			□ Poor □ Fair □ Good □ Excellent
			□ Poor □ Fair □ Good □ Excellent
			□ Poor □ Fair □ Good □ Excellent
			□ Poor □ Fair □ Good □ Excellent
			□ Poor □ Fair □ Good □ Excellent
			□ Poor □ Fair □ Good □ Excellent
			□ Poor □ Fair □ Good □ Excellent

8) Stereotypic Behaviors

Please list any stereotypies associated with your animals:

Behavior	Estimated % Time of Occurrence	Animal/Location/ Time of Day	History (Were stereotypies performed at previous institution?)
Object licking			
Tongue playing			
Mouthing/cribbing			
Conspecific licking			
Pacing			

9) Giraffe Public Feeding Programs

Please identify the behavioral experience each giraffe has with feeding program:

Individual								
Docile								
Aggressive								
Timid								
Approach spontaneously								
Approach when called								
Other (please specify)								
Years at present program								
Years at previous program								

a. Is touching of giraffes permitted? Do giraffes allow it?

Please describe the conditions of the giraffe feeding platform and program:

Feeding Platform	
Length (adjacent to exhibit):	
Height (from giraffe's perspective, top of rail):	
Composition of platform (*e.g.*, wood, metal)	
Substrate at base of platform (where giraffes stand):	
Max number of people it can hold:	
Feeding Program	
Type of feed offered	
Daily frequency of feeding events:	
Duration of each feeding event:	
Daily average amount of people participating in giraffe feeding:	
Is there any record of visitor aggravation (*e.g.*, illegal feedings, illegal entry to exhibit)?	

a. Do any other demonstrations or keeper chats occur in or adjacent to giraffe exhibits?

b. Have there been any issues or problems in adapting giraffes to your feeding program?

c. Does your feeding program and a giraffe's participation in it affect how you would manage your giraffe herd? This includes breeding and animal transfers.

d. How does the zoo benefit financially from the guest feeding program?

10) <u>Zoo Attendance</u>

Total for ___ / ___ / 2012:	
Total for ___ / ___ / 2012:	
Total for ___ / ___ / 2012:	

Or Contact Information:

11) <u>Additional Questions or Comments</u>

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