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A Close Keeper–Nonhuman Animal Distance Does Not Reduce Undesirable Behavior in Contact Yard Goats and Sheep

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This study investigated the relation between zookeeper–nonhuman animal distance and the undesirable behavior goats and sheep exhibited toward visitors of Zoo Atlanta's contact yard. It hypothesized that a close distance between keeper and animal would be associated with a lower rate of undesirable behavior than would a distant keeper–animal distance. The study recorded rate of undesirable behavior exhibited, number of visitors in the yard, and number of times visitors touched an animal under near and distant keeper–animal distances. Seven African pygmy goats (*Capra hircus*) and 4 Romanov sheep (*Ovis aries*) were the subjects. The study used linear regression methods to analyze approximately 48 hr of behavioral data collected using a focal sampling technique. Findings indicated a familiar animal keeper nearby was not associated with lower rates of undesirable behavior toward visitors. Higher rates of undesirable behavior occurred when keepers were nearby than when they were distant. The study also found that undesirable behavior increased as visitors' touching of the animals increased. Applying the study's findings may improve human–animal interactions and increase animal well-being in a contact yard through animal management techniques.

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Zoo Atlanta maintains a contact yard with the underlying goal of fostering in its visitors positive attitudes toward nonhuman animals. Previous research indicates that positive human–animal contact creates attitudes in humans that are more positive toward animals (Kidd & Kidd, 1997; Kidd, Kidd, & Zaslof, 1995). For one to have a positive experience at a contact yard, the animals must tolerate attempts to make contact. Unfortunately, the animals do not always tolerate contact; instead, they may attempt to escape or avoid. Thus, aggressive, avoidance, and escape behaviors directed at humans by the animals are termed *undesirable behaviors* to indicate that they are incompatible with the goals of the contact yard. The term does not indicate that the behaviors are maladaptive or inappropriate in any other way. This study was designed to determine if such undesirable behaviors exhibited by African pygmy goats (*Capra hircus*) and Romanov sheep (*Ovis aries*) toward visitors to Zoo Atlanta's contact yard could be reduced by the nearby presence of a zookeeper to individual animals in the contact yard.

CRITICAL DISTANCES, FEARFULNESS, AND BREED CHARACTERISTICS

Both domestic goats and sheep are members of the ungulate family *Bovidae.* As prey animals, goats and sheep are adapted to avoid predators. Both monitor their flight distance and rely on quick escapes when threatened (Grandin, 1987). Observations of domestic animals in the presence of humans have revealed that these animals will maintain a critical distance around their bodies by allowing or preventing the approach of humans (Hart, 1985). A breach in critical distance may result in an animal's exhibiting escape, avoidance, and aggressive behaviors to restore the critical distance (Hediger, 1964). As human density increases in confined spaces such as contact yards, it may become increasingly difficult for animals to maintain critical distances; thus, aggressive or escape behaviors may be initiated in attempts to restore and maintain critical distances. A previous study (Anderson, Benne, Bloomsmith, & Maple, 2002) found a positive relation between human density and undesirable behavior in support of this explanation.

Sheep aggressive and escape behaviors include rearing, charging, foot stamping, head butting, head tossing, threat jumps, rigid alarm posture, nose blowing, and sudden movements toward conspecifics (Geist, 1971). Goat aggressive and escape behaviors include rearing, charging, foot stamping, head butting, and head tossing (Geist, 1965). Despite the similarity in aggressive and escape behaviors, goats and sheep appear to react differently to humans. The African pygmy goat was bred in the United States as a companion animal (pet), and this breed is described as adaptable in new encounters and particularly gregarious (Porter, 1996). Romanov sheep were bred not as pets, but for their wool and meat (Maijala, 1997). Several breed comparison studies suggest that Romanov sheep exhibit a higher tendency to avoid, keep the greatest distance from, and display more fear of hu-

mans than do several other sheep breeds (Hemsworth, Barnett, Treacy, & Madgwick, 1990; Le Neindre, Boivin, & Boissy, 1996; Le Neindre, Poindroin, Trillat, & Orgeur, 1993; Romeyer & Bouissou, 1992). Results of an earlier study at Zoo Atlanta demonstrated that African pygmy goats exhibited a lower rate of undesirable behavior than did Romanov sheep in a contact yard setting (Anderson et al., 2002). This higher rate of undesirable behavior in Romanov sheep is consistent with other behavioral measures, indicating their greater fear of humans.

Fear can be described as a powerful and aversive emotional state triggered by environmental stimuli (Boissy, 1995). It also is acknowledged that sheep and other domestic animals exhibit fear reactions to the presence and approach of humans (Anderson et al., 2002; Bouissou & Vandenheede, 1995; Le Neindre et al., 1996; Le Neindre et al., 1993; Romeyer & Bouissou, 1992; Vandenheede & Bouissou, 1993; Vandenheede, Bouissou, & Picard, 1998). However, their reactions to familiar caregivers, handlers, and animal keepers may be different because these persons typically administer both rewarding and aversive procedures. Some studies suggest that the behavior of sheep, pigs, and cattle toward individual humans are based on their individual experiences with that human and are not simply generalizations from previous encounters with all other humans (Rushen, Taylor, & de Passille, 1999). Thus, in a contact yard, the presence and approach of a familiar human caretaker may not elicit a fear reaction from the contact yard animal. In addition, the nearby presence of a familiar human caretaker may mediate undesirable behavior exhibited toward contact yard visitors.

PURPOSE AND HYPOTHESES

In this study, we hypothesized that the distance between zookeeper and animal would be a factor in the rate of undesirable behaviors exhibited by the contact yard animals toward visitors. Specifically, because keepers have mostly positive and neutral experiences with the animals (daily feeding, positive reinforcement behavioral training, facility maintenance), we hypothesized that the presence of a keeper near an animal would be associated with lower rates of undesirable behavior in comparison to the rate of undesirable behavior directed at visitors when keepers were distant. Based on the previously discussed findings, we expected also a species effect, with the sheep exhibiting a higher rate of undesirable behaviors than did the goats.

METHOD

Subjects and Setting

The subjects of this study are 7 adult female African pygmy goats and 4 adult Romanov sheep (2 male and 2 female) living in Zoo Atlanta's contact yard. The

goats were introduced into the contact yard at an average age of 5 weeks, and the sheep were introduced at an average age of 32 weeks. At the beginning of this study, three goats were 7 years old, and four goats were 5 years old. All the sheep were 5 years old. All subjects were captive born; however, their early rearing conditions are unknown.

The contact yard zookeepers were 4 women and 1 male. Each had worked in the yard for more than 3 months. The keepers were responsible for feeding, behavioral training, performing all routine husbandry procedures, maintaining the facility, and monitoring visitor interactions with the animals. The keepers also were present during all veterinary procedures. Prior to admitting visitors into the yard, the keepers issued verbal instructions on proper petting techniques. Contact yard visitors ranged from toddlers to adults.

The contact yard is corral style and the animals' full-time habitat. Yard 1 was approximately 233 m^2 and contained a barn, shed, covered feeder, shade structure, a pool of fresh water, two climbing structures, and four nest boxes. Access to the barn and the shed (retreat space) was restricted to zookeepers and the animals; visitors had only visual access and were not allowed to enter the retreat space. Except for the barn and shed, visitors had full access to Yard 1. Yard 2 was approximately 67 m^2 and contained three climbing structures. For husbandry reasons, Yard 2 was gated and closed to both animals and visitors. The contact yard was occasionally closed during testing because of extreme weather conditions and various animal husbandry and veterinary procedures.

Procedure

Using a focal scan sampling method (Altmann, 1974), each of the 11 animals was studied unobtrusively. Data collection occurred between the hours of 10:00 a.m. and 12:00 p.m. and between 1:00 p.m. and 3:00 p.m. in June and August 2001. The observation period was for 1 hr, and scans were made every 10 sec during that period. Observations were discontinued if the yard was empty of visitors for 20 min. One data collector recorded behaviors for the entire experiment. Standing outside the contact yard, the data collector recorded the following: (a) the focal animal's head tossing, head butting, foot stamping, rearing, nose blowing, and sudden leaves from a human (undesirable behavior); (b) the number of touches the focal animal received from visitors (visitor touches); (c) the number of visitors in the yard (visitor density); and (d) the distance between keeper and focal animal (keeper–animal distance).

Keeper–animal distance was recorded as either close or distant. Zookeepers were instructed before data collection to stay either close to or distant from the focal animal. Only one keeper was allowed in the yard during data collection, and that keeper maintained the appropriate distance to the focal animal by moving ei-

ther toward or away from the focal animal. Separation of keeper and animal by less than two focal animal body lengths—but not in contact—was defined as close. Typically, keepers stayed within one body length of the focal animal. Distant was defined as the keeper and animal being more than two focal animal body lengths away—but less than four body lengths. Keepers typically stayed about three body lengths away from the focal animal. Keepers were not allowed to carry food during the observation period. A total of 47.53 hr of data were analyzed for the entire experiment: 14.63 hr at distant keeper–animal distance and 32.90 hr at near keeper–animal distance.

Statistical Analysis

The data were analyzed with descriptive statistics and linear regression methods. The regression analyses used the forward stepping method with an F enter criterion of $p < .05$ and listwise deletion of missing data. For the data, the assumptions of normality, linearity, independence, and equality of variances were evaluated and met. For statistical analysis, the number of visitors in the contact yard was divided into four categories representing low (1 to 5 visitors), medium (6 to 10 visitors), medium high (11 to 15 visitors), and high (15 to 28 visitors) levels of visitor density. Animal species, visitor density, keeper–animal distance, and the rate of visitor touches (the number of visitor touches per hr) were used as predictor variables. The dependent variable was the rate of undesirable behavior (the number of undesirable behaviors exhibited per hr). All results reported were significant at the $p < .05$ level.

RESULTS

A linear regression analysis was conducted to predict the rate of undesirable behavior from the predictor variables of animal species, visitor density, keeper–animal distance, and the rate of visitor touches. Animal species, visitor density, and keeper–animal distance predictor variables were coded in the regression analysis as follows: animal species as 0 = goats and 1 = sheep; visitor density as 1 = low, 2 = medium, 3 = medium high, and 4 = high; and keeper–animal distance as 0 = near and 1 = distant.

Table 1 displays the analysis of variance summary table for the regression models. The results indicate that the rate of visitor touches, animal species, and keeper–animal distance related significantly to the rate of undesirable behavior. The regression equations for predicting the rate of undesirable behavior were different statistically from zero for the initial, second, and final regression models as indexed by the F test. The predictor variable visitor density was not statistically re-

TABLE 1
Analysis of Variance Summary Table for the Regression Models

Model	*Source*	*df*	*Sum of Squares*	*Mean Square*	*F*	*p*
1[a]	Regression	1	82.57	82.57	23.07	.001
	Residual	103	368.65	3.58		
	Total	104	451.22			
2[b]	Regression	2	99.11	49.55	14.36	.001
	Residual	102	352.11	3.45		
	Total	104	451.22			
3[c]	Regression	3	114.28	38.09	11.42	.001
	Residual	101	336.94	3.34		
	Total	104	451.22			

Note. The dependent variable was the rate of undesirable behavior.
[a]Predictors: (constant), rate of visitor touches. [b]Predictors: (constant), rate of visitor touches, animal species. [c]Predictors: (constant), rate of visitor touches, animal species, keeper–animal distance.

lated to the rate of undesirable behavior, as this variable did not met the *F* enter criterion and thus was not entered into the initial, second, or final regression model. Concern for a possible interaction between the predictors' keeper–animal distance and the rate of visitor touches led us to include an interaction/cross-product term hierarchically for a subsequent fourth model. There was not a significant change in the *F* test associated with including the interaction term in the model (significance of *F* change = 0.89), indicating that a significant interaction was not present. Hierarchical inclusion of the interaction term as a fourth model produced an *F* statistic of $F(4, 100) = 8.49$, $MSE = 28.59$, $p < .001$.

The sample R^2 for the final model with predictors of the rate of visitor touches, animal species, and keeper–animal distance was .25, indicating that 25% of the variance in the dependent variable was explained by the regression model (Table 2). Table 2 also displays the significance level of changes in the *F* statistic with the addition of predictors in each model.

The results displayed in Table 3 indicate that the final regression equation predicting the rate of undesirable behavior was $Y'_{\text{Rate of undesirable behavior}} = \text{constant} + b_1 \times X_{\text{Rate of visitor touches}} + b_2 \times X_{\text{Animal species}} + b_3 \times X_{\text{Keeper–animal distance}}$. The significance levels of the *t* tests presented in Table 3 indicate that the unstandardized beta coefficients b_1, b_1, and b_3 were significantly different from zero in the final model. The unstandardized beta coefficient indicated a negative relation between keeper–animal distance and the rate of undesirable behavior, such that near keeper–animal distances were associated with higher rates of undesirable behavior and distant keeper–animal distances were associated with lower rates of undesirable behavior. The unstandardized beta coefficients indicated a positive relation between the rate of visitor touches and the rate of undesirable behavior. In addi-

TABLE 2
Regression Model Summary

Model	*R*	R^2	*Adjusted* R^2	*SE*	*Sig. F Change*
1[a]	.43	.18	.18	1.89	
2[b]	.47	.22	.20	1.86	.03
3[c]	.50	.25	.23	1.83	.04

Note. Sig. *F* change = significance level of changes in the *F* statistic with the addition of predictors. [a]Predictors: (constant), rate of visitor touches. [b]Predictors: (constant), rate of visitor touches, animal species. [c]Predictors: (constant), rate of visitor touches, animal species, keeper–animal distance.

TABLE 3
Regression Coefficients for the Regression Models

Model	*Predictor Variables*	*b*	*SE*	*t*	*p*	*Partial Correlations*
1	(Constant)	0.71	0.22	3.25	.002	
	Rate of visitor touches	0.13	0.03	4.80	.001	.43
2	(Constant)	0.41	0.26	1.61	.11	
	Rate of visitor touches	0.13	0.03	5.00	.001	.44
	Animal species	0.84	0.38	2.19	0.03	.21
3	(Constant)	0.92	0.35	2.66	.01	
	Rate of visitor touches	0.11	0.03	3.99	.001	.37
	Animal species	0.82	0.38	2.17	.03	.21
	Keeper–animal distance	–0.81	0.38	–2.13	.04	–.21

tion, the unstandardized beta coefficients showed a positive relation between animal species and the rate of undesirable behavior, such that lower rates of undesirable behavior were associated with the goats and higher rates with the sheep. Descriptive statistics of mean and standard error of the rate of undesirable behavior and the rate of visitor touches are displayed in Table 4.

DISCUSSION

The effect of keeper–animal distance on the rate of undesirable behavior was opposite to our expectations. We predicted that the nearby presence of a familiar keeper would exert a calming influence on contact yard animals and thus be associated with lower rates of undesirable behaviors exhibited toward visitors. The results indicated the opposite: Near keeper–animal distances were associated with higher rates of undesirable behavior, and distant keeper–animal distances were associated with lower rates of undesirable behavior. The higher rate of undesirable behaviors when keepers were near may be due to three possible interrelated factors.

TABLE 4
Mean and Standard Error for the Rate of Undesirable Behavior and Visitor Touches

		Near				*Distant*			
Animal Species	*Visitor Density*	*M Rate of Undesirable Behavior*	*SE*	*M Rate of Visitor Touches*	*SE*	*M Rate of Undesirable Behavior*	*SE*	*M Rate of Visitor Touches*	*SE*
Goats	Low	1.30	0.55	2.55	0.78	0.64	0.28	1.95	1.05
	Medium	0.81	0.26	8.06	3.64	0.72	0.17	2.27	0.61
	Medium high	2.04	1.10	10.35	4.35	0.40	0.08	2.43	0.65
	High	1.85	0.74	7.73	2.55	0.37	0.17	2.52	0.90
	Total	1.56	0.38	7.27	1.53	0.50	0.09	2.34	0.44
Sheep	Low	2.88	1.66	1.54	0.99	0.27	0.09	0.46	0.46
	Medium	5.92	2.62	12.79	9.78	0.88	0.28	1.97	1.27
	Medium high	2.47	1.17	9.58	2.55	1.34	0.64	1.83	0.52
	High	0.65	0.41	3.91	1.81	0.75	0.33	1.32	0.95
	Total	2.72	0.82	6.61	2.34	0.80	0.19	1.39	0.43
Total	Low	1.87	0.69	2.18	0.60	0.50	0.18	1.41	0.70
	Medium	2.66	1.18	9.78	4.00	0.78	0.14	2.16	0.56
	Medium high	2.20	0.79	10.07	2.82	0.74	0.26	2.21	0.44
	High	1.47	0.53	6.52	1.85	0.48	0.15	2.16	0.69
	Total	1.96	0.38	7.04	1.27	0.60	0.09	2.02	0.33

First, the sheep and goats may or may not have been able to distinguish their keepers from zoo visitors. Several experiments report the failure of pigs, chickens, and cows to discriminate between different animal handlers or between familiar and unfamiliar humans (Hemsworth, Coleman, Cox, & Barnett, 1994; Hemsworth, Price, & Borgwardt, 1996; Hemsworth, Verge, & Coleman, 1996; Jones, 1994). Instead, these animals tended to generalize aversive experiences with one animal handler to all humans. Thus, the goats and sheep may have considered the nearby presence of their keepers as simply the nearby presence of another human to escape or avoid.

Other experiments report that pigs, cows, and sheep are able to discriminate between different humans (de Passille, Rushen, Ladewig, & Petherick, 1996; Fell & Shutt, 1989; Munksgaard, de Passille, Rushen, Thodberg, & Jensen, 1997; Tanida, Miura, & Yoshimoto, 1995). Fell and Shutt (1989) found sheep who received an aversive procedure from an animal handler kept farther away from that animal handler than did sheep not receiving the aversive procedure. In addition, when the sheep receiving the aversive procedure and the sheep not receiving the aversive procedure were observed with the animal handler responsible only for feeding, there was not a difference in the distances maintained between sheep and handler.

Thus, sheep may be able to distinguish among their human caregivers and base their behavior to individuals according to past interactions with that individual.

Second, if the goats and sheep in the contact yard were able to discriminate their keepers from other humans, then the goats and sheep may have exhibited behaviors that were more undesirable when the keepers were near because of a possible negative bias toward the keepers. The relations between Zoo Atlanta animal keepers and animals are not composed of solely positive events. Keepers are responsible for positive (feeding and behavioral training using positive reinforcement), neutral (facility cleaning and monitoring visitors), and occasional aversive procedures (isolation and restraint for husbandry and veterinary procedures). Although most interactions are positive, infrequent aversive experiences may influence the animals' perception of their keepers. Rushen et al. (1999) wrote that inadvertently we may reinforce an animal's natural fear of humans by not balancing the occasional aversive procedure with daily positive and neutral experiences. Thus, the goats and sheep may have exhibited behavior that was more undesirable when the keepers were near than when the keepers were distant because of a possible imbalance among positive, neutral, and aversive events.

Last, the continual nearby presence of a keeper may have been more strongly associated through conditioning with an impending aversive procedure (however infrequent) than with a rewarding procedure. Anticipation of this aversive event may have resulted in heightened vigilance, stress, and undesirable behavior in the animals.

We hypothesized that the African pygmy goats would exhibit lower rates of undesirable behavior than would the Romanov sheep because this goat breed typically interacts well with humans (Porter, 1996). Because several reports indicate that Romanov sheep are highly fearful of humans, they were expected to exhibit a higher rate of undesirable behaviors (Anderson et al., 2002; Hemsworth et al., 1990; Le Neindre et al., 1996; Le Neindre et al., 1993; Romeyer & Bouissou, 1992). Our findings supported this hypothesis: The goats exhibited a lower rate of undesirable behavior than did the sheep—both when the keepers were near and when they were distant.

Contrary to findings in an earlier study by our group revealing no relation between visitor touches and undesirable behavior (Anderson et al., 2002), in this study the rate of undesirable behavior increased as the rate of visitor touches increased. In addition, in our previous study undesirable behavior increased linearly with increasing visitor density (Anderson et al., 2002). However, a linear relation between undesirable behavior and visitor behavior was not found in this study. The implementation of full retreat spaces (areas in the yard where visitors have only visual access to the animals) 1 year prior to this study may explain why we did not find a relation between visitor density and undesirable behavior. Specifically, the presence of retreat spaces in the contact yard may moderate the effects of visitor density on undesirable behavior.

The results of this experiment indicated that the nearby presence of a familiar keeper was not an effective method of mitigating undesirable behavior in the contact yard animals. The close presence of a keeper actually was associated with higher rates of undesirable behavior among adult contact yard animals. Future research on moderating undesirable behavior should explore the effects of positive reinforcement training to encourage behaviors incompatible with the undesirable behaviors documented here—desensitization training of animals being approached and handled by unfamiliar humans and the effects of increasing positive keeper–animal interactions in relation to aversive interactions.

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