

BRIEF REPORT

Failure of a Chemical Spray to Significantly Reduce Stereotypic Licking in a Captive Giraffe

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The repetitive licking of nonfood substrates is a common stereotypic behavior in captive giraffes. In this study we attempted to reduce stereotypic licking in a Masai giraffe (*Giraffa camelopardalis tippelskirchi*) by applying a bitter chemical (marketed as a taste deterrent to prevent the unwanted licking and chewing of substrates) to the areas of the fence licked most frequently by the giraffe. We hypothesized that this treatment would reduce stereotypic licking. However, there were no significant overall changes in stereotypic licking following treatment with the chemical spray. Although licking of the treated area was observed to decrease, the behavior increased in nontreated areas. These results suggest that the underlying motivation driving the behavior was not affected by the aversive stimulus. Because stereotypic licking in giraffes may be based on a motivation to use their tongues in foraging, more effective techniques for reducing stereotypic fence-licking in giraffes may include increasing feeding duration by increasing the quantity, processing time, or distribution range of food. Zoo Biol 22:601–607, 2003. © 2003 Wiley-Liss, Inc.

Key words: abnormal behavior; oral stereotypies; aversive conditioning; giraffe; animal welfare

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INTRODUCTION

Stereotypic behaviors are defined as invariant patterns of behavior that are regularly repeated by an animal but serve no apparent function or purpose [Mason, 1991]. These behaviors can take many forms [Mason, 1993] and are often used as indicators of an abnormal animal–environment interaction [Carlstead, 1998]. Oral stereotypies, such as bar-chewing, crib-biting, wood-chewing, and tongue-rolling or -playing, have been reported in many species of domesticated ungulates [Dallaire, 1993], and are also prevalent in captive giraffes. A recent survey of zoological institutions revealed that 72.4% of captive giraffes and okapis engage in repetitive licking of nonfood objects or substrates [Bashaw et al., 2001].

Considering the prevalence of stereotypic licking in giraffes and okapis, reducing such behaviors is a management priority. Several techniques can be used to reduce the occurrence of a problem behavior. One such method is aversive conditioning, which attempts to decrease the occurrence of a behavior by associating the behavior with an unpleasant stimulus. Although experimental results on the success of this technique have been mixed (for discussion, see Mazur [1998]), it is commonly used to change the behavior of animals in captive environments (e.g., electric fencing to keep animals in a desired area). Because some acacia species eaten by giraffes produce chemical deterrents that reduce their palatability [Pellew, 1984], it is plausible that aversive conditioning using a chemical designed to reduce the palatability of a substrate might discourage giraffes from performing oral stereotypic behavior. If chemical application could be shown to be effective, this would be a quick and relatively inexpensive solution to the problem of oral stereotypy.

Bitter Apple[®] (Grannick, Rhinelander, WI) is marketed as a powerfully bitter substance to deter horses from chewing on manes, tails, bandages, blankets, and wood. At Zoo Atlanta we applied this chemical to the areas of the fence that were most frequently licked by our giraffes. Because giraffes in the wild are sensitive to the chemical composition of food items [Pellew, 1984], we hypothesized that applying this bitter chemical would reduce licking in treated areas. In addition, we expected that the animals' use of the portion of the exhibit near the preferred licking substrate would decrease when the aversive stimulus was associated with licking.

MATERIALS AND METHODS

Subjects

The subjects of this study were two female Masai giraffes (*Giraffa camelopardalis tippelskirchi*) (Betunia and Kamili) and one male giraffe (Aaron), which were housed in a mixed-species exhibit at Zoo Atlanta. The giraffes were housed on exhibit in a 1.5-acre outdoor yard from approximately 0930 to 1730 hr each day. All three giraffes were housed for the remainder of the day in individual stalls in an indoor barn with full visual, olfactory, and auditory access, but limited tactile access, to each other.

Materials and Data Collection

We conducted this experiment using an ABA design [Saudargas and Drummer, 1996], and collected data using 30-sec instantaneous scan samples [Altmann, 1974] to record the behavior, and location of each giraffe within the exhibit. We also recorded

the location of the stereotypic licking to determine the area of the exhibit to be treated with the bitter chemical spray. In a previous study of giraffe behavior [Tarou et al., 2000b], it was observed that the majority of oral stereotypic behaviors occurred in the afternoon. Therefore, we conducted five 1-hr sessions in the afternoon between 1400–1600 hr. We also collected data during five 30-min data collection sessions in the morning within 1 hr of the release of the giraffes into the exhibit. Morning data collection sessions were added because we were concerned that if no effect of the chemical spray was observed in the afternoon, it could be argued that the spray applied in the morning was no longer detectable or effective in the afternoon. A total of 23 hr of data were collected for each animal.

It was evident from the baseline phase that over 50% of the licking occurred along one particular fence line in the exhibit near the indoor holding facility. Therefore, we applied Grannick's Bitter Apple® (a nontoxic bitter apple spray that can be purchased at most pet supply stores, and has been approved and used by the Zoo Atlanta veterinary staff) as evenly as possible to the preferred fence line for 5 days (the treatment phase). Spraying was done each morning before the giraffes were allowed into the exhibit. The sessions of the treatment phase were not consecutive calendar days, but were consecutive days that the giraffes had access to the yard. The treatment phase was followed by 5 days of a return to the baseline condition, during which time the fence line was cleaned and left untreated. All data were collected from a slightly raised research platform behind one side of the exhibit. This position elicited minimal attention from the giraffes while allowing observers a view of the entire exhibit. Data were not collected in inclement weather, because the giraffes were not allowed in the exhibit when the yard was wet.

Data Analysis

The data were analyzed using 99% confidence intervals (CIs) computed from the baseline data. We considered a change in behavior to be significant if the mean of the treatment or posttreatment data fell outside the CI (for examples of this technique, see Bard and Nadler [1983] and Tarou et al. [2000a, b]).

RESULTS

Kamili and Aaron did not perform the licking behavior often enough to be included in the analysis. Therefore, analyses were conducted only on the behavior of Betunia. Before the fence was treated with Grannick's Bitter Apple®, Betunia was recorded licking the fence line in an average of 24.2% of the scans in the morning and 5% of the scans in the afternoon. Kamili, the other adult female, and Aaron, a young male, did not engage in stereotypic licking during the pretreatment phase in the morning sessions, but were recorded licking in an average of 0.1% and 1.0% of the scans, respectively, in the afternoon pretreatment sessions.

The application of Grannick's Bitter Apple® resulted in a nonsignificant decrease in stereotypic licking on the treated area to an average of 19.7% of the recorded scans in the morning (CI: $-11.8\% < X < 47.8\%$; see Fig. 1a). Stereotypic licking remained lower in the posttreatment phase ($M = 19.3\%$). There was no significant change from baseline pretreatment behavior in the afternoon in either the treatment ($M = 6.5\%$) or posttreatment ($M = 4.8\%$) phases (CI: $-6.0\% < X < 16\%$). There were significant differences in stereotypic licking on the nontreated areas

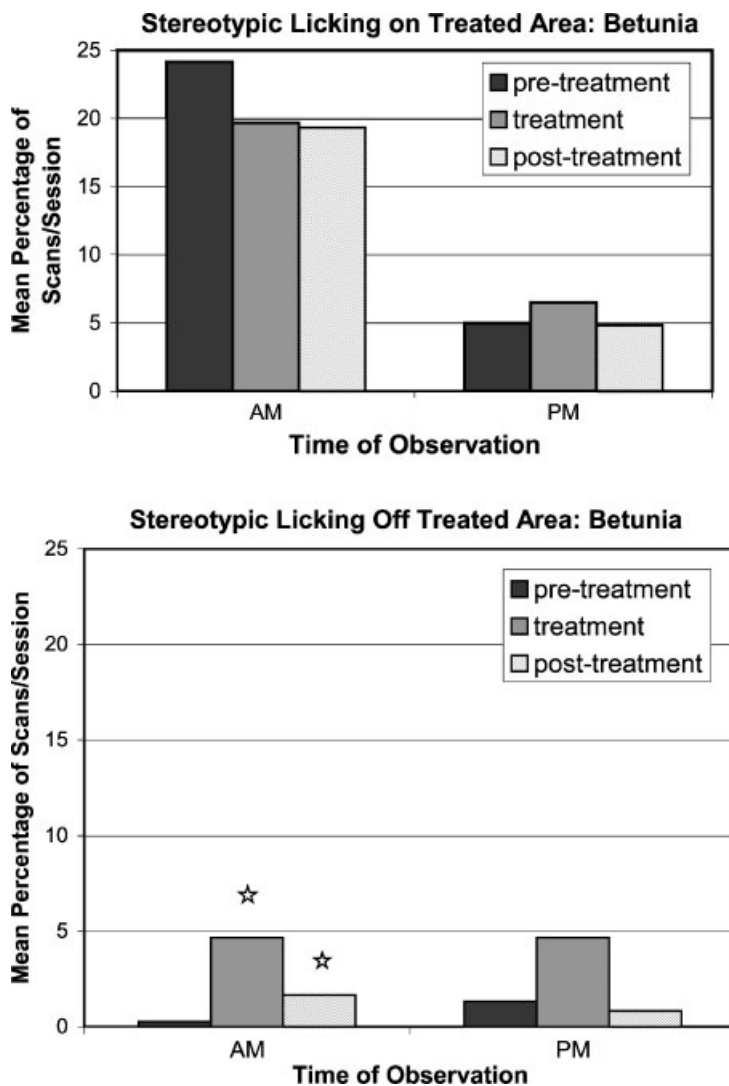


Fig. 1. Mean percentage of scans in which stereotypic licking was recorded for Betunia. **a:** Stereotypic licking of the treated areas of the exhibit. **b:** Stereotypic licking of the nontreated areas of the exhibit. The stars indicate behaviors that fell outside the CI based on the pretreatment rate of stereotypic licking.

following application of the Bitter Apple[®]. In the morning (see Fig. 1b), the decrease in licking of the nontreated area was accompanied by a significant increase from an average of only 0.28% of the scans to 4.7% (CI: $-6.6\% < X < 1.3\%$). Licking of the nontreated area again decreased in the morning in the posttreatment phase, but still occurred in a significantly higher percentage of scans than it had in the pretreatment phase ($M = 1.7\%$). An increase in stereotypic licking of the nontreated area from pretreatment levels ($M = 1.3\%$) also occurred in the afternoon ($M = 4.7\%$), and approached significance by falling just inside the CI of the mean pretreatment level

of licking ($CI: -2.4\% < X < 5\%$). The percentage of scans fell to the pretreatment level in the posttreatment phase ($M = 0.83\%$).

DISCUSSION

The hypotheses that Bitter Apple[®] would significantly reduce stereotypic licking and decrease use of the treated area were not supported by the data. Although licking of the treated area during the treatment phase did decrease from that of baseline levels of licking, the change was not significant. Therefore, it appears that the Bitter Apple[®] spray simply redirected licking to a less aversive area of the fence.

There are several possible explanations for the failure of the Bitter Apple[®] treatment to reduce licking. First, the giraffe may have been unable to detect the spray. This is unlikely, given that giraffes in the wild use chemical cues to determine the palatability of food [Pellew, 1984] and that there was a nonsignificant decrease in licking on the treated areas. It is also possible that the taste is not aversive to giraffes. However, if the taste was undetectable or not aversive, the giraffe should have exhibited no change in licking associated with the application. Instead, there was a trend toward a decrease in licking on the treated area and an increase in licking on the untreated area. It is more likely that the application of the aversive chemical did not work because it did not reduce the motivation of the giraffe to perform stereotypic licking behavior.

Giraffes in the wild spend the majority of their time feeding and foraging on the leaves of acacia trees [Ginnett and Demment, 1997; Pellew, 1984]. It is difficult to remove leaves from an acacia tree, and to do so requires significant manipulations of the tongue [Dagg and Foster, 1976]. However, this type of tongue use is not required to obtain hay or alfalfa from feeders at Zoo Atlanta. We have previously suggested that stereotypic licking in captive giraffes may result from a motivation to use their tongue in feeding, because feeding frequency, method of feeding, and type of food provided to giraffes and okapis are predictive of stereotypic licking [Bashaw et al., 2001]. Experimental studies have found that environmental and husbandry changes, such as increases in feeding duration [Lindstrom and Redbo, 2000; Savory and Maros, 1993; Terlouw et al., 1991] and the amount of roughage in the diet [Redbo and Norblad, 1997], significantly decrease the occurrence of oral stereotypies in domesticated animals. Similarly, captive giraffes perform less oral stereotypies and more ruminating following an increase in the amount of fiber in their diet, which suggests that licking may also be linked to rumination [Baxter and Plowman, 2001]. Whether stereotypic licking is related to feeding motivation [Redbo, 1990] or ruminating motivation [Baxter and Plowman, 2001], it is not surprising that our attempt to decrease licking through aversive techniques failed to eliminate the behavior. Aversive conditioning could not reduce the underlying motivation for the behavior, and thus the behavior was simply displaced. More effective techniques for reducing stereotypic fence-licking in giraffes may include increasing feeding duration by increasing the quantity, fiber content, processing time, or distribution range of food [e.g., Koene and Visser, 1996; Baxter and Plowman, 2001] (Tarou et al., unpublished data).

Oral stereotypies have been shown to be indicative of stress in the environment. For example, Redbo [1990] found that physical restraint caused an increase in

tongue-rolling by dairy cows. Vieuille-Thomas et al. [1995] reported that group-housed pigs exhibited less stereotypic behaviors than stall-housed pigs. Giraffes exposed to a stressful situation, such as separation from a conspecific, respond with an increase in stereotypic licking of nonfood substrates [Tarou et al., 2000b]. Therefore, the welfare of animals exhibiting oral stereotypic behavior may be compromised.

If the presence of stereotypies is indicative of a deficient animal/environment interaction, then a reduction of the frequency of stereotypical behavior may improve the well-being of captive populations of giraffes and okapis. Identifying variables that are related to the performance of these behaviors, as well as variables that are not, is an important step in ultimately reducing stereotypic behaviors in these animals.

CONCLUSIONS

1. The treatment of a substrate with Bitter Apple[®] was effective in displacing, but not eliminating, stereotypic licking by a captive giraffe.
2. Oral stereotypy in giraffes may be linked to a motivation to use the tongue in feeding or rumination. The aversive stimulus failed to reduce stereotypic behavior because it did not decrease or provide an outlet for the motivation underlying the stereotypy.

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