A GRASS FORAGING DEVICE FOR CAPTIVE CHIMPANZEES (*PAN TROGLODYTES*)

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Abstract *Animal Welfare 1994, 3:* 13-24

In the wild, chimpanzees spend most of their time foraging, so any device that stimulates this behaviour in captivity could potentially be effective enrichment. A simple grass foraging device constructed of a polyvinyl chloride (PVC) pipe cut in half lengthwise and planted with rye grass seed was designed to allow captive chimpanzees living in non-grassy enclosures to exhibit foraging similar to that of their wild counterparts. The grass containers were attached to the outside of six different enclosures. Observational data were collected on 14 adult chimpanzees (eight females, six males) within groups of either two or four members. A total of 54 hours of behavioural observations were conducted and comparisons were made across three conditions: baseline; grass container; grass container with extra foraging material (one half cup of sunflower seeds). Subjects used the grass container for 4.0 per cent of their time, but for 19.8 per cent of their time when the grass container with extra foraging material. There was no statistical evidence of habituation to the device. Overall, the grass container only increased time spent foraging when it contained additional food items. Since behavioral benefits associated with this device are few, its potential application is limited.

Keywords: *animal welfare, chimpanzees, environmental enrichment, foraging, psychological well-being*

Introduction

Feeding and foraging make up the most time-consuming activity of wild chimpanzees (Wrangham 1977; Goodall 1986), while foraging in captivity is generally much less time-consuming. In the design of feeding enrichment procedures for captive chimpanzees, it may be useful to use the feeding behaviour of their wild counterparts as a model to simulate (Line 1987; Novak & Suomi 1988; Bloomsmith 1989). Primatologists have suggested that the great reduction in feeding time in captivity is responsible for some behavioural management problems such as certain stereotypical behaviour (Fritz & Fritz 1979; Maple 1980).

Several devices and procedures have been studied that provide primates with opportunities to exhibit natural foraging behaviours in captivity (Nash 1982; Tripp 1985; McGrew *et al* 1986; Maki *et al* 1989; Hayes 1990). Some feeding enrichment strategies have increased

activity, reduced agonism (Chamove & Anderson 1979; Bloomsmith *et al* 1988; Boccia 1989; Brent & Eichberg 1991) and reduced pathologic behaviours (Chamove *et al* 1982; Gould & Bres 1986; Bloomsmith *et al* 1988; Bayne *et al* 1991). It is important to quantitatively evaluate the effects of these enrichment strategies on a variety of behavioural patterns, and to report the results, either positive or negative, so that those designing enrichment programmes can make informed decisions about the value of various feeding enrichment procedures.

The current study quantifies the use of a grass container as a foraging device for adult captive chimpanzees living in enclosures without a foraging substrate. At The University of Texas M D Anderson Cancer Center, chimpanzees living in large, outdoor corrals spend two per cent of their time feeding on grass or foraging for items in the grass (unpublished data). Seeding a ground cover with small foods has successfully increased foraging in several primate species (Chamove & Anderson 1979, 1982; Bloomsmith *et al* 1988; Boccia 1989). The use of a grass substrate helps to simulate conditions in the wild and also allows hiding small foods to promote foraging. However, since some captive primates do not have access to a grassy substrate, a device was designed to offer an opportunity to forage in grass. This study was completed to determine whether this device increased species-typical foraging behaviour, and to assess any other behavioural effects.

Methods

Subjects and housing

The subjects were eight female and six male adult chimpanzees (*Pan troglodytes*) housed at the Science Park chimpanzee breeding facility of The University of Texas M D Anderson Cancer Center. Subjects were housed in six different enclosures with one group of four animals and the remaining subjects in pairs. Subjects lived in indoor/outdoor runs, measuring 2.4 x 6.1 x 2.4m with a concrete floor, resting boards, barred ceilings, and cinder block or chain link fencing separating the runs. The group of four subjects lived in two of these indoor/outdoor runs. During the course of the study, animals were given browse, manipulable objects such as balls, cardboard boxes and plastic barrels, and a variety of feeding enrichment opportunities according to a daily enrichment programme.

Apparatus

A 7.69cm diameter, schedule 40 (thickness) polyvinyl chloride (PVC) pipe 61.5cm in length was capped at both ends and cut in half lengthwise. Two 1.28cm drain holes were cut in the bottom of each pipe (see Figure 1). Supplies for each grass container cost about US$5.67. The containers were filled with potting soil and planted with rye grass seed. When the grass reached about 8cm in height (5 to 8 days after planting), two J-bolts were used to anchor the grass container to the chain link fencing on the front panel of each subject's enclosure. The container was positioned 62cm from the floor, allowing the subjects to use the planter at eye level. The expected behaviour was for a chimpanzee to insert two or more fingers through the chain link fencing to forage or pick grass, without being able to destroy the device.

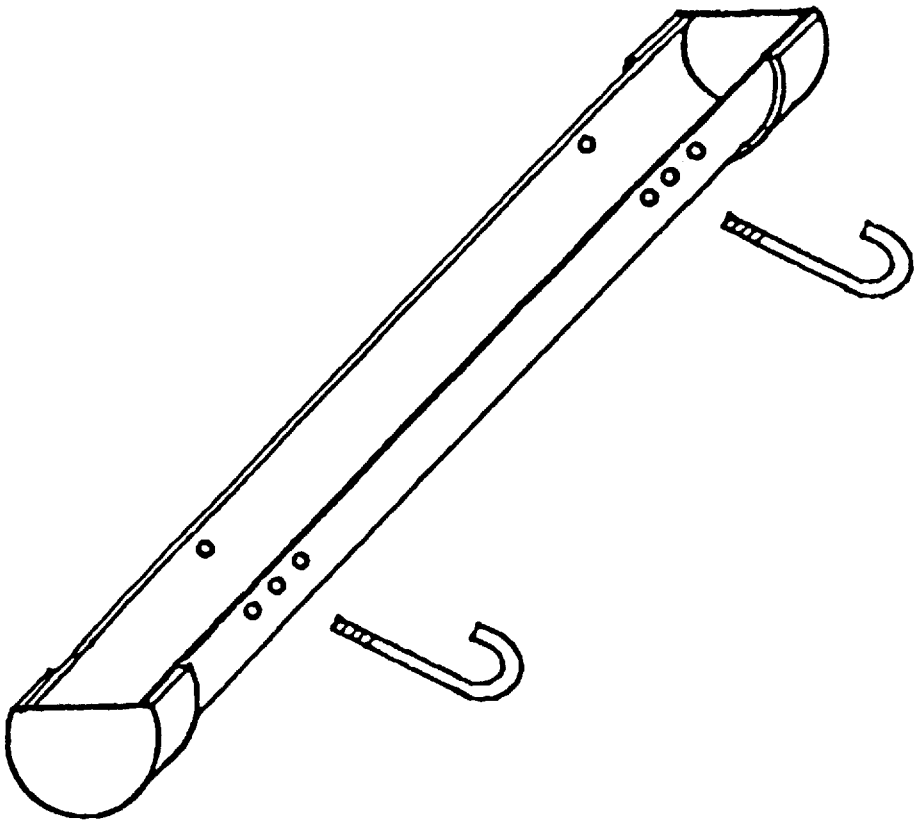

Figure 1 **Design of grass container.**

Procedure

The first condition of the study was conducted as a baseline with no grass container present. Since the enclosures had concrete floors the subjects had no opportunity to forage in a substrate. The second condition consisted of attaching the container with only grass to the front panel of the chain link fencing of the subjects' enclosures. In the third condition, approximately one half cup of sunflower seeds was distributed in the grass, providing extra foraging material. These three study conditions were concurrently completed over a four month period. The conditions were alternated on an unpredictable schedule with the condition determined by the experimenter prior to each session. This methodology eliminates the potential confound of time which would exist if the study conditions were completed sequentially.

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Table 1 Ethogram of recorded behaviours.

Behaviours	Definitions
Abnormal	Coprophagy, urophagy, faeces spreading, hair pulling, head shaking, bizarre posturing, regurgitating, rocking, self-slapping and idiosyncratic other stereotypies.
Agonism	Attacking, hitting, tugging, biting, throwing, threatening, warning barking and brusque rushing, crouching, bobbing, presenting, fleeing, avoiding, bared-teeth, screaming, and pant-grunting.
Sway/display	Standing bipedally or quadrupedally and shifting weight from one side back to the other: this behaviour may evolve into nonvocal or vocal behavioural sequence incorporating drumming, repeated swaying, exaggerated and often bipedal locomoting.
Sexual	Genital exploring of another animal, presenting, soliciting and copulating.
Social behaviour	Picking through hair or skin of another chimpanzee and removing debris with hands or mouth, rough-and-tumble, quiet playing, or play initiating with another animal.
Self/object-directed	Self-grooming, self-inspecting, masturbating, quiet or rough playing with self or in an object (other than the planter), manipulating any inanimate object or part of caging structure that an animal is handling, touching, moving, smelling, mouthing, tasting or carrying.
Locomote	Climbing, brachiating, walking, pacing.
Other	Sitting or standing still, hanging, lying down, sleeping, defecating/urinating, yawning, attending to people or other chimps, eating of any object/food other than the container or forage material.
Out of view	Animal cannot be clearly seen by the observer to record a behaviour.
Grass container use	
Forage in container	Manipulating the substrate or food items in the container while intermittently transferring items to mouth.

Continued

Table 1 *Continued*

Behaviours	Definitions
Manipulate container	Touching, moving, smelling, mouthing or tasting the container. Playing with, shaking, or bouncing the container on the wire (but not shaking the wire as an aggressive act).
Pick grass from container	Removing strands of grass from the container.
Watch other chimpanzee use container	Visual attention directed at another animal in group using container (within 60cm).
Contact with container	All other physical contact with the container not recorded under manipulate the container.
Dominance interaction over container	Displacing other animal in the group for access to container, monopolizing container.
Other container behaviours	Any behaviour not included in the ethogram that is associated with the container. Examples: carrying grass or forage item(s) away from the container, eating or manipulating dirt/grass/forage items while not in contact with the container.

Data collection

A total of 108 thirty-minute observation sessions were completed by two observers between June and October of 1991. An all-subjects scan sampling data collection technique was used, with recordings made every 10 seconds. This inter-sample interval generated 180 data points per subject for each observation session, and was judged to be the shortest interval possible which still maintained acceptable levels of inter-observer reliability. Six observations were collected for each of the six subject groups in each of the three study conditions for a total of 54 hours of data. Subjects were not exposed to the grass containers outside of these observation periods so they had a total of 12 exposures to the containers - six times with grass alone and six times with extra foraging material. The order in which the groups were observed was randomized. Observations were conducted between 0730h and 1130h in the morning. Generally, 10 tests a week were collected. Subjects had access to both the indoor and outdoor portions of the enclosures during 71 per cent of the tests; during 29 per cent of the tests they were restricted to the outside area of the enclosure while the indoor enclosures were being cleaned. Restriction to the outside portion of the enclosure had no effect on grass container use as measured by analysis of variance ($P>0.05$), so no further analysis of that

factor was undertaken and data were collapsed for that factor in the other analyses completed. Inter-observer reliability was 92 per cent when measured by a Kappa coefficient (Martin & Bateson 1986). See Table 1 for definitions of the behaviours recorded.

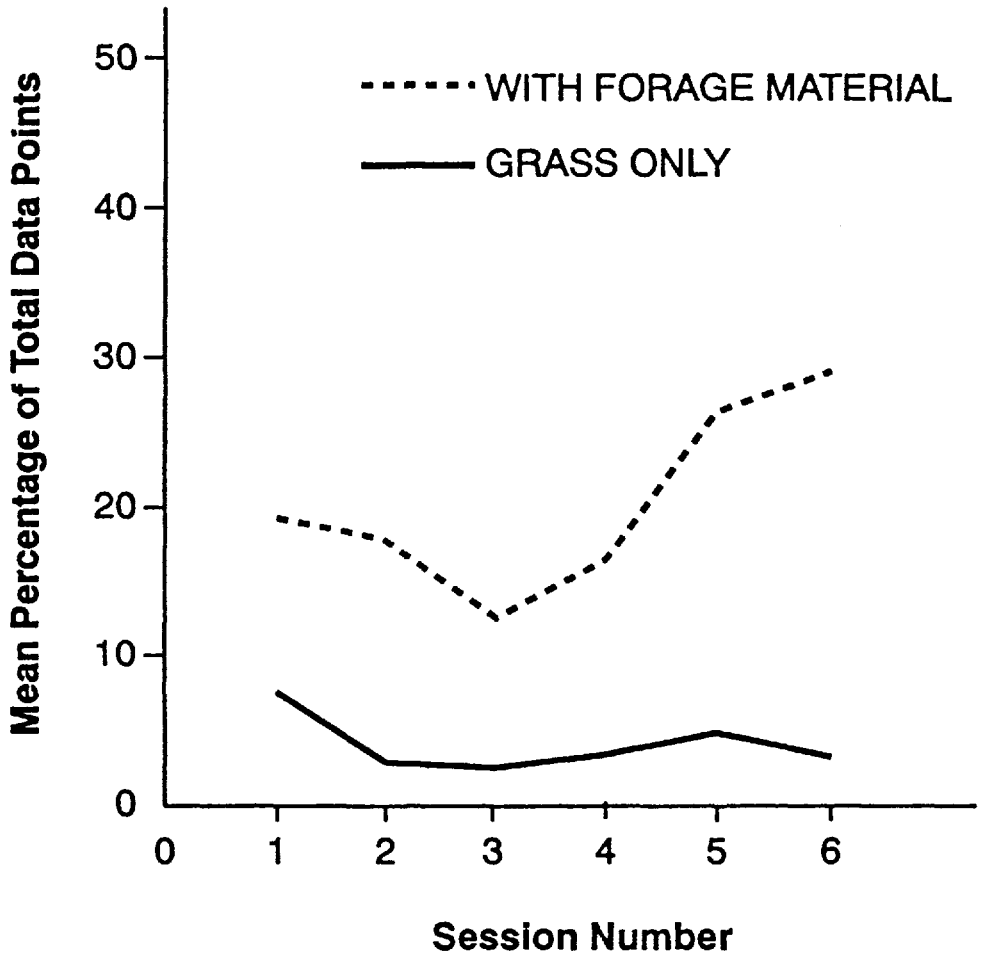

Figure 2 **Mean percentage of container use over repeated exposures for device with grass only or grass with extra foraging material.**

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Analysis

The nine categories of behaviour indicated in Table 1 were used for analysis: abnormal; agonism; sway/display; sexual; social behaviour; self/object-directed (other than grass container); locomote; other and grass container use. The mean percentage of the data points were generated for each of these nine behavioural categories, for each of the 14 subjects within each of the three experimental conditions. These percentage scores served as the unit of measure for statistical analysis.

A Pearson's correlation analysis of container use against time was conducted to test for habituation of container use. A multivariate analysis of variance (MANOVA) for repeated measures was used to analyse the grass container's effect on the mean percentage scores for the nine behavioural categories. ANOVA was used to measure whether there was a sex difference in the amount of container use. To control for Type I errors with the large number of statistical tests performed, significance was defined by $P<0.001$.

Results

A Pearson's correlation analysis of grass container use against time for each of the two experimental conditions was used to test for habituation. No significant correlations were found ($P>0.05$), indicating that the subjects did not habituate either to the container with grass only or to the container with extra foraging material.

A MANOVA for repeated measures revealed an overall significant effect of the grass container among the three conditions (Wilks' Lambda = 0.30; $F = 3.41$; $df = 18, 74$). *Post-hoc* pairwise comparisons revealed that the container with grass did not significantly affect the subjects' behaviour as compared to baseline. However, the container with extra foraging material did significantly affect the subjects' behaviour when compared with the baseline condition as measured by a MANOVA (Wilks' Lambda = 0.42; $F = 5.73$; $df = 9, 37$). The univariate tests showed a significant increase in container use ($F = 45.40$; $df = 1, 45$) when the container with extra foraging material was available. (See Table 2 for mean percentages of behaviours.)

The container with extra foraging material also significantly affected the subjects' behaviour when compared to the container with grass only, as measured by a MANOVA (Wilks' Lambda = 0.46; $F = 4.93$; $df = 9, 37$). The univariate tests showed higher amounts of container use ($F = 29.18$; $df = 1, 45$) when the grass container had extra foraging material (see Table 2 for mean percentages of behaviours; Figure 2).

An ANOVA conducted on container use revealed no influence of sex when subjects had the container with grass only or when they had the container with extra forage material.

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Table 2 Mean percentages of behaviour in the three conditions of the study.

Behaviour	Grass planter		
	Baseline	Grass only	With forage material
Abnormal	1.2	1.1	0.9
Agonism	0.4	0.2	1.1
Sway/display	1.7	2.1	2.1
Sexual	0.05	0.1	0.03
Social	1.5	0.04	0.7
Self/object-directed	4.5	4.2	3.7
Locomote	8.0	7.8	7.9
Other	44.3	41.0	36.4
Grass container use	-	4.0	19.8
Forage in container	-	2.2	11.9
Manipulate container	-	0.6	0.7
Pick grass from container	-	0.2	0.03
Watch other use container	-	0.3	1.1
Contact with container	-	0.4	0.3
Dominance over container	-	0.006	0.02
Other container	-	0.3	5.8

Discussion

The results of this study indicate that only when the grass container had extra foraging material did it effectively change chimpanzee behaviour in a species-appropriate direction by increasing foraging time. The container with grass alone was ineffective in changing the chimpanzees' behaviour. In many enrichment studies subjects habituate to the device or material and use declines over the course of the study (Bryant *et al* 1988; Paquette & Prescott 1988; Bloomsmith *et al* 1990; Pruetz & Bloomsmith 1992). In this study subjects did not habituate to the grass container (with or without extra foraging material) over six different 30-minute exposures. This finding concurs with some other foraging studies that have also shown consistent use over time (Bloomstrand *et al* 1986; Bryant *et al* 1988; Bloom & Cook 1989; Boccia 1989; Bayne *et al* 1991), so the container may be practical for long-term implementation. Both males and females consistently used the device.

The amount of use of the foraging device when it contained extra foraging material (19.8% of the time) in this study generally corroborates the level of foraging found in other studies of enrichment devices to stimulate foraging (Maki *et al* 1989; Hayes 1990; Brent & Eichberg 1991; Bayne *et al* 1991), but no other behavioral consequences were found. Some other studies have reported more widespread effects of feeding devices or techniques beyond influences on foraging. Chamove and colleagues (Chamove & Anderson 1979; Chamove *et al* 1982) documented influences on aggression, inactivity, play and other affiliative behaviour by using woodchip litter sometimes seeded with food. Bloomsmith *et al* (1988) measured lower levels of agonism and abnormal behaviour when a feeding enrichment programme was implemented. Maki *et al* (1989) developed a food puzzle device to simulate termite fishing and found an increase in aggression associated with its use in a large group of chimpanzees. Hayes (1990) constructed a hanging feeder filled with hay and food items for capuchin monkeys which decreased inactivity and locomotion while increasing foraging. A foraging/grooming board reduced abnormal behaviour among rhesus monkeys (Bayne *et al* 1991). Brent & Eichberg (1991) provided a puzzleboard for captive chimpanzees and found reductions in inactivity, aggression, affiliation, and self-directed behaviour.

Even though there were high levels of container use in one condition of the current study, abnormal behaviour was not moderated. An explanation may be that the baseline value for abnormal behaviour, consisting mainly of coprophagy, was low (1.2% of their time). The subjects have been participating in a daily enrichment programme since long before the study began, and perhaps the limit of influence that enrichment could have had on abnormal behaviour patterns in these animals in their current housing situation had already been reached. Some other enrichment studies have also found abnormal behaviour to be resistant to change (Bloomstrand *et al* 1986; Brent & Eichberg 1991; Lambeth & Bloomsmith 1992).

The success of the enrichment device described in this paper was limited to increasing species-typical foraging behaviour while maintaining a higher level of consistent use by chimpanzees of both genders when it contained extra foraging material. This device cannot be recommended to address other behavioural problems such as moderating aberrant behaviour or stimulating prosocial interactions. It is important to report the evaluation of this device even though it did not extensively alter behaviour, because the limitations of enrichment devices should be understood if the devices are to be used appropriately in an enrichment programme. Because of the limitations of this device, other feeding devices might be easier or more effective to use in some circumstances. However, the device was inexpensive and well-suited for captive chimpanzees in this housing situation in terms of safety, ability to be sanitized and ease of installation, although it requires several days for growing the grass. It may be more practical for example, to use this same device as a container for woodchips that could be seeded with food since the subjects did not benefit from the grass alone. This device may be appropriate for other primate species as it could be attached to the outside of many types of enclosures. However, the limited behavioural benefits associated with this device may mean that other feeding enrichment devices should first be considered when trying to design an enrichment programme that would alter many behaviours in species-typical directions, thereby improving psychological well-being.

Animal welfare implications

One method of assessing animal welfare is to objectively measure behavioural indices of psychological health. Some behavioural scientists have argued that the behaviour of wild primates should serve as a model such that the behaviour of captive primates would ideally approximate that of wild primates (Line 1987; Novak & Suomi 1988; Bloomsmith 1989). Many techniques exist to enrich captive primates by altering their environments, some of which can be shown to be beneficial by increasing species-typical behaviour. This study quantifies the use of a foraging enrichment device to measure whether it can change the behaviour of captive chimpanzees to more closely resemble that of chimpanzees in the wild.

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