WOODCHIP BEDDING AS ENRICHMENT FOR CAPTIVE CHIMPANZEES IN AN OUTDOOR ENCLOSURE

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Abstract

The use of woodchips as bedding for 16 juvenile chimpanzees (Pan troglodytes) was evaluated for the effects on behaviour, health and husbandry practices. Woodchip bedding was placed in two outdoor play areas for five consecutive days. Behavioural data were recorded in the morning and afternoon of each day, and compared to pre- and post-test data. A total of 44 hours of observations, made up of 1 hour scan sample sessions, were completed for the study. Behaviours in the following categories were measured: abnormal, affinitive, aggressive, environmental manipulation, inactivity, locomotion, play, self manipulation and woodchip manipulation. The location of each animal was also recorded. Analysis of the data indicated that the chimpanzees engaged in woodchip-related behaviours for an average of 20.52 per cent of the data points, and that they spent more time manipulating the substrate in the morning than in the afternoon. In addition, abnormal behaviour, environmental manipulation and affinitive behaviours were significantly lower during the woodchip condition than during pre-test and post-test conditions. The subjects spent the most time on the floor of the enclosure, and this measure did not differ between conditions. The woodchip bedding did not cause any known health problems for the chimpanzees. Although the daily addition and removal of woodchips took more time than did routine cleaning, it kept the play areas cleaner and drier. The evaluation of woodchip bedding as enrichment was favourable and indicated that bedding may be used regularly in the maintenance of captive chimpanzees.

Key words: *animal welfare, chimpanzees, enrichment, husbandry, woodchip bedding*

Animal welfare benefits

Woodchip bedding improved the captive environment of juvenile chimpanzees by providing them with a substrate to manipulate and to use in play activity. Abnormal behaviours, especially faeces ingestion and manipulation, were reduced when woodchip bedding was available as compared to the bare floor condition. The area with bedding remained drier, and little additional personnel effort was required to maintain the woodchips.

Introduction

The captive environment of non-human primates, and especially how it relates to psychological health, has received much attention in recent years. Numerous techniques have been devised to improve different aspects of the environment, ranging from the addition of toys to the construction of naturalistic enclosures (eg Chamove 1989, Fajzi *et al* 1989). In choosing which are the most effective, recent research has emphasized practical implementation of environmental enrichment schemes in which the needs of the animals, the housing conditions, the animal's response, safety, cost and personnel effort are evaluated (Bloomsmith *et al* 1991). A floor covering is one environmental enrichment option. However, for non-human primates in standard caging systems, the floor is often neglected as an area for improvement (Chamove & Anderson 1989).

Several investigators have demonstrated that bedding has beneficial behavioural effects while providing a clean, cost effective environmental improvement. Chamove and Anderson (1979) reported that aggression was decreased in a group of stumptailed macaques when deep woodchip litter and grain were provided in the outdoor portion of their enclosure. Only a slight increase in personnel time was necessary to provide bedding, and the animal area remained drier and had less odour. These results were extended to include seven monkey and one prosimian species (Chamove *et al* 1982). Woodchips or woodchips and food items were added to the indoor enclosures of each group. The authors found that the subjects spent an increased amount of time on the ground, and decreased abnormal, aggressive and inactive behaviours during the treatment conditions. In addition, microbiological analysis indicated that the bedding became increasingly inhibitory to bacteria with time. Others have reported positive results with the use of a substrate and manipulatable objects for capuchins (Westergaard & Fragaszy 1985). The authors reported that straw and several portable objects placed in the outdoor enclosure elicited greater expression of manipulative tendencies. Individuals with the lowest object contact scores increased this behaviour the most when straw was provided. McKenzie and colleagues (1986) found that arboreal species, such as marmosets and tamarins, spent more time on the floor and decreased their inactivity when woodchips or shredded paper were used as floor covering. Long-term benefits of woodchip bedding, such as decreased stereotyped behaviour, low levels of agonism, and increased exploration have been found for a group of pigtail macaques (Boccia 1989a,b). However, differences between species and group composition may also influence the effect of bedding. A recent study by Byrne and Suomi (1991) reported that increases in activity, exploration, and foraging were noted when woodchips and food items were provided for two groups of rhesus macaques, but no changes were noted in abnormal, aggressive or play behaviours.

Although woodchip bedding has been reported to be an effective enrichment and husbandry practice with many small primate species, quantitative evaluation of the effects of bedding for apes is lacking. The great apes have an affinity for manipulation, and manipulatable objects are important environmental components. Wilson (1982) found

that the presence of manipulatable objects had a pronounced influence on the activity level of apes. Unfortunately, manipulation may also take the form of faeces smearing or coprophagy in captive settings (Hill 1966).

A preliminary study was conducted to determine the efficacy of using woodchip bedding as enrichment for juvenile chimpanzees. Behavioural and positional measures were obtained on the subjects before, during and after bedding was provided. Health and husbandry issues were also examined as they related to this form of enrichment. We expected that the bedding would provide a material for manipulation which might replace behavioural disorders and a cleaner, drier environment for the animals.

Methods

Subjects

Sixteen juvenile chimpanzees (*Pan troglodytes*) housed in two groups of eight served as subjects. One group consisted of four males and four females, while the other group had one male and seven females. Their ages ranged from 3.25 to 4.50 years. Seven had been raised with their mother for 5-13 months and nine were raised in peer groups in a nursery. Housing conditions were identical for each group. They were caged in pairs at night and released to a small outdoor play area (4.75m x 3.58m) for approximately 7 hours daily as weather permitted. While in the play area, the chimpanzees did not have access to the indoor portion of the enclosure. The play area consisted of chain link walls and roof attached to the primary enclosure. Corrugated tin was attached to the roof structure to provide shade, and the floor was made of treated concrete. A concrete curb and 30cm of wire mesh around the perimeter of the play area helped to keep the woodchips inside. The area was bare except for a swinging tyre, balls and a rubber pool. The chimpanzees were fed standard monkey chow, fruit and vegetables, as well as a variety of daily feeding enrichment items. The subjects were not fed during observation periods and received regular feeding while in the indoor cages.

Research design and procedure

Observational data were collected in a pre-test, treatment, post-test repeated measures design (Myers & Well 1991). One hour scan samples with 2 minute intervals were recorded for each group. Half of the observations were completed in the morning (0900h to 1200h) and half in the afternoon (1300h to 1600h). A total of 44 hours of observation was completed for the study during autumn 1990. Pre-test and post-test conditions each consisted of 6 hours of observation per group in the outdoor play area without bedding. During the treatment condition, each group was observed in both the morning and afternoon for five consecutive days with the bedding for a total of 10 sessions per group. For each day of the treatment condition, the drain was covered and *c* 0.2 cubic metres of woodchip bedding was spread in the play area before the subjects were released. The area was cleaned after the chimpanzees were returned to their sleeping quarters.

Table Definitions of behavioural categories.

Behavioural category	Definition
Abnormal	Stereotyped movement, faeces ingest or smear, urine ingest, poke eye, self aggression, self suck, and hair pull and ingestion
Affinitive	Give or receive grooming, embrace, tandem walk, touch, reach out to, follow, beg, sexual behaviour
Aggressive	Bite, hit, kick, lunge, attack using object
Environment	Bite, lick, hold, carry or manipulate caging or toys
Inactivity	Lie, sit or stand
Locomotion	Climb, run, swing, walk
Play	Interactions usually accompanied by play face, including: chase, grab, grab object from, jump upon, kick out at, tickle, wrestle (see Berdecio & Nash 1981)
Self	Groom, scratch, pick or manipulate part of own body
Substrate	Hold, manipulate, taste, nest or play with woodchips

Behaviours were grouped into nine categories (see Table). Inactivity and locomotion were recorded only if they occurred in the absence of other behaviours. In addition, the subject's location was noted for each interval: fence, floor, roof or tyre swing. A portable computer was used to record the data.

Personal observations and interviews with the animal attendant in charge of the two groups of chimpanzees were conducted to determine the effect of using woodchip bedding on personnel time and animal health.

Data analysis

The mean number of occurrences of each behavioural category and location for each chimpanzee were calculated for each experimental condition. A repeated measures analysis of variance was performed on these data with the use of the SAS statistical package (SAS Institute, Cary, NC, USA). Multivariate analysis was used when a sphericity test indicated that the variables were not independent. Social group was used as a categorical factor. Contrasts between treatment and baseline conditions were then evaluated for individual behaviour categories. A value of $p<0.05$ was used to define significance.

Results

Woodchip use

The subjects spent an average of 20.52 per cent of possible data points in woodchip-related behaviours (range 9.57% to 44.3%). The percentage of substrate behaviour showed a gradual decline over the 10 sessions (Figure 1). In addition, a pattern of fluctuation by time of day was noted. Analyzing the difference between AM and PM data indicated that the subjects spent significantly more time manipulating the bedding in the morning sessions than in the afternoon sessions [$F(1,29)=22.95$, $p<0.001$].

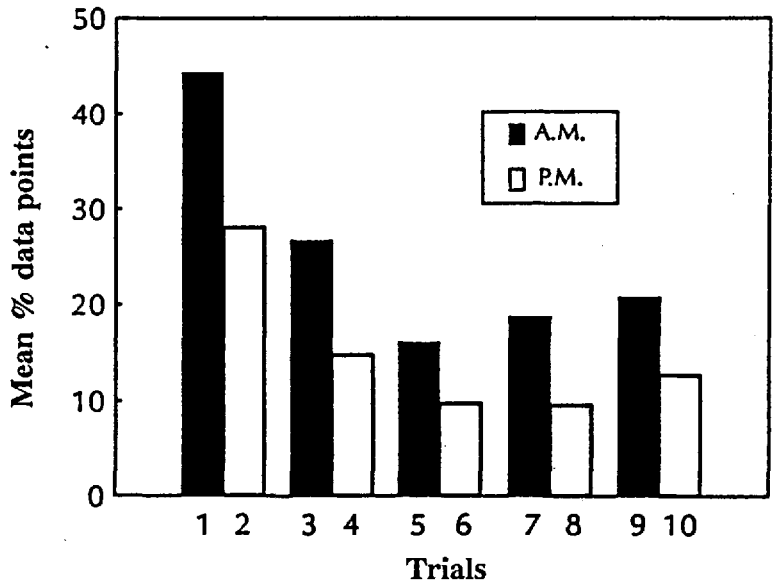

Figure 1 Substrate manipulation over 10 trials. Differences between morning and afternoon means are significant ($p<0.001$).

Behavioural data

Multivariate analysis was applied due to the lack of independence of the behavioural variables as indicated by a sphericity test (Mauchley's = 0.5315, $p<0.016$). Initial analysis showed that the overall effect of the experimental condition was significant (Pillai's trace = 0.921, $p<0.001$), but the difference between groups was not ($P>0.05$). Further analysis of each behavioural category was completed by comparing the pre- and post-test conditions. Play behaviour significantly differed between the baseline measures [$F(1,14)=11.15$, $p<0.005$], but the other seven categories were similar in both conditions ($p>0.13$). Because the subjects' behaviours had returned to levels similar to pre-test measures after the treatment condition, a comparison of the average of the baselines to the experimental phase was completed for all behaviour categories.

Three behaviour categories were significantly lower during the treatment condition: abnormal behaviours [$F(1,14)=72.48$, $p<0.001$]; environmental manipulations [$F(1,14)=41.52$, $p<0.001$], and affinitive behaviours [$F(1,14)=11.97$, $p<0.004$] (Figure 2).

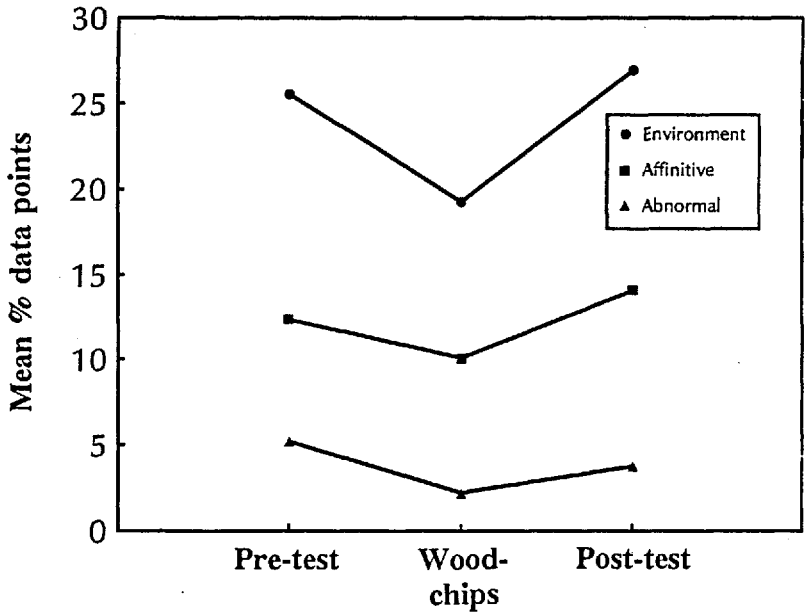

Figure 2 Behaviour categories with significant differences between treatment and baseline measures ($p<0.05$).

Further analysis of the abnormal behaviour category indicated that the peer-reared subjects displayed more abnormal behaviours per session than the mother-reared over the course of data collection (peer n=9, mean=4.07, SD=3.21; mother n=7, mean=2.62, SD=1.17). However, the difference was not statistically significant. In addition, the changes in abnormal behaviour from baseline to woodchip condition were not related to the amount of time the subject was reared with its mother. Faeces ingestion and smearing was one of the most common abnormal behaviours for these subjects. For both groups the pre-test level of 5.5 occurrences per session for this behaviour dropped to 1.4 during the woodchip condition, and increased to 7.8 during post-test. The difference between baseline and woodchip condition was significant [$F(1,14) = 37.50$, $p<0.001$].

Location data

The overall effect of the experimental phases for location was not significant. Because trends were evident in the graphical representation, pairwise contrasts between conditions were performed. Changes in means were evident for the fence [increase from pre-test to woodchip treatment, $F(1,14)=5.17$, $p<0.039$] and the tyre swing [decrease from treatment to post-test, $F(1,14)=6.05$, $p<0.028$]. However, the amount of time spent on the floor was

the category of interest. The chimpanzees were recorded to be on the floor for approximately 75 per cent of the time, and this amount did not differ when woodchip bedding was provided (pre-test 75.50%, woodchip 72.25%, post-test 73.57%).

Health and husbandry

Unlike adult chimpanzees, the juvenile chimpanzees used as subjects did not avoid walking in faeces. The outdoor play area normally had to be disinfected and scrubbed daily to remove faeces which were spread on the walls, fence and flooring. During the study, the woodchips were added and removed daily, which took approximately 30 minutes. The bedding absorbed urine and water, and kept the animals from walking in and smearing faeces around the enclosure. This decreased the amount of time needed for scrubbing the area by approximately 10 minutes per day.

After termination of the study, woodchip bedding was routinely added to the enclosure. Rather than cleaning the area and replacing all the bedding daily, it was decided that spot cleaning was sufficient when the bedding had little soiling. In this way, time was saved in cleaning and money was saved in the cost of the bedding.

The woodchip bedding did not cause any known health problems for the subjects. Although they chewed on the bedding, the chimpanzees were observed to make a wad which they spat out and little bedding was noted in their stool. The type of woodchip bedding used in this study produced dust when moved around the play area. Although this was not a problem in the outdoor area, fine bedding may not be as appropriate in a confined space. Food items that were sticky were not given to the animals in the play area with woodchips because they would often drop the item and then eat it and the clinging bedding. The bedding was advantageous during weather extremes since it kept the animals from contacting the warm or cool cement floor.

Discussion

The woodchip bedding provided young chimpanzees with an appropriate and effective enrichment option, as measured over a 5 day test period. The results of the behavioural analysis were consistent with several studies utilizing monkeys as subjects. The main finding was that abnormal behaviours were reduced during the woodchip condition. Others have reported similar results using woodchips (Chamove *et al* 1982) or woodchips and sunflower seeds (Boccia 1989a). However, no reduction in the abnormal behaviours of rhesus macaques as a result of bedding was found by Byrne and Suomi (1991). These authors noted that this may be related to rearing history. Their peer-reared adult subjects most often exhibited abnormal behaviours. They reasoned that since peer-reared rhesus macaques may be more reactive to stress than mother-reared macaques, the woodchip enrichment may not have been sufficient to reduce abnormal behaviour. Although in the present study the peer-reared chimpanzees did exhibit slightly high levels of abnormal behaviour, the response to the woodchip condition was not related to rearing.

Changes in abnormal behaviour patterns may also be dependent on the type of behaviours considered, particularly in cross-species comparisons. Coprophagy and faeces manipulation were not included in the abnormal behaviours recorded in the studies on monkeys and woodchips, although this is a more common occurrence in the apes (Hill 1966, Walsh *et al* 1982). Obviously, providing woodchips made faeces less accessible to our subjects, this directly influenced the amount of abnormal faeces-related behaviours.

Foraging and exploratory behaviours have been noted to increase when bedding and food items were provided for several monkey species (Boccia 1989b, Byrne & Suomi 1991, Chamove *et al* 1982). The chimpanzees in the present study played with and manipulated the substrate for a large percentage of time, even though no food items were present in the bedding. Perhaps because the chimpanzee has a great interest in manipulating its environment (Maple 1979), woodchips alone were sufficient to incite use. The decrease in other behaviours, such as affinitive behaviours and other environmental manipulations, was probably a result of the increased attention to the substrate. Other investigators have noted results over a longer time period. Social interactions have been reported to decrease when woodchips were added to an enclosure (Byrne & Suomi 1991), and affiliative behaviours were reduced when the environment was made sufficiently interesting by adding woodchips and food items (Chamove *et al* 1982).

Play behaviour has been reported to increase (Boccia 1989a, Chamove & Anderson 1979, Chamove *et al* 1982, McKenzie *et al* 1986), decrease (Chamove *et al* 1982, McKenzie *et al* 1986) or remain unchanged (Byrne & Suomi 1991) when bedding and food items were provided for a variety of species. In the present preliminary study with chimpanzees, play behaviour was reduced from pre-test to treatment but did not return to baseline during post-test. This may be interpreted as the subjects' reaction to the removal of the woodchips, or a reflection of complicated influences of the social and physical environment on play behaviour. Long-term monitoring of the chimpanzees' behaviour with and without a woodchip substrate may clarify the impact on play behaviour.

The attenuation of aggression may be a primary goal of enrichment procedures for socially housed non-human primates. Bedding has been reported to reduce aggression in some cases (Boccia 1989a, Chamove *et al* 1982). However, Byrne and Suomi (1991) noted that in stable groups aggression may already be low and would be affected more by the social environment than by physical enrichment. The levels of aggression in our chimpanzee groups were lower than the levels of any other behaviour category, and did not fluctuate with the addition or removal of the bedding.

Several investigators have noted that both terrestrial and arboreal monkey species spent more time on the floor when it was covered with bedding (Chamove *et al* 1982, McKenzie *et al* 1986). In a study which focused on space utilization by captive chimpanzees, juvenile subjects housed in a multi-room enclosure with resting benches and straw bedding were not found to have spatial preferences (Traylor-Holzer & Fritz 1985). In our study, the subjects' predominant use of the floor recorded during baseline data

collection did not change when woodchip bedding was provided. These findings are probably related to the enclosure design. The enclosure did not contain above ground resting areas, and it appeared that the fence and swing locations were used mainly for short play bouts and locomotion. It is possible that with the addition of small food items to the bedding, time spent on the floor would increase.

The effects of any new enrichment procedure should be carefully weighed with respect to husbandry and health-related issues as well as behavioural effects. Devices which may be appropriate and beneficial to the animals may also be too costly, hazardous or time consuming for the animal handler to use. As Chamove and Anderson (1979) found with macaques, the use of woodchips for juvenile chimpanzees produced a slight increase in husbandry time. The animals' health did not suffer due to the woodchip bedding, and long-term use may indicate other advantages of keeping chimpanzees off the wet, sometimes cool, cement floor. The positive results of the initial behavioural responses of the subject, as well as consideration of husbandry and health, indicated that woodchip bedding was a viable enrichment option for juvenile chimpanzees.

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