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Benefits of positive human interaction for socially housed chimpanzees

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Abstract

*Human interaction as environmental enrichment for chimpanzees (*Pan troglodytes*) and other primates is widely promoted and believed to be of value, but has been subject to little objective evaluation. This study assessed the effects of positive human interaction (eg relaxed treat feeding, playing, and other forms of social interaction compatible with personnel safety) on the behaviour of adult chimpanzees. Subjects were housed indoors in groups of two or three individuals. The level of interaction during routine care and management (ie in the process of cleaning, feeding, and monitoring) represented the baseline condition. The test condition involved a familiar caretaker spending an additional 10 mins per day, 5 days a week, with each chimpanzee. This study was designed to assess carry-over effects of interaction on behaviour outside the context of care staff presence. Therefore, in all phases of the study, data (97 h of focal animal sampling) were collected only when caretakers were absent from the building. During the increased human interaction phase, the chimpanzees groomed each other more and showed lower levels of the following behaviours: regurgitation/reingestion, other oral abnormal behaviours, inactivity, and reactivity to the displays of neighbouring groups. A trend towards reduced agonistic display was also detected. Attempted interactions with the observer shifted significantly from predominantly aggressive to predominantly affiliative in nature. These results suggest that simple, unstructured affiliation between humans and chimpanzees should be a valued component of behavioural management.*

Keywords: *animal welfare, behavioural disorders, captive management, chimpanzees, environmental enrichment, human interaction*

Introduction

For the purposes of refining the behavioural management of chimpanzees (*Pan troglodytes*), the effects of varying the physical and conspecific social environment have been investigated in some detail. In comparison to these factors, the amount and manner of human interaction with chimpanzees is a relatively neglected variable in behavioural management. Those humans who work with captive chimpanzees are familiar with the frequent and varied social interchanges between the two species. Particularly when working with chimpanzees in restricted social housing conditions, such as single caging and pairs, caretakers intuitively perceive their status as potential social partners for chimpanzees.

The relatively widespread opinion that human interaction can enhance captive environments, and recommendations thereupon (eg Markowitz & Spinelli 1986; Wolfle 1987, 1996; Novak & Drewsen 1989; Bennett 1990; Mahoney 1992; National Research Council 1996), have been subject to relatively little objective evaluation in any taxa. With the exception of anecdotal reports, there have been very few objective evaluations of the effect of human interaction on captive primate well-being. Bayne *et al* (1993) found that human interaction associated with treat provisioning resulted in reduced abnormal behaviour in singly housed rhesus macaques. Positive reinforcement training provided as environmental enrichment was also found to reduce abnormal behaviour, as well as anxiety-related behaviour, in singly housed rhesus macaques (Baker *et al* 2003). Positive effects of human interaction as enrichment for great apes have been reported once, by Bloomsmith *et al* (1999). Both positive reinforcement training and less structured interaction conferred benefits to chimpanzees, although the types of behaviours affected varied with the style of interaction provided. Training appeared to benefit social behaviour more broadly, while non-training also ameliorated stereotypic and anxiety-related behaviours (Bloomsmith *et al* 1999).

Another body of research concerning the effects of human interaction on captive primate behaviour relates to positive reinforcement training as a management style. In monkeys, training has been used to foster cooperation during clinical, management, and research procedures (for reviews see Reinhardt 1997a,b; see also Perlman *et al* 2000). In great apes, training has been used to mitigate social aggression during feeding (Bloomsmith *et al* 1994) and is effective for fostering cooperation with management and research routines, such as sample collection (Laule *et al* 1996; Brown & Loskutoff 1998; Lambeth *et al* 2000; Perlman *et al* 2001) and transfer between enclosures (Kessel-Davenport & Gutierrez 1994; Bloomsmith *et al* 1998). Although clearly relevant to reducing stress by obviating invasive and/or aversive techniques such as darting and squeeze-boxing, the effect of training (ie the shift from coercive to cooperative management) on overall welfare remains to be demonstrated.

Table 1 Details of study subjects.

Individual	Sex	Age	Group
Ar	F	16	Trio 1
Be	F	15	Trio 1
Jy	F	16	Trio 1
Ha	F	10	Trio 2
Ro	F	14	Trio 2
Ti	F	15	Trio 2
Bu*	M	15	Trio 3
Mn*	M	15	Trio 3
Jn	M	13	Pair 1
Ma	M	13	Pair 1
Na	M	15	Pair 2
Sa	F	16	Pair 2

*Data from the third member of this trio, a male aged 13 years, were not employed as a result of this individual's illness and removal from the social group during the period of data collection. The other two members of the trio were pair-housed for the remainder of the study.

One other way in which humans influence primate well-being is through their passive presence. Primates that are generally considered habituated to people may in fact still be responding negatively. For example, species subject to heavy predation pressure in the wild may persist in performing anti-predator strategies in response to familiar people (Caine 1992). Routine monitoring or observation of macaques by familiar personnel results in persistent stress responses (Malinow *et al* 1974; Manuck *et al* 1983; Line *et al* 1989). In chimpanzees, it has been found that individuals fight and wound each other more frequently during those times when facilities are subject to more human traffic and activities (Maki *et al* 1987; Lambeth *et al* 1997). Group dynamics in zoo chimpanzees and other species are generally affected in a negative fashion by the presence of large crowds of visitors, which are associated with lower levels of affiliative behaviour and increased aggression (reviewed in Hosey 2000). Negative effects of noisy zoo visitors have also been observed in orang-utans (Birke 2002).

The negative effects that the presence of people can have on captive primates underscores the importance of careful evaluation of human interaction as a form of enrichment, no matter how intuitive the apparent benefit. The present study quantifies the effect of increased positive human interaction on the psychological well-being of chimpanzees. This study involves a group of pair-housed and trio-housed chimpanzees that had previously been studied in investigations of single versus small-group housing (Baker 1996) and bedding/forage as enrichment (Baker 1997). The latter study provides the opportunity to contrast the behavioural effects of two different interventions with the same subjects and housing. The present study aims to assess the effects of increased positive human interaction on chimpanzees housed in small groups, and to compare these effects with those of providing foraging opportunities.

Methods

Subjects and housing

Subjects included seven female and five male adult chimpanzees (*Pan troglodytes*) housed in the Chimpanzee Infectious Disease building at the Yerkes Regional Primate Research Center in Atlanta, Georgia, USA (see Table 1). All subjects had been challenged with Human Immunodeficiency Virus (HIV), but none showed clinical symptoms during the period of data collection. All individuals were nursery-reared except for one mother-reared male. Six individuals were housed in pairs (one male/female, two male/male), and six in single-sex trios. One further individual, a member of an all-male trio, was not included as a subject in the study. Midway through the test condition he was separated from his trio because of serious illness. Therefore, one single-sex trio was reduced to a pair. The social setting of all other subjects remained constant throughout the study period.

All individuals were housed in one building containing interconnecting enclosures with chain link ceilings and cage fronts and solid cement flooring and side walls. Each social group was housed in two or three interconnecting enclosures measuring 3.7 × 3.1 × 2.9 m. Available space per individual ranged from 24.4 to 36.6 m^3. Individuals were able to view other groups across a central corridor. Enclosures contained resting boards and several portable objects. Twice-daily meals included commercial biscuits at every meal accompanied by varied produce or other feeding enrichment at least daily, with water available *ad libitum*.

Procedures

The baseline phase involved twice-daily caretaking visits by care staff. Total care staff presence in the building averaged approximately 2.25 h per day, seven days a week, as it had for at least the previous two years. The test phase also involved twice-daily caretaking visits, but with care staff presence in the building being increased to 4.25 h per day as a result of interaction between one caretaker and the chimpanzees; this averaged 10 mins of extra interaction with each chimpanzee five days per week. The caretaker received no specific instructions associated with participation in the study. Interactions consisted of unstructured bouts of play, grooming, treat feeding and talking, contingent only upon what the chimpanzees initiated, and restricted only by the need for personnel safety. The order of interaction between individuals and the duration of interaction on a daily basis resulted from the caretaker's personal judgement and empathy rather than a predetermined schedule.

Data collection

A total of 97 h of data were collected for this study, approximately 5 h per subject during baseline conditions and 3 h during test conditions. After baseline data were collected, a straw/forage intervention was conducted (for details see Baker 1997). This intervention was concluded six months before the onset of additional human interaction. Data collection during the human interaction phase began three

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Table 2 Definitions of the twelve behavioural categories assessed (indicated in bold).

Behaviour	Description
ABNORMAL BEHAVIOURS	
Regurgitation and reingestion	Deliberate regurgitation; the vomitus may be retained within the mouth or deposited on a surface or the hand and reingested
Other abnormal behaviours with oral components	
Coprophagy	Ingestion of faeces
Eat saliva	Repetitive depositing and sucking up of own saliva
Faeces paint	Smear faeces on a surface with the hands and/or the mouth
Suck thumb	Common usage
Urine drink	Ingest urine
Abnormal behaviours without oral components	
Hair pluck	Pull out own or another animal's hair
Ear poke	Poke finger(s) into one or both ears
Eye poke	Poke one or more fingers into the eye socket
Rock	Repeated rocking not accompanied by elements of an aggressive display
Stereotypy	Unusual idiosyncratic posture, movement, or gesture
TENSION-RELATED BEHAVIOURS	
Display	Piloerection accompanied by at least one of the following: bang, drum, rapid locomotion, slapping, sway, throw, or other bluff elements
Scratch	Rake hair or skin with fingernails
ACTIVITY LEVEL	
Inactivity	Passive or apparently sleeping
Locomotion	Walk, run, suspensory locomotion; pace and stereotypic behaviours are not included in this category
SOCIAL BEHAVIOURS	
Groom	Clean or manipulate the hair or skin of another individual
Play	Gnaw, wrestle, poke, and/or chase another individual, usually with play face
Aggression	Behavioural sequence including at least one of the following: bared-teeth, bite, brusque rush, crouch, flight, scream, tug, waoaw-bark
HUMAN-DIRECTED BEHAVIOURS	
Affiliative	Play invite, present to groom, hold-out hand, clap
Aggressive	Threat gestures, spit, throw faeces

months after the onset of the phase. During all phases, data were collected between the twice-daily caretaker visits. The observer entered the building to collect behavioural data at least 30 mins after the caretaker had left for the morning. No systematic data were collected when the caretaker was present. Therefore the carry-over effects of human interaction, rather than behaviour during visits, were assessed.

Data collection methods were identical to those used in the prior evaluation of straw and forage material (Baker 1997). An instantaneous point sampling technique (Altmann 1974) with 5 min focal animal test sessions and a 15 s inter-sample interval was supplemented with *ad libitum* recording of aggressive interactions and other behaviours of short duration. Individuals were observed according to a pre-defined schedule between 1100 and 1500 h.

Statistical analysis

Table 2 defines the 12 behavioural categories analysed. Data for each individual were pooled across focal tests, and statistical analyses were performed using individuals' percentage of samples for each behavioural category in each of the two experimental conditions. In addition, the prevalence of affiliation in human-directed behaviour was calculated by dividing the number of *ad libitum* observations of this behaviour by the total number of observations of human-directed behaviour (both affiliative and aggressive). Subjects' reactivity was measured by calculating the percentage of neighbour vocalisations and displays that were followed within 5 s by the subject vocalising or displaying. This reaction represents a normal chimpanzee behavioural pattern (Baker & Aureli 1996), but nevertheless is of concern because it can result in intra-group aggression and is an

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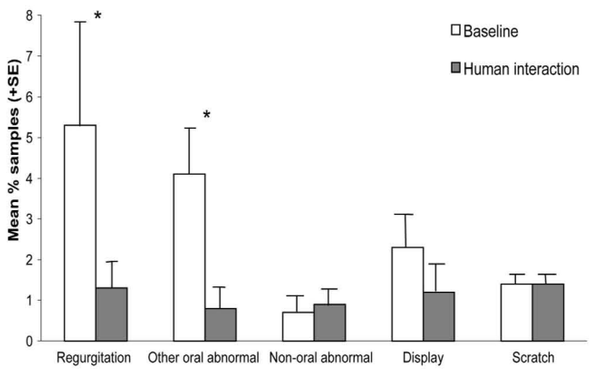
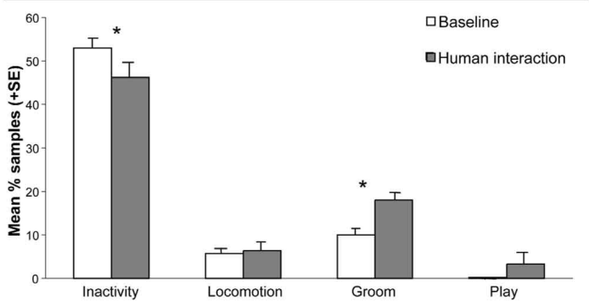
Figure 1



Effect of additional human interaction on levels of abnormal and tension-related behaviours (*$P < 0.05$).

Figure 2



Effect of additional human interaction on levels of activity and social behaviours (*$P < 0.05$).

apparent source of stress to socially housed captive chimpanzees (Baker & Aureli 1997).

Two-tailed Wilcoxon matched-pair signed-rank tests were used for comparing scores in the baseline and test conditions, and alpha was set at 0.05. A *P*-value between 0.10 and 0.05 was reported as a trend.

Results

Removal of data collected on the two males whose social group was altered during the study did not alter the direction of change in any behaviour category analysed and therefore their data are included in the reported results. Baseline results used in this study vary from those previously reported (Baker 1996, 1997; Baker & Easley 1996) because of the exclusion of one subject from the present study (see Methods).

Figures 1 and 2 show levels of behaviours in the baseline and human interaction phases. Both regurgitation/reingestion (n = 11; $T = 9$; $P < 0.05$; see Figure 1) and other abnormal behaviours with oral components (n = 10; $T = 3$; $P < 0.05$; see Figure 1) were significantly reduced during the period of additional human interaction. Non-oral abnormal behaviours, already at very low levels (0.9 ± 0.4% of samples), were not significantly affected (n = 10; $T = 28$; ns). While levels of scratching were not affected by the test condition (n = 12; $T = 39$; ns), there was a trend towards significance for agonistic display (n = 11; $T = 12$; $P < 0.06$), with lower levels being observed during the period of extra human interaction. Subjects spent significantly less time inactive during test conditions (n = 12; $T = 7$; $P < 0.05$; see Figure 2) and groomed each other more (n = 12; $T = 3$; $P < 0.05$; see Figure 2); in fact levels of grooming almost doubled. Aggressive interactions occurred too rarely to permit statistical analysis.

Most of the chimpanzees spent a considerable amount of time attempting to interact with the data collector (5.5 ± 2.8% of samples), who was strictly unresponsive. While the reduction in these behaviours during the period of extra human interaction failed to reach statistical significance for either affiliative (n = 12; $T = 29$; ns) or aggressive behaviour (n = 9; $T = 9$; ns), the proportion of social behaviour that was affiliative in nature increased considerably (n = 11; $T = 6$; $P < 0.05$; see Figure 3).

During the phase of extra human interaction, study subjects were significantly less reactive to the vocalisations and displays of chimpanzees in other social groups (n = 11; $T = 11$; $P < 0.05$; see Figure 3).

Discussion

For chimpanzees housed indoors and in small social groups, providing additional positive human interaction influenced their behaviour in a number of positive ways. Levels of abnormal behaviour fell, subjects were less tense and reactive by several measures, spent less time idle, and engaged in higher levels of affiliative behaviour. These findings are the precise opposite of the effects of passive presence on chimpanzees (Maki *et al* 1987; Lambeth *et al* 1997; Wood 1998).

However, this study does not address the behaviour of the chimpanzees when the interactor was present. Bloomsmith *et al* (1999) found a decrease in grooming and an increase in aggression in the presence of the interactor; probably attributable to competition for attention. Increases in abnormal and anxiety-related behaviours were also found. The present study involved no data collection during interaction. However, even if subjects in the present study showed undesirable changes in behaviour during the 10 mins per day of human interaction, this effect is of minimal significance given the benefits to their behaviour during the bulk of their day. It would nonetheless have been helpful to have information on behaviour during interactions given the contrast in behaviour during, versus outside, the interaction period in the study by Bloomsmith *et al* (1999). One important application of this information would be for interpreting informal assessments during implementation. Many forms of enrichment show behavioural benefits during and immediately following provisioning, but, if measured at all, behavioural responses may not persist when the enrichment is no longer present (eg Bryant *et al* 1988; Bayne *et al* 1992). It is reasonable to expect that people may use the reaction of the chimpanzees during human interaction as a measure of the overall effect of the intervention. What the interactor perceives as her effect on the chimpanzees' behaviour may be

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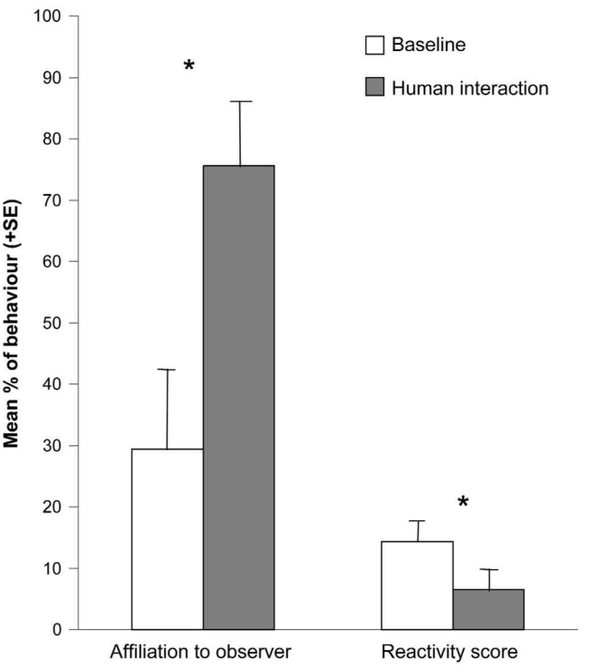
unrelated to, or even the opposite of, the actual effect outside visits. In other words, one should not judge the effectiveness of this technique solely by what occurs during interactions.

Whereas previously only positive reinforcement training has been demonstrated to be effective for improving social dynamics (Bloomsmith *et al* 1994, 1999), in the present study unstructured human interaction benefited social behaviour in several ways. The chimpanzees not only groomed each other at higher levels, but also engaged in non-contact aggressive interactions less and showed less aggressive 'contagion' when others displayed. Anecdotal observations of potentially agitating events (eg visits to the building by unfamiliar people, prolonged activity in the caretakers' workspace adjacent to the animal enclosures without entry to the animal area [personal observation]) are in line with this objective measure of decreased reactivity. This shift may have promoted more relaxed relationships within social groups. This is clearly a positive change since levels of grooming are generally higher in more physically and socially enriched groups of captive chimpanzees (eg Nieuwenhuijsen & de Waal 1982; Bloomsmith *et al* 1988). It is important to note that unstructured interaction, in addition to training, can benefit social dynamics in chimpanzees, since a wider pool of employees can be drawn from to supply a form of interaction requiring less expertise. In fact, the caretaker involved in the present study received no specific instructions or schedule for interacting with the animals, and took the lead from the chimpanzees themselves to determine the sequence and style of interaction. The absence of rigorous rules or instructions for interacting with the chimpanzees makes the results of this study relevant to a situation in which care staff are provided time and support for interacting with the chimpanzees. It should be noted, however, that for personnel safety, as well as for the benefit of the chimpanzees, individuals interacting with chimpanzees should be familiar not only with the species, but also with the individual chimpanzees involved.

The present study found positive effects on more classes of behaviour than did Bloomsmith *et al* (1999). In Bloomsmith *et al* (1999), reductions in abnormal behaviour and aggression were observed. In the present study, these same results were found, as well as reduced inactivity and increased grooming. There are several possible explanations for the contrast in findings. First, the current study involved chimpanzees housed only in pairs and trios, while Bloomsmith *et al* (1999) included study subjects housed in groups numbering from two to seven. It is possible that the higher level of conspecific social opportunities for many subjects decreased the impact of additional social interaction with humans. Second, while the subjects in Bloomsmith *et al* (1999) were housed in indoor/outdoor runs, the subjects in the present study had no access to the outdoors and showed lower baseline levels of well-being than a comparable cohort housed with outdoor access (Baker & Ross 1998). If the baseline level of environmental complexity is lower, the response to an environmental enhancement may be more pronounced. Third, the subjects in the present study were predominantly nursery-reared, while the background of the subjects in Bloomsmith *et al* (1999) was more varied. While unstudied, it is likely that rearing by humans, even when housed with conspecific peers, influences reaction to people in adulthood. Fourth, the social setting remained consistent for all subjects used in Bloomsmith *et al* (1999), whereas two subjects in the present study experienced a reduction in group size during the study. This represents a potential confound, but is unlikely to be responsible for the types of behaviours altered and the direction of change in behaviours. Last, the extra amount of human interaction provided to the chimpanzees was smaller in the study by Bloomsmith *et al* (1999), involving 60 mins per week of extra interaction to each social group regardless of its size. In the present study, groups received 100–150 mins of interaction depending on size. Because so many variables differed between the two studies, their comparison does not suggest that the larger amounts of interaction are of no added benefit. Controlled comparisons of different quantities of human interaction are needed in order to determine realistically implemented manpower efforts with maximal benefit to chimpanzee welfare. It would also be valuable to compare the effect of increased interaction implemented by one person with increased interaction involving visits by a number of individuals, since this could be an especially practical means for boosting overall interaction time with humans.

The results of this study are surprisingly similar to the effects of a different class of enrichment — the addition

Figure 3



Effect of additional human interaction on affiliation to observer (proportion of human-directed behaviour that was affiliative in nature), and reactivity score (proportion of neighbour vocalisations that were responded to with agonistic display) (*$P < 0.05$).

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of straw and forage material — on the same population. Providing constant opportunities for foraging was hypothesised to be the most promising intervention to reduce the high levels of appetitive abnormal behaviours in this population (Baker & Easley 1996; Baker 1997). However, while these abnormal behaviours seemed clearly tied to increasing hunger, increased human interaction appeared equally effective in ameliorating these behaviours; in fact, levels of regurgitation/reingestion and other oral abnormal behaviours were indistinguishable between interventions. Also similar were the decreases in agonistic displaying and increased activity. Affiliative behaviour also increased in the presence of straw and forage. However, in that study it was play rather than grooming that showed an increase. This difference probably relates to the opportunities for play in the presence of straw, which was frequently incorporated in play sessions between animals (Baker 1997). Methodologically, the comparison between the two studies calls into question the necessity of tailoring interventions to the precise nature of the behavioural deficits found in an individual. While tailoring enrichment to the underlying motivation for undesirable behaviours can often be productive (eg Carlstead & Seidensticker 1991), one may not in fact need to restrict oneself to interventions strictly related to the class of behaviour that is undesirable.

Reaction to the observer is perhaps an under-used measure in behavioural management studies. A few exceptions include a comparison of chimpanzee housing configurations (Rice *et al* 1999) and the use of alarm vocalisations in evaluating levels of stress in capuchins (Boinski *et al* 1999). The ability to compare responses to people with other measures of well-being is important for validating the use of this behaviour as a measure of well-being. For example, Boinski *et al* (1999) found concomitant reductions in cortisol and abnormal behaviour in response to increased inanimate enrichment. Singly housed chimpanzees are aggressive to observers more frequently and show higher levels of aggressive and anxiety-related behaviours than do socially housed chimpanzees (Baker 1996). In the present study, the change from predominantly aggressive to predominantly affiliative attempts to engage the observer was accompanied by several other positive behavioural changes. This finding supports the use of reaction to people as a measure of well-being in chimpanzee management studies. This would be a practical addition to data collection since it involves no additional procedures or effort.

Animal welfare implications

Adding 50 mins per animal per week of positive human attention to the management of chimpanzees housed indoors in pairs and trios resulted in improved welfare by several measures: reduced abnormal behaviour, tension-related behaviour, inactivity, aggression towards the observer, and reactivity to the agonistic displays of others, and increased social grooming between conspecifics — all during periods when the interactor was not present. These results confirm the often-perceived notion that human interaction benefits captive chimpanzees, as well as the often-recommended notion that human interaction should be valued as a part of behavioural management.

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