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# The influence of a camouflage net barrier on the behaviour, welfare and public perceptions of zoo-housed gorillas

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## Abstract

*Visitors to zoos can be a potential source of stress to captive-housed primates, resulting in increased abnormal behaviour and intra-group aggression. Finding a way to screen primates from human visitors may be one method of decreasing stress and enhancing animal welfare. For this study, the behaviour of six zoo-housed gorillas was studied for one month during standard housing conditions (control condition) and for a further month following the installation of a camouflage net barrier to the viewing area of the exhibit (barrier condition). Visitors' (n = 200) perceptions of the animals and the exhibit were also recorded during each condition. The net barrier had a significant effect on some components of the gorillas' behaviour. The gorillas exhibited significantly lower levels of conspecific-directed aggression and stereotypic behaviours during the barrier than the control condition. The net barrier also had a slight effect on visitors' perceptions both of the animals and of their exhibit. The gorillas were considered to look more exciting and less aggressive during the barrier than the control condition. The exhibit was also considered to be more appropriate for visitors following the introduction of the camouflage netting. Overall, the addition of a screen such as camouflage netting could be considered a positive change, resulting in a reduction in those behaviours typically induced by large groups of visitors and an improvement in public perceptions of the animals and their environment.*

**Keywords**: *animal welfare, behaviour, enrichment, gorilla, housing conditions, visitors, zoos*

## Introduction

Worldwide, thousands of animals are held in captive conditions, ranging from farms, laboratories and rescue shelters to zoos and safari parks. The welfare of a captive animal may be directly influenced by its environment. It is now well established that impoverished environments can lead to reduced animal welfare (see Broom & Johnson 1993 for review), and many attempts to improve well-being by enriching the environment through the provision of extra stimulation have been undertaken (eg Markowitz 1982; Bloomstrand *et al* 1986; Beaver 1989; Wells & Hepper 1992, 2000; Larsson *et al* 2002; Renner & Lussier 2002; Wells *et al* 2002).

Whilst it is important to pay attention to the captive environment, an animal's welfare may also be directly influenced by stimuli outside its enclosure. Numerous institutions housing animals (eg zoos, safari parks and rescue shelters) are open to the general public. Animals housed at such sites are thus routinely exposed to the sight, sound and/or scent of human visitors. This stimulation, whilst serving many of the suggested goals of environmental enrichment (eg complexity, unpredictability and novelty [Poole 1998]), may also act as a potential source of stress to captive animals (see Hosey 2000 for a review).

Many studies now report that the behaviour of captive-housed animals is significantly altered by the presence of visitors (eg Nimon & Dalziel 1991; Cook & Hosey 1995; Miura *et al* 1996; Wood 1998; Wells & Hepper 2000). Particular attention has been paid in recent years to the impact of visitors on the behaviour of captive-housed primates. Studies suggest that visitors may have detrimental effects on some primates, resulting in changes in the animals' behaviour that are indicative of stress, including, for example, decreased exploration, increased intra-group aggression and/or stereotypies (eg Oswald & Kuyk 1977; Glaston *et al* 1984; Chamove *et al* 1988; Mitchell *et al* 1991; Hosey 2000; Birke 2002).

Finding a suitable method of 'buffering' primates from the sight, sound and/or scent of human visitors would be a valuable exercise, possibly resulting in decreased stress and enhanced animal well-being (Birke 2002). A recent report suggests that zoo-housed gorillas may benefit from the introduction of a camouflage net to the front of their normally glass-fronted exhibits (Norcup 2000). This type of barrier is believed to buffer the animals from the general public, thereby reducing levels of stress in the animals. Unfortunately this particular study failed to record the behaviour of the animals before the introduction of the netting and lacked any form of statistical analysis. The specific effects of such a barrier on the behaviour and welfare of zoo-housed gorillas thus remain unknown.

The following study explores the effects on the behaviour of zoo-housed gorillas of adding a barrier, in the form of camouflage netting, to the viewing area of their enclosure. The



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**Table 1 Information on the sex, age and origins of the six gorillas studied.**

| Name | Sex | Age (years) | Origin |
|---|---|---|---|
| Boulas | M | 16 | Captive-born |
| Kukuma | M | 12 | Captive-born |
| Gugas | M | 7 | Wild-born |
| Delilah | F | 39 | Wild-born |
| Kamili | F | 15 | Captive-born |
| Bakira | F | 6 | Captive-born |

impact of the barrier on visitors' perceptions of the animals and their enclosure is also explored on the basis of reports that public perceptions of captive-housed animals are significantly influenced by the type of environment in which the animals are housed (Shettel-Neuber 1988; Wells & Hepper 2000).

## Methods

### Experiment 1: The influence of a camouflage net barrier on the behaviour and welfare of zoo-housed gorillas

#### *Subjects*

Six western lowland gorillas (*Gorilla gorilla gorilla*) housed at the Belfast Zoological Gardens, Northern Ireland, UK, were studied (see Table 1 for details).

All of the gorillas were housed together in an exhibit consisting of an outdoor grass arena (60 m long × 40 m wide) containing climbing apparatus, and a large indoor den (20 m long × 12 m wide × 7 m high). The latter consisted of a straw-covered concrete floor and a complex climbing apparatus constructed of logs. The gorillas also had individual sleeping quarters, which were at the rear of the indoor den. All animals had free access between the indoor and outdoor enclosures during the day but were confined to the indoor area outside zoo opening hours. The gorillas' enclosures were cleaned thoroughly every morning. The animals were fed once each day, following husbandry duties, with a variety of fruit and vegetables.

Visitors to the zoo were able to view the gorillas' exhibit between 1000–1700 h every day. A glass barrier (7 m high × 12 m wide) separated the visitors from the gorillas in the indoor enclosure, whilst a concrete wall served as the divide in the outdoor enclosure.

#### *Procedure*

The gorillas were studied by one of the experimenters (ECB) for 2 h per day, 5 days a week (Monday to Friday), for a period of one month, to collect baseline information on the animals' behaviour (control condition). The animals were observed from an unobtrusive position in the visitors' indoor viewing area. From this vantage point the experimenter could observe all of the gorillas wherever they were located. The animals were studied at the same time each day (1200–1400 h) to prevent inconsistent exposure to extraneous events (eg feeding and cleaning). Each gorilla's behaviour was recorded every 5 mins throughout the recording period using a scan-sampling technique (eg Martin & Bateson 1986); thus providing 24 observations of each animal's behaviour per day. At each sample point, the behavioural state of each individual was recorded according to an ethogram devised from existing work in this area (eg Hoff *et al* 1997) and from pilot observations of the animals' behaviour (see Table 2).

Following the collection of baseline data, the camouflage netting (see Figure 1) was fitted to the visitors' side of the glass barrier in the indoor enclosure. The netting covered the entire viewing area. Whilst it was still possible to see the gorillas by looking between the artificial leaves on the netting, 20 additional 'peep-holes' (approximately 15 cm × 10 cm) were cut into the net at different heights to facilitate the public's viewing of the animals. The gorillas were held in the outdoor enclosure during installation of the net to ensure they were not frightened by the extraneous noise involved in its fitting. Following installation of the netting, the gorillas were allowed back into their indoor enclosure and their behaviour was recorded for a subsequent one-month period (barrier condition) using the same procedure employed for the control condition.

#### *Data analysis*

The number of times each animal was observed performing each behaviour was summed for each of the two conditions, providing an overall frequency count per gorilla per behaviour per condition. For each behaviour (eg standing, sitting, aggression, abnormal, etc), a repeated measures design ANOVA (eg Howell 1992) was conducted with gorilla sex (male/female) as a between-subjects factor and condition (control/barrier) as a within-subjects factor, to determine whether the animals' behaviour was influenced by the presence of the camouflage netting and/or by the individual's sex.

For behaviours that were influenced by the net barrier, a mixed-design ANOVA was subsequently performed with gorilla sex as a between-subjects factor and week of study (week 1, week 2, week 3, week 4) as a within-subjects factor, to determine whether the gorillas' behaviour changed over the one-month period of exposure to the netting.

The assumptions underlying parametric analysis (eg Howell 1992) were sufficiently met in terms of population normality, sample independence and homogeneity of variance (confirmed using Mauchly Sphericity and Kolmogorov-Smirnov tests).

### Experiment 2: The influence of a camouflage net barrier on public perceptions of zoo-housed gorillas and their exhibit

#### *Participants*

Two hundred visitors to the gorillas' indoor exhibit participated in the study: 100 prior to the installation of the camouflage barrier (control condition) and the remaining 100 following its installation (barrier condition). Information on the demographics of participants is provided in Table 3. As can be seen, most of the participants were female, aged between 31–40 years and were married/cohabiting. The majority of the respondents had visited Belfast Zoo before and at the time of the study were touring the zoo in a party of at least four individuals. One-way ANOVAs revealed no

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**Table 2 Ethogram of gorilla behaviours recorded in the study.**

| Behaviour | Definition |
|---|---|
| Resting | Reclining with eyes open or closed; maintaining dorsal, ventral or lateral contact with floor |
| Standing | Bipedal, tripedal or quadrupedal stance with two to four extremities in contact with floor |
| Sitting | Sitting on posterior; supported by two extended legs |
| Moving | Walking, running or climbing |
| Looking | Looking directly at visitor(s) |
| Position | Located directly in front of visitors' viewing area |
| Aggression | Hitting, charging, lunging or throwing object(s) at conspecific |
| Social | Allogrooming or playing with conspecific |
| Abnormal | Performing repetitive, functionless behaviour, eg repetitive teeth clenching, body rocking, spinning, scratching upon being watched, ear-covering using hands |
| Autogroom | Grooming, licking, picking or otherwise manipulating own body |
| Bang glass | Knocking on glass barrier using hand(s) |

significant differences in visitor profile between the control and barrier conditions.

*Survey*

A purpose-designed survey (available upon request) was developed to assess visitors' perceptions of the gorillas and their enclosure. The survey was divided into three sections. Section 1 collected information on the participant's demographics, for example, sex, age, marital status, number of people in visiting group and whether or not the individual had visited Belfast Zoo before. Section 2 collected information on the participant's perceptions of the gorillas. Participants were required to indicate how: (1) happy; (2) healthy; (3) occupied; (4) attractive; (5) exciting; (6) aggressive; (7) natural-looking; and (8) contented, they considered the gorillas to be on a 5-point Likert scale, ranging from 1 (eg very unhappy) to 5 (eg very happy). The final section of the survey was developed to assess the participant's perceptions of the gorillas' enclosure. Participants were required to indicate how: (1) well-maintained; (2) well-designed for gorillas; (3) well-designed for visitors; (4) natural-looking; and (5) interesting, they considered the animals' enclosure. Again, a 5-point Likert scale was used to collect information on the participant's perceptions, ranging from 1 (eg very unnatural-looking) to 5 (eg very natural-looking).

*Procedure*

All visitors who entered the gorillas' indoor exhibit between 1400–1500 h, Monday to Friday (immediately after the gorillas' behaviour had been observed, see Experiment 1), were approached by the experimenter (ECB) and asked whether they would be willing to participate in a survey aimed at assessing their views on the gorillas' behaviour and enclosure. Where a pair or group of visitors entered the exhibit, only one person per pair/group was asked to complete a survey. Visitors who agreed to participate (100%) were provided with a copy of the survey and asked to complete it at their leisure and return it to the experimenter before leaving the exhibit. All participants returned their completed questionnaires.

**Figure 1**

Photographs of the camouflage net barrier employed in the study.

*Data analysis*

A one-way ANOVA was conducted for each of the adjectives employed in the survey to describe the gorillas (eg exciting, aggressive, etc) and their enclosure (eg natural-looking, etc), with condition (control/barrier) as a between-subjects factor, to determine whether the presence of the



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**Table 3 Demographic information on visitors who participated in the study and results arising from one-way ANOVAs conducted to look for differences in visitor profiles between the control and barrier conditions.**

| Demographic factor | Control condition | Barrier condition | ANOVA results |
|---|---|---|---|
| ***Sex*** | | | |
| Male | 33 | 45 | |
| Female | 67 | 55 | $F_{1,199} = 3.04$; ns |
| ***Age (years)*** | | | |
| <18 | 15 | 15 | |
| 19–30 | 21 | 30 | |
| 31–40 | 40 | 33 | |
| 41–50 | 12 | 14 | |
| 51+ | 12 | 8 | $F_{1,199} = 0.84$; ns |
| ***Marital status*** | | | |
| Single | 25 | 32 | |
| Married/cohabiting | 64 | 60 | |
| Divorced/widowed | 11 | 8 | $F_{1,199} = 1.28$; ns |
| ***First visit to Belfast Zoo*** | | | |
| Yes | 20 | 22 | |
| No | 80 | 48 | $F_{1,199} = 0.12$; ns |
| ***Number of visitors in party*** | | | |
| 1 | 9 | 11 | |
| 2 | 6 | 16 | |
| 3 | 21 | 17 | |
| 4+ | 64 | 56 | $F_{1,199} = 2.36$; ns |

camouflage netting had any effect on the visitors' perceptions of the animals or their exhibit.

Further one-way ANOVAs were conducted to determine whether the participants' responses on the survey were influenced by any of the demographic factors recorded, for example, sex, age and marital status.

## Results

### Experiment 1: The influence of a camouflage net barrier on the behaviour and welfare of zoo-housed gorillas

The camouflage barrier had no significant effect on the amount of time the gorillas were observed standing, sitting, resting, moving, socialising, autogrooming, looking towards the visitors, locating themselves in front of the visitors' viewing area or banging on the glass barrier (Table 4). A gorilla's sex had no effect on any of the behaviours recorded ($P > 0.05$ for all ANOVAs).

The gorillas showed significantly less aggressive behaviour during the barrier condition than the control condition ($t = 2.65$; $df = 5$; $P < 0.05$; see Table 4), and this did not change significantly over the course of the four weeks of the barrier condition (number of observations of aggressive behaviour per week [mean of all gorillas ± standard error]: week 1 = 2.17 ± 0.83, week 2 = 2.00 ± 0.86, week 3 = 2.33 ± 0.99, week 4 = 0.83 ± 0.31; $F_{3,12} = 1.21$; ns).

The animals showed significantly less abnormal behaviour during the barrier condition than the control condition ($t = 3.04$; $df = 5$; $P < 0.05$; see Table 4), and again this did not change significantly over the course of the four weeks of the barrier condition (number of observations of abnormal behaviour per week [mean of all gorillas ± standard error]: week 1 = 1.67 ± 1.11, week 2 = 1.17 ± 0.75, week 3 = 0.83 ± 0.65, week 4 = 1.66 ± 1.47; $F_{3,12} = 0.40$; ns).

### Experiment 2: The influence of a camouflage net barrier on visitors' perceptions of zoo-housed gorillas and their exhibit

#### *Visitors' perceptions of the gorillas*

Overall, the visitors' perceptions of the gorillas were largely favourable, with people providing significantly more ratings on the positive side of the Likert scale (Friedman ANOVA test statistic = 280.84; $df = 7$; $P < 0.001$; see Table 5).

The barrier condition influenced the participants' perceptions of the gorillas on adjectives of 'exciting' and 'aggressive' only. The animals were considered to be more exciting ($F_{1,199} = 4.26$; $P < 0.05$) and less aggressive ($F_{1,199} = 15.40$; $P < 0.001$) in the barrier than in the control condition (Table 6).

No significant associations were found between the participants' demographics (eg sex, age, number of people in group, etc) and their perceptions of the gorillas on any of the adjectives used to describe the animals ($P > 0.05$ for all one-way ANOVAs).

#### *Visitors' perceptions of the gorillas' enclosure*

The visitors' perceptions of the gorillas' enclosure were very positive, with people providing significantly more ratings on the positive side of the Likert scale (Friedman ANOVA test statistic = 167.02; $df = 4$; $P < 0.001$; see Table 5).

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**Table 4 The mean (± standard error) number of point samples in which gorillas were recorded displaying each behaviour, and results arising from ANOVAs conducted to look for differences in behaviour between control and barrier conditions.**

| Behaviour | Control condition Mean (SE) | Barrier condition Mean (SE) | ANOVA results |
|---|---|---|---|
| Standing | 39.67 (8.79) | 35.00 (7.54) | $F_{1,4} = 1.32$; ns |
| Sitting | 266.00 (27.47) | 273.83 (23.45) | $F_{1,4} = 0.60$; ns |
| Resting | 103.16 (33.32) | 97.50 (31.97) | $F_{1,4} = 1.17$; ns |
| Moving | 20.50 (4.76) | 23.50 (3.41) | $F_{1,4} = 1.15$; ns |
| Looking | 182.66 (35.07) | 175.50 (31.74) | $F_{1,4} = 0.33$; ns |
| Position | 100.83 (33.85) | 108.17 (31.10) | $F_{1,4} = 1.39$; ns |
| Social | 14.00 (3.01) | 24.33 (12.69) | $F_{1,4} = 1.06$; ns |
| Aggression | 34.67 (11.17) | 7.33 (1.96) | $F_{1,4} = 7.89$; $P < 0.05$ |
| Abnormal | 19.67 (6.59) | 5.33 (3.35) | $F_{1,4} = 8.40$; $P < 0.05$ |
| Autogroom | 49.33 (10.31 | 51.83 (7.76) | $F_{1,4} = 0.11$; ns |
| Bang glass | 8.00 (4.58) | 2.83 (1.43) | $F_{1,4} = 2.52$; ns |

The barrier condition influenced the participants' perceptions of the gorillas' enclosure on the adjective 'appropriate for visitors' only (see Table 6). The exhibit was considered to be more appropriate for visitors in the barrier condition than in the control condition.

No significant associations were found between the participants' demographics (eg sex, age, number of people in group, etc) and their perceptions of the gorillas' enclosure on any of the adjectives employed to describe the exhibit ($P > 0.05$ for all one-way ANOVAs).

## Discussion

The findings of the present study suggest that the presence of a camouflage net over the viewing area of a gorilla exhibit can have a significant effect upon certain aspects of the animals' behaviour and also upon visitors' perceptions of the animals and their enclosure.

Previous research suggests that captive-housed primates tend to show more abnormal behaviour in the presence of visitors. Chamove and colleagues (1988), for instance, found that exposure to visitors resulted in higher levels of stereotyped locomotion, masturbation and leg/hair pulling in captive mandrills. More recently, Birke (2002) discovered that adult orang-utans used paper sacks to cover their heads more often during periods of high visitor density. The addition of a barrier such as camouflage netting may be one method of reducing such abnormal behaviours. In the present study there was a pronounced decline in abnormal behaviours during the barrier condition, suggesting that they are, in part, visitor-induced behaviour patterns.

It has been noted that conspecific-directed aggression in primates is often augmented by exposure to visitors (Maki *et al* 1987; Chamove *et al* 1988; Mitchell *et al* 1991; Perret *et al* 1995). The gorillas in the present study exhibited a pronounced decrease in intra-group aggression following the introduction of the camouflage netting. The higher levels of agonistic behaviour observed during the control condition would suggest that the behaviour of gorillas, like that of other primates, is adversely affected by the presence of humans. The addition of a barrier, such as the camouflage netting employed here, may be one method of reducing the potential stress-inducing influence of visitors.

Both of the behaviours that were influenced by the camouflage netting (ie abnormal behaviour and aggression), remained at a consistently lower level during all four weeks of the barrier condition. This is a positive finding, suggesting that gorillas do not habituate to the presence of such a screen. Further long-term research is required, however, to explore the influence of such a barrier over longer periods of time.

The camouflage netting also reduced the amount of time that the gorillas spent banging on the glass barrier, although this change was not statistically significant. This reduction may have been due to the decreased amount of knocking on the exhibit window instigated by the visitors (see later).

The camouflage netting exerted no significant influence on most of the gorillas' other behaviours (eg position, standing, etc), possibly because such behaviours were not influenced by the presence of visitors. Further work is needed to explore the types of behaviours in gorillas that are influenced by visitors so that the value of screening such a species from humans can be accurately ascertained from behavioural measures.

It must be borne in mind that a scan-sampling technique was employed in the present study, with the animals' behaviour being recorded once every 5 mins. It is possible that the incidence of rare but significant events (eg glass banging, chasing, abnormal behaviour) might have been higher had a continuous recording technique been employed.

Visitors' perceptions of the gorillas and their environment were also influenced, albeit slightly, by the presence of the



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**Table 5 Participants' (n = 200) perceptions of the gorillas and their enclosure. Results are expressed as the percentage of respondents allocating ratings of 1–5 (1 = strongly opposed to adjective; 5 = strongly agree with adjective) to 13 adjectives employed to describe the animals and their exhibit.**

| Adjective | Likert scale rating | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| ***Gorillas:*** | | | | | |
| Happy | 2.0 | 9.0 | 31.0 | 50.0 | 8.0 |
| Healthy | 0.5 | 0 | 6.0 | 53.5 | 40.0 |
| Occupied | 3.0 | 20.5 | 28.5 | 36.0 | 12.0 |
| Attractive | 0.5 | 4.5 | 21.1 | 44.7 | 29.1 |
| Exciting | 0.5 | 8.0 | 26.5 | 43.0 | 22.0 |
| Aggressive | 6.0 | 26.0 | 34.0 | 23.0 | 11.0 |
| Natural-looking | 2.0 | 15.5 | 17.0 | 48.5 | 17.0 |
| Contented | 1.0 | 8.5 | 22.0 | 47.5 | 21.0 |
| ***Enclosure:*** | | | | | |
| Well-maintained | 0 | 1.0 | 6.5 | 54.8 | 37.7 |
| Appropriate for gorillas | 0 | 6.5 | 21.6 | 50.8 | 21.1 |
| Appropriate for visitors | 0.5 | 4.5 | 14.1 | 51.8 | 29.1 |
| Natural-looking | 3.5 | 19.2 | 26.8 | 39.4 | 11.1 |
| Interesting | 0 | 6.0 | 19.0 | 55.5 | 19.5 |

camouflage netting. Specifically, the visitors considered the animals to look less aggressive and more exciting during the barrier than the control condition. This is perhaps not surprising given the decrease in intra-group aggression during the barrier condition. The findings suggest that this change in the animals' behaviour was sufficiently pronounced to be noticed by visitors.

The visitors also considered the gorillas' enclosure to be more appropriate for the general public during the barrier than the control condition. This is a positive finding, particularly since the visitors' view of the gorillas was considerably more obscured during the barrier condition. Visitors to the gorillas' exhibit were often overheard commenting on the camouflage barrier, with parents highlighting to their children, for instance, that they were now in a 'jungle' and hence should be quiet.

Whilst this study explored the influence of the camouflage netting on the visitors' perceptions, an investigation into the effects of the barrier on the visitors' behaviour would also be valuable. Thus far it has been assumed that the changes observed in the gorillas' behaviour were directly due to the presence of the camouflage netting. For example, the netting may simply have acted as a buffer, reducing the amount of visual and/or auditory stimulation that the animals received from visitors. However, one cannot overlook the possibility that the camouflage netting changed the behaviour of the visitors, which then in turn altered the animals' behaviour. Whilst it was not the intended purpose of this study to examine the behaviour of the visitors, it was noticed that their behaviour differed quite markedly between the two conditions. The camouflage netting appeared to encourage quieter, more relaxed behaviours in the visitors than were observed in the control condition. For example, less time was spent banging on the glass of the viewing area, particularly by children, during the barrier condition. The public also tended to speak slightly less, and any conversations that did take place were quieter in volume in the barrier condition. Further work is underway to explore the effect of the camouflage netting on the behaviour of visitors to elucidate the mechanism underlying the changes in the animals' behaviour.

## Animal welfare implications

The findings of this study suggest that the welfare of captive-housed gorillas may be somewhat enhanced by the addition of a barrier designed to reduce the amount of stimulation that animals receive from visitors. Overall, the net barrier exerted little effect on most of the gorillas' behaviours. It did, however, have an influence on those behaviours known in other primates to be affected in an adverse manner by the presence of visitors, ie abnormal behaviour and intra-group aggression. Snyder (1975) suggested that captive-housed animals invariably ignore the public during normal visiting hours. However, the higher levels of stereotypic activities and agonistic displays observed during the control condition in the present study suggest that gorillas, like many other primates, do not habituate to the presence of visitors, and, moreover, may regard the presence of visitors as stressful, rather than as enriching. The reduction both in abnormal behaviour and conspecific-directed aggression observed during the barrier condition can be considered advantageous, suggesting that the animals were more relaxed following the introduction of a screen between themselves and visitors.

This study does admittedly suffer from the weakness that there was no post-intervention control condition. This raises the possibility that the results are due to some time-related factor rather than to the netting. However, previous studies

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**Table 6 Mean (± standard error) scores arising from zoo visitors' (n = 200) perceptions of the gorillas and their enclosure in the control and barrier conditions (1 = strongly opposed to adjective; 5 = strongly agree with adjective), and results arising from ANOVAs conducted to look for differences between control and barrier conditions.**

| Adjective | Control condition Mean (SE) | Barrier condition Mean (SE) | ANOVA results |
|---|---|---|---|
| ***Gorillas:*** | | | |
| Happy | 3.49 (0.96) | 3.59 (0.68) | $F_{1,199} = 0.71$; ns |
| Healthy | 4.36 (0.70) | 4.29 (0.55) | $F_{1,199} = 0.61$; ns |
| Occupied | 3.39 (0.11) | 3.28 (0.95) | $F_{1,199} = 0.57$; ns |
| Attractive | 4.08 (0.87) | 3.87 (0.83) | $F_{1,199} = 3.07$; ns |
| Exciting | 3.65 (0.95) | 3.91 (0.82) | $F_{1,199} = 4.26$; $P < 0.05$ |
| Aggressive | 3.36 (0.10) | 2.78 (0.10) | $F_{1,199} = 15.40$; $P < 0.001$ |
| Natural-looking | 3.63 (0.10) | 3.63 (0.92) | $F_{1,199} = 0.00$; ns |
| Contented | 3.76 (0.97) | 3.82 (0.83) | $F_{1,199} = 0.22$; ns |
| ***Enclosure:*** | | | |
| Well-maintained | 4.26 (0.64) | 4.32 (0.62) | $F_{1,198} = 0.49$; ns |
| Appropriate for gorillas | 3.94 (0.75) | 3.78 (0.88) | $F_{1,198} = 1.72$; ns |
| Appropriate for visitors | 3.91 (0.93) | 4.18 (0.64) | $F_{1,198} = 5.70$; $P = 0.01$ |
| Natural-looking | 3.41 (0.10) | 3.29 (0.99) | $F_{1,197} = 0.69$; ns |
| Interesting | 3.93 (0.77) | 3.84 (0.80) | $F_{1,199} = 0.66$; ns |

on this particular group of gorillas have revealed behavioural data similar to that of the control condition in the present study; thus strengthening the likelihood that the netting, rather than some extraneous factor, was responsible for the change in the animals' behaviour.

It must be borne in mind that visitors can provide a unique and complex form of stimulation for many species of zoo animal. Nonetheless, captive-housed animals often find it difficult to escape the attention of, and disruption caused by, zoo visitors. This lack of control over the environment can lead to compromised animal welfare, for example, learned helplessness and aberrant behaviours (eg Seligman 1975; Wemelsfelder 1984; Sambrook & Buchanan-Smith 1997). The addition of a barrier, such as camouflage netting, may be one method of reducing the extent to which primates are in the public eye; thereby leading to a greater sense of control for the animals and enhanced animal well-being. It is thus recommended that zoos and similar institutions consider the introduction of such a medium to their primate exhibits.

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