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The reduction of stereotypic pacing in tigers (Panthera tigris) by obstructing the view of neighbouring individuals

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Abstract

*Until recently, little attention has been focused on the influence of social interactions and the presence of conspecifics on stereotypic pacing in captive carnivores. This study examined the effect of adding a visual barrier between two tiger (*Panthera tigris*) exhibits on stereotypic pacing behaviour. Continuous sampling was used to record the duration of time tigers spent pacing and the total number of pacing bouts. The results show a significant decrease in stereotypic pacing for the group of six female tigers after obstruction of the view of neighbouring tigers. These results suggest that the opportunity for tigers to view conspecifics in other exhibits may influence time spent pacing therefore it is felt that the design or renovation of tiger exhibits should take the visibility of neighbouring individuals into account.*

Keywords: *animal management, animal welfare, conspecifics, exhibit design, stereotypic behaviour, tiger*

Introduction

The trend in zoo settings is for tigers to be housed singly, in pairs, or occasionally in larger groups composed, typically, of related individuals that have grown-up together (Shorey & Eaton 1974; Tilson *et al* 1995). Stereotypic pacing has been shown to occur in both the social and solitary-housed felids (De Rouck *et al* 2005). While the causes of pacing in felids are not completely understood, possibilities that have been suggested include: inability to perform feeding-related appetitive (ie hunting) behaviours (Hughes & Duncan 1988); stress-reducing or coping mechanism (Mason 1991); re-directed hunting/patrolling behaviour (Mellen *et al* 1998); inability to hide (Carlstead *et al* 1993) and being housed adjacent to the same species (De Rouck *et al* 2005). Although stereotypic behaviour is not always an indication of poor animal welfare, it has been linked to situations of stress or frustration (Dawkins 1988; Mason *et al* 2001). Determining the exact cause or motivation behind stereotypic behaviour is often difficult, but is an important step towards understanding this behaviour. Mason (1991) suggests that any occurrence of pacing should be investigated on the grounds of welfare.

Techniques used to reduce stereotypic behaviour often include various forms of environmental enrichment as well as exhibit modification. Historically, cat exhibits consisted of barren concrete cages with bars for increased animal viewing. More modern designs tend to feature more naturalistic settings that seek to address a number of the felids' biological needs. Studies on stereotypic behaviour have examined the effect of adding novel objects, providing olfactory enrichment, training, major exhibit renovation, rotating animals between enclosures and feeding (Swaisgood & Shepherdson 2005). Each of these enhancements has demonstrated varying degrees of effectiveness in alleviating stereotypic behaviour, but results varied by species. In tigers, studies aimed at reducing stereotypic behaviour have focused primarily on feeding enrichment (eg Jenny & Schmid 2002; Bashaw *et al* 2003). However, De Rouck *et al* (2005) found that tigers being housed adjacent to other tigers contributed significantly to stereotypic pacing.

In the past, many zoological institutions displayed felids in indoor exhibits that were adjacent to and across from one another. Exhibit complexity, creating places for cats to hide from other cats, has been found to correlate negatively to pacing in small felids (Mellen *et al* 1998). However, there have been no studies examining the ability of visual barriers between exhibits to reduce stereotypic pacing. This study sought to assess the impact of the addition of a visual barrier on stereotypic pacing in six female tigers (*Panthera tigris*).

Materials and methods

Subjects

The subjects consisted of six female captive tigers at Disney's Animal Kingdom® in Lake Buena Vista, Florida, USA. All the individuals were born in the spring of 1997 at a private institution in Texas and hand-reared together and

managed using free-contact until arrival at Disney's Animal Kingdom® in October 1998. Since their arrival, the tigers have been managed in a protected contact situation.

Exhibits and holding area

Animals were on daily exhibit between 0730 and 1700h. During the day, tigers were exhibited in two enclosures (west and east yards) in various social combinations that usually resulted in two-to-four animals in each enclosure. The west enclosure connected directly to the holding area and consisted of a shallow pool, trees, shrubs and grass. A dry moat was located at the back of this exhibit, separating the animals from a hoofed stock exhibit. The east enclosure consisted of a pool, water moat, trees, shrubs and grass. Both enclosures encompassed an area of approximately 4,050 m^2 and were connected via two 3.7 m underground tunnels. The tigers' access to the tunnels was controlled remotely and each morning a subset of the tigers was cued into the east yard, tunnel access was closed, and the remaining tigers were given access to the west yard. Directly above the tunnels was a public area containing large glass windows where visitors could view the tigers in both enclosures. Additionally, tigers in both enclosures could view one another across the visitor pathway. In the evening, the tigers were cued into a holding area which consisted of six separate, but connected, stalls and a transfer chute running the length of the stalls. The tigers were fed individually but housed at night as a group of five and a single individual for animal management reasons.

Data collection and analysis

Data were collected using two video cameras set up to observe both east and west exhibits. Camera locations were based on preliminary observations and cameras focused on areas where the subjects were seen to perform stereotypic pacing. Excluded from video coverage was an area leading to night quarters. Anticipatory pacing had been observed at this location, but only late in the day just before access was given to the tigers for feeding.

Baseline data were recorded from 23rd February to 6th April 2005. Once recording had finished, shutters were erected in the glass viewing area between the two exhibits, to obstruct tigers' view from one exhibit to the other. Shutters were closed daily from 0700 to 1100h during the treatment phase. After a period of three weeks had elapsed, to allow for habituation, treatment data were collected from 11th May to 18th June 2005. Video recording during both baseline and treatment began at approximately 0800h and continued until 1600h.

Inter-observer reliability was determined using one full day of tape for each exhibit. Three observers scored the video and reliability was reached on both frequency and duration of pacing bouts ($r > 0.90$). After achieving reliability, all the tape from a specific day was scored by the same observer and approximately the same amount of video was scored from each of the conditions by all observers. Pacing was defined as a repetitive ambulatory movement with the minimum criterion used to identify pacing as traversing the same pathway at least twice (Mellen *et al* 1998). Bouts began at the beginning of the second turn as the animals traversed the path and ended when the animal paused in the same location for longer than 10 s or broke away from the pathway being traversed.

Data were only collected on days on which all six tigers were present with two-to-four tigers in each of the exhibits. Additionally, data were matched for social combination between baseline and treatment conditions to remove any potential confounds. A total of 448 h of data was used in this analysis which includes 223 h during the baseline condition and 225 h during the treatment condition. The difference between baseline and treatment data duration was due to fluctuations in animal management routines leading to animals being released into the yards at slightly different times each day. Continuous sampling was used to record the duration of each pacing bout in addition to total number of bouts. Pacing duration (min h^{-1}) was calculated for each of the six tigers and corrected for the total time on camera for each individual tiger. Data were also divided into morning (0800–1159h) and afternoon (1200–16:00h) based on the times when the shutters were opened and closed during the treatment. The Wilcoxon signed ranks test for matched samples was used for statistical analysis of the data to compare baseline and treatment.

Results

Table 1 illustrates the rates of pacing per hour and total number of bouts per hour for each phase of the experiment. The results show a significant decrease in the duration of pacing when the visual barrier between the two exhibits was in place ($z = –1.992$, n = 6, $P = 0.046$). Analysis of data for morning (visual barrier in place) showed a significant decrease in pacing duration between the baseline and treatment conditions ($z = –2.023$, n = 6, $P = 0.043$). However, analysis of data from the afternoon (no barrier, tigers could see conspecifics in adjacent yard) was not significant when baseline and treatment conditions were compared ($z = –1.782$, n = 6, NS). Descriptive statistics show that the duration of pacing was lower in five of the six tigers during the treatment phase (Figure 1).

The results from the analysis of the frequency of pacing bouts mirrored the results of pacing duration. There was a significant decrease in the number of pacing bouts between baseline and treatment conditions ($z = –1.992$, n = 6, $P = 0.046$). Additionally, there was a significant decrease in the number of pacing bouts between the two conditions in the morning ($z = –2.023$, n = 6, $P = 0.043$), but analysis of data from the afternoon was not significant ($z = –1.782$, n = 6, NS).

Discussion

The results of this study suggest that tigers paced to a significantly greater extent when they could see conspecifics in an adjacent enclosure. During the first half of the day, when the visual barrier was in place, the tigers paced less than in the baseline condition. However, this was not the case in the afternoon as, with the visual barrier removed, pacing duration did not differ significantly from

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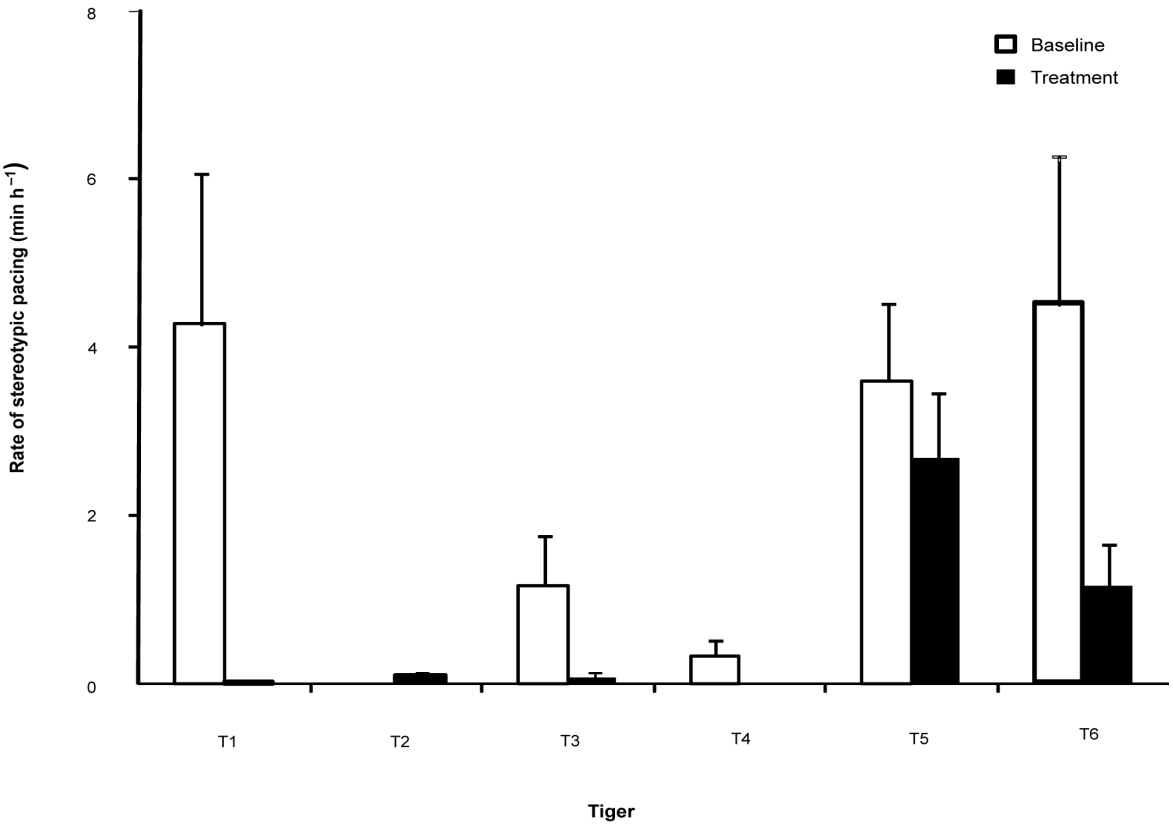
Table 1 Stereotypic pacing duration and bouts during the baseline and treatment phases for the study.

	Duration (min h^{-1})		Bouts (number h^{-1})	
	Mean (± SD) baseline	Mean (± SD) treatment	Mean (± SD) baseline	Mean (± SD) treatment
AM (0800–1159h)	1.864 (± 2.383)	0.303 (± 0.633)	0.756 (± 0.801)	0.172 (± 0.300)
PM (1200–1600h)	2.252 (± 2.368)	0.832 (± 1.447)	1.529 (± 2.089)	0.525 (± 0.969)
Total (0800–1600h)	2.310 (± 2.044)	0.668 (± 1.088)	1.146 (± 1.186)	0.425 (± 0.688)

Figure 1



Rate of stereotypic pacing for each individual tiger during the baseline and treatment phases for the study.

the baseline condition. These results are confounded because the visual barrier prevented the tigers from seeing both conspecifics in the adjacent enclosure and visitors in that specific area. However, when visitors were present in the park, they were visible to the tigers in several other viewing areas. Thus, the visual presence of conspecifics and not visitors, may be a trigger for pacing behaviour.

We suggest that pacing may occur as a response to the tigers' inability to have affiliative or agonistic interactions with the tigers in adjacent enclosures. Pacing may be a redirection of this inability to interact directly with conspecifics. Prevention of the expression of behaviour has been linked to stressful or frustrating situations (Dawkins 1988; Mason *et al* 2001) and may lead to stereotypic behaviour (Mason *et al* 2007). These findings are similar to those of De Rouck *et al* (2005) in that having tigers housed adjacent to one another influenced stereotypic pacing. Thus, it may be that obstructing the view of neighbouring tigers removes one of the motivations for pacing, ultimately reducing the frequency of stereotypic pacing.

While providing a degree of insight into this complex topic, future research could further evaluate the impact of exhibit design on behaviour. A multi-institutional study would provide an increased sample size and allow for generalisation across facilities. Finally, while these results are suggestive that neighbouring individuals influenced stereotypic behaviour for these individuals, there are a multitude of other variables that may have an influence on this complex behaviour.

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Animal welfare implications

Attempting to determine the underlying motivation behind stereotypic behaviour can be extremely challenging but is essential in decreasing this behaviour. Many zoological institutions in the northern United States were designed originally to have visitor areas with felid exhibits across from one another. Assessing the impact of this style of exhibit on pacing behaviour could ultimately benefit the quest to create the best possible quality of care for captive felids. These animals essentially represent ambassadors for their species, encouraging conservation action and felids that exhibit a range of species-typical behaviours offer a more naturalistic viewing opportunity for visitors. This information, in conjunction with further studies on other carnivore species, would be beneficial in enhancing the welfare of many captive animals. During the creation or renovation of tiger exhibits, managers should take into account not only the viewpoint of the visitor, with regard to tiger observation, but also what it is that the tigers see from their exhibit.

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