

Tigers Stereotypic Pacing and Enrichment

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Authors' contributions

This work was carried out in collaboration between all authors.

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ABSTRACT

Aim: Determine effect of enrichment on tiger pacing in Liberec zoo.

Study Design: The design of the study was a randomized one.

Place and Duration of Study: The experiment lasted 60 days; 360 min per day; 9.00 – 11.00 and 13.00 – 15.00. Four tigers were monitored: two males ages 5 and 17 years and two females ages 5 and 15 years. There were 30 days with enrichment and 30 days without enrichment (baseline). The study was carried out in the Liberec zoo.

Methodology: A ball made of fire hoses, a plastic barrel with the lid removed and ungulates' excrement (controlled by the vet) were used as enriching elements (toys). We found differences between baseline (not enriched) and treatment (enriched).

Results: Pacing decreased significantly after enriching the enclosures for 3 animals: young male Paris $P < 0.004$, young female Artemis $P < 0.024$ and old female Isabella $P < 0.032$. There was no significant change for the old male (Tibet) $P < 0.256$. Pacing decreased in all tigers with a significance of $P < 0.0412$.

Conclusion: An enriched environment may improve the lives of animals under human care. Enrichment can be a very good and effective mechanism for the reduction of pacing in tigers. It is important to periodically modify and change the types of enrichment items used.

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1. INTRODUCTION

Enrichment affects animal behavior under human care significantly. The addition of environmental enrichment can have a significant impact on the behavior of animals under human care. Provision of appropriate enrichment may help with breeding programs by creating an environment more conducive to breeding and animal activity. Active, healthy animals attract the public and generate higher zoo attendance. The enrichment improves animal welfare and zoo economy as well. Robert Yerkes presented a concept of enriched environment in 1920, which continues to inspire animal breeders nowadays as well [1]. The enrichment is an important component of animal husbandry principles as it shows a high level of quality care by identifying and providing the necessary stimuli for optimal psychological and physiological well-being [2]. Most enrichment programs apply methods for stereotypic behavior reduction. Some stimuli positively affect an animal's interest and includes factors such as biotic and a biotic objects, scents, and novel types of foods and it's various preparation methods. The environmental enrichment is divided into five groups: first sensory, stimulating animals' senses - visual, olfactory, auditory, tactile and taste; second feeding, which is more challenging, different methods of food presentation encourage animals to investigate and manipulate food as they would in nature; third are manipulations and puzzles which provide objects for manipulation, promote investigatory behavior and exploratory play, toys; fourth is the environmental enrichment which enhance the animal habitat under human care, with opportunities to change the environment; fifth social enrichment provides the opportunities for social linter actions and trains animals using positive reinforcement or habituation [3]. Feeding enrichment is most frequently used. Supplements offish or hind limbs of horse decrease stereotypic behavior of lions and Sumatran tigers [4], for example. This enrichment affords opportunities and provides motivation to encourage normal behavior, reduce stress and all stereotypic types of behavior, support reproduction and positive social interactions and improve animal welfare [1]. Enrichment also plays an important role in the preventive medicine program as it affects the physical, mental and social welfare of animals [5]. It makes animal life interesting for keepers which observe their play, hunt and other natural behaviors. The environment enrichment reduces or eliminates many undesirable stereotypic manifestations [6].

2. MATERIALS AND METHODS

The study lasted for 60 days (30 days without and 30 days with EE), change 1 day with enrichment with one day for changing from enriched to non enriched environment. Specifically tiger pacing was observed in Liberec zoo. Ungulate excrements (after vet control, weight 300g), a ball of fire hoses and plastic barrel with lid removed (about 10 liters) were used. The change in elements on experiment days is presented in Table 1. All subjects were observed in a baseline condition prior to any manipulation. The subjects were observed in an enclosure without EE and observation of their pacing was timed. In the second half of experiment EE were introduced into the enclosure and observation of the subjects pacing was timed. Pacing occurred repeatedly back and forth in a straight line as well as in circular and figure-eight patterns. The straight line pacing was observed most often at the boundary of the enclosure. We recorded other behavior as activity (locomotion, feeding, animal and people observing etc.) and inactivity (lying, resting, sleep). Each tiger was monitored for a total of 6 hours per day, with a 180 minute session in the morning (9-11 am) and another 180 minute one in the afternoon (13.00 – 15.00). Instantaneous pacing was monitored in 1-

min intervals. All tigers received the same enrichment treatment located in a ground area enclosure visible to the public.

Table 1. Enrichment change (day)

Day	EE	day	EE	Day	EE
1	excrements	11	excrements	21	barrel
2	ball	12	ball	22	ball
3	barrel	13	barrel	23	excrements
4	ball	14	excrements	24	ball
5	barrel	15	barrel	25	barrel
6	excrements	16	excrements	26	excrements
7	barrel	17	barrel	27	barrel
8	excrements	18	ball	28	ball
9	ball	19	excrements	29	excrements
10	barrel	20	ball	30	ball

Four tigers were observed; two males- TIBET, 17 years old (imported 2005 from Sóstó Zoo Hungary, born 1990 in USA) and PARIS, 2 years old (imported 2006 from Lisieux zoo France, born 2005); two females – ISABELLA, 15 year old (imported 1994 from Eskilstuna zoo Sweden) and ARTEMIS, 5 years old (born 2002 in Liberec zoo).

The basic diet consisted of beef carcass on the bone. The carcasses of rabbit and chickens were added once a week, day without feeding was twice a week (Wednesday and Sunday). There are four enclosures and 4 indoor quarters in the carnivore building for tigers in the Liberec zoo. Enclosures are equipped with several layers of laminated glass and top bars and the edges are covered to protect animals from the weather. A stone substrate, rocks and woods (jungle environment) (an elevated space for easy observation and tagging) are also in the enclosures. The first enclosure is 52.25 m², alternately inhabited by the oldest members, Isabella and Tibet. The second outdoor enclosure with pool is 94.88 m² is the biggest. The third enclosure with pool is 90 m² and is inhabited by Paris, the young male. The last enclosure is 47.25 m² and is inhabited by Artemis, the young female. Inside the building there are four areas for the tigers.

All tests used the $P < 0.05$ criteria to establish statistical significance. The level of stereotypic pacing was computed by calculating the number of monitored cats which moved or engaged in active behavior (each animal and together). Data collected from the baseline (no enriched days) were compared with treatment (enriched days). Data did not appear to be normally distributed, the number of subjects was small, a repeated-measures design was used and nonparametric statistics employed. The data was analyzed using the statistical program SAS 9.2[®]. Significant differences between the means was determined using the Wilcoxon signed-ranks tests evaluated the differences between two samples, based on the magnitude and sign of the differences between each pair of scores in a correlated sample. Results were used to evaluate differences between days with and without EE. We computed means time of pacing and pacing using percentage.

3. RESULTS AND DISCUSSION

Statistically significant differences were found between treatment days with EE and baseline (without EE) Table 2, Figs. 1 and 2 though there was only approximately an 8.4% reduction

of pacing. Four animals were monitored therefore the results are significant at the 0.05 level. Pacing decreased in all tigers with a significance of $P < 0.0412$. Significant differences in stereotypical pacing were found in the young male Paris, $P < 0.004$, young female Artemis, $P < 0.024$ and the older female Isabella, $P < 0.032$. No significant differences were observed in the oldest tiger Tibet, $P < 0.256$. Enrichment supplement decreased the time of pacing. Time of pacing were from approximately 30 min to 6 min during the monitored time. The results correspond with results in other studies. For example, after introduction of enrichment, leopards decreased their time spent pacing and tigers demonstrated a decrease in stereotypic behavior [4,7,8]. The enrichment devices showed a significant positive effect on thereof the four animals, both females (Artemis and Isabelle) and young male Paris (see Table 2). The old male Tibet had osteoporosis and arthritis which affected results. The plastic barrel and the ball made of fire hoses were most interesting for the tigers. Environmental enrichment strategies were applied to improve animal welfare. Successful enrichment includes the improvement of design of the enclosure, feeding devices, new objects, appropriate social groupings and other sensory stimuli [9]. Results of tiger observations show that the animals paid more attention to the environment and reduced their pacing on days with presentations. On these days there was also an increase in animal interaction [4,10,11].

Table 2. Mean time of pacing (min, %) each tiger and together, between days with and without EE

Tiger/with or without EE/	Time of pacing-mean(min and %)		
	N	Mean min±S.D	Mean %±S.D
Tibet (♂ 17 years) with EE	30days/360 min per day	39±10.52	16.3±11.46
Tibet (♂ 17 years) no EE	30days/360 min per day	45±4.21	18.8±5.02
*Isabella (♀ 15 years) with EE	30days/360 min per day	25±7.42 ^b	10.4±6.39 ^b
*Isabella (♀ 15 years) no EE	30days/360 min per day	45±4.01 ^a	18.8±3.01 ^a
*Paris (♂2 years)with EE	30days/360 min per day	35±3.8 ^b	14.6±3.56 ^b
*Paris (♂2 years) no EE	30days/360 min per day	60±2.7 ^a	25±2.58 ^a
**Artemis (♀ 5 years)with EE	30days/360 min per day	36±4.32 ^b	15±4.26 ^b
**Artemis (♀ 5 years) no EE	30days/360 min per day	66±4.54 ^a	27.5±4.41 ^a
*alltigerstogether- with EE	30days/360 min per day	33.8±3.91 ^b	14.1±3.99 ^b
*alltigerstogether- no EE	30days/360 min per day	54±4.65 ^a	22.5±5.26 ^a

Means within a column with different superscripts are significantly different at $P < 0.05$, (*= $P < 0.05$, **= $P < 0.001$), $df=3$, with EE – treatment, without EE- baseline

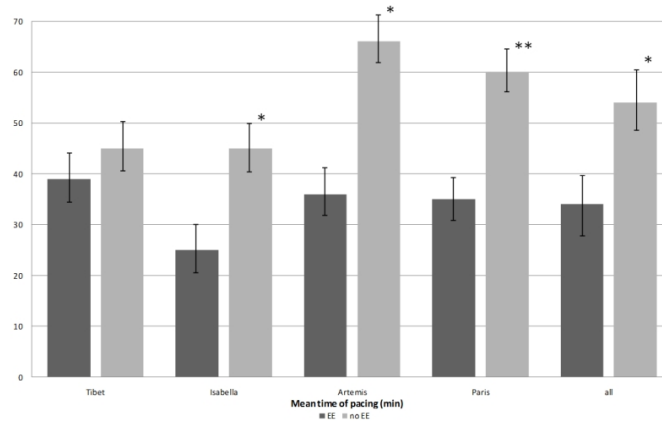


Fig. 1. Average time of pacing
 EE with enrichment, no EE, mean values and S.D., (without enrichment) * = $P < 0.05$,
 ** = $P < 0.001$

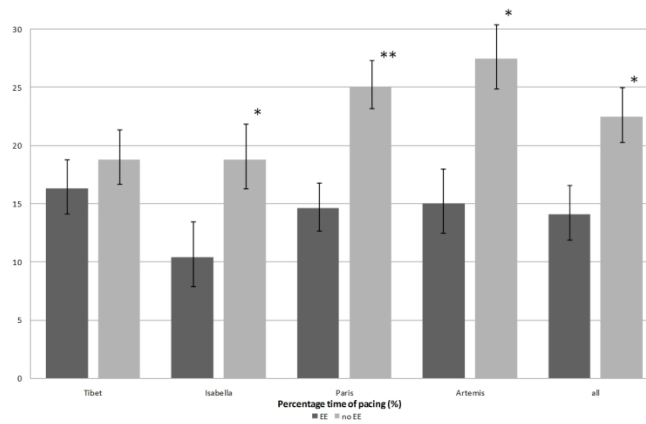


Fig. 2. Percentage time of pacing
 EE with enrichment, no EE, mean values and S.D., (without enrichment), * = $P < 0.05$, ** = $P < 0.001$

Enrichment affects tiger activity by decrease pacing. The same results were also found [12,13] for lions; increased activity and social affiliations [14,15,11].

The most preferred enrichment item was the plastic barrel followed by the ball made of fire hoses and in last position were the feces.

4. CONCLUSION

Results in our short-term study show that enrichment can effectively reduce pacing. Positive effects of enrichment were demonstrated on tigers which were monitored. The elements are necessary change and it is important to rotate enrichment items to promote novelty in the environment and maintain tiger interest. Introduction of EE has a long term positive effects but it is necessary to periodically change the type of elements used. After completion of

experiment, subsequent modifications of elements increased tiger interest in them. No further excrements were used.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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