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Research article

A preliminary study of the effects of environmental enrichment on the behaviour of captive African wild dogs (*Lycaon pictus*)

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Environmental enrichment has been used in a number of studies of captive animals with goals of increasing activity, increasing behavioural diversity, increasing the utilization of the environment and reducing the abnormal behaviours of captive animals. This study investigated the effects of environmental enrichment on the behaviour of captive African wild dogs. Five enrichment treatments were presented to the dogs over a 5 week period. One enrichment treatment was placed into the dogs' enclosure once a week. The treatments were boomer balls, various scents, a sandpit with hidden food, a blood trail leading to rawhide items/pig's ears and all the foregoing enrichments simultaneously presented to the dogs. Behavioural responses of the dogs during pre-enrichment (baseline), enrichment treatments and post-enrichment were observed using instantaneous scan sampling, at 5 min intervals. Behaviours were subdivided into nine behavioural categories and allocated to 'active' and 'inactive' behaviours, which were used for analysis. Boomer balls had no effect on activity levels; however, the scent, blood trail and sandpit enrichment significantly increased the dogs' activity levels. A rise in behaviours such as 'locomotion' and 'scanning' were observed during the scent, blood trail and sandpit enrichment. 'Sniffing' escalated during the scent and blood trail enrichment. When all enrichments were presented simultaneously, activity levels were significantly decreased. Overall enrichment did not reduce abnormal/undesirable behaviours. The results indicate that some environmental enrichment can be used to increase active behaviours of African wild dogs in captivity and shows promise in eliciting positive effects on behaviour and welfare.

Key words: African wild dog, *Lycaon pictus*, environmental enrichment, activity levels, abnormal behaviour.

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Introduction

Over the past few decades environmental enrichment has become an important part of the animal husbandry regimes of captive animals.[1] The concept has been defined as a principle that aims to enhance the welfare of captive animals by providing stimuli needed for optimal physiological and psychological wellbeing.[2] The basic goals of animal welfare are good physical and psychological health,[3] thus it is assumed that enrichment improves animal welfare.[1] Enrichment may improve an animal's biological functioning by modifying their captive environment.[4] Some of the goals of environmental enrichment include increasing activity, stimulating a more diverse range of behaviours, increasing exploration and use of their environment and reducing abnormal behaviours in captive animals. A variety of different techniques have been used. For example, feeding enrichment has increased activity levels and reduced the number of undesirable behaviours of captive ringtailed lemurs (*Lemur catta*)[5] and providing hidden food to captive Maned Wolves (*Chrsocyon brachyurus*) significantly increased the activity and exploratory behaviours.[6] The hiding of food in specially constructed wood piles and around the enclosure of Bush dogs (*Speothos venaticus*) increased their searching behaviour.[7]

In addition to the provision of food, scent enrichment has also been used to increase active behaviours of captive felids.[8] Other behavioural studies have shown the positive effects of enrichment on captive animals, including reducing stereotypic behaviours.[9] The effects of enrichment on captive vicugna (*Vicugna vicugna*) reduced stereotypic behaviour, which was described as pacing around their indoor enclosure and performing exaggerated head-swings.[10] Enrichment also increased zoo-housed black-footed cats' (*Felis nigripes*) activity levels, reduced inactive behaviours and encouraged exploration, which are changes considered advantageous in improving animal well-being.[11]

Stereotypies are repetitive behaviours that have no apparent function[12] and may be caused by exposure to an ecologically relevant problem that a captive animal cannot solve within its environment,[9] for example, the inability to carry out natural hunting behaviours. Abnormal behaviours may indicate the inability of a captive animal to adjust behaviourally to its environment.[13] Examples of abnormal behaviours include stereotypic pacing in felids and feather plucking in birds. Environmental enrichment can be used to create opportunities for species-specific behaviours and can reduce abnormal behaviours in captive zoo mammals.[9] Creating a stimulating environment using enrichment may occupy the animal thus preventing abnormal behaviours.[14] At the West Midland Safari and Leisure Park, where the study was based, the pack of African wild dogs *Lycaon pictus* (Temminck) had been exhibiting abnormal behaviours such as chewing visitor car tow bar covers, mud flaps and spare wheel covers and at times ripping them off. The dogs were interested in sniffing and licking car exhausts as well as rubbing their bodies up against the cars and exhausts. These behaviours may not be regarded as typical stereotypic behaviours, and will thus be referred to in this study as abnormal/undesirable behaviours.

The African wild dog is a carnivorous mammal of the family Canidae. They are lean and tall (65–75 cm at the shoulder), with outsized ears and their patchwork coats are brown, black and white.[15] The sense of smell is well developed in Canidae and sight is important in this family.[16] The African wild dog is one of the most diurnal of African carnivores[16] and has one of the greatest territorial boundaries of any wild animal, estimated at 1500–2000 km^2.[15] They spend most of their time in the wild searching for food and travelling large distances.[16] The African wild dog is listed as endangered and wild populations are declining.[17]

Currently, there are no articles that test the use of enrichment on captive African wild dogs in scientific databases. There is therefore a lack of studies that have focused on captive African wild dogs and enrichment. Thus there is a lack of understanding on how this species behaves within a captive environment, and especially the types of abnormal behaviours they may exhibit. A wide range of enrichment strategies need to be investigated in order to assess which are most effective in terms of providing a more stimulating environment. An understanding of what kinds of enrichment are effective and what is not is important to the development of experimental design in enrichment research.[18]

The aim of the study was to provide a more stimulating environment, in terms of the dogs' physical and physiological 'needs' and to discourage undesirable behaviours. The purpose of the study was to examine the effects of five enrichment treatments on captive African wild dogs. Behavioural responses of the dogs to enrichment treatments were assessed based on the activity levels. It was predicted that (i) enrichment would increase activity levels and (ii) enrichment would reduce the occurrence of abnormal/undesirable behaviours.

Materials and methods

Subjects and housing

The study was conducted at the West Midland Safari and Leisure Park, Bewdley, Worcestershire, England (OS grid reference SO797957). The reserve consists of a 4-mile self-drive safari, forming reserves, such as, Kingdom of the White Lions, African Wild Dog Reserve, Elephant and Waterbuck Reserve, etc. It is generally open to the public from the hours of 10:00 to 17:00 h with increased hours of 10:00–19:00 h during August.

Experimental subjects in this study were a group of 14 African wild dogs. The pack consisted of six adults and eight juveniles, of which six were males and eight females. All 14 dogs were born in captivity. The African wild dog reserve consists of 2.2 acres of grassland divided into two sections by a tarmac road. The reserve contains artificial termite mounds, Acacia trees (*Acacia greggii*), logs, a pool, a shelter, a water trough, a wooden scratching post, three concrete hollowed blocks, a play platform as well as a night house. The dogs were let out of their night enclosure at opening time and let back in at the end of the day when the reserves were closed to the public. The reserve is fully fenced off and has two electric grids at either end to discourage the dogs from entering the next reserve. The dogs were fed chunks of horse (*Equus ferus caballus)* meat and beef (*Bos primigenius taurus*) on alternate days, in the afternoon inside their night enclosure. Prior to the study the keepers presented the dogs with disused fire hose and scents, although no enrichment was used on a regular basis. Previous enrichment consisted of placing car tyres in the enclosure and tying rope to the back of the keeper's car for the dogs to chase.

Experimental design

Two weeks prior to the start of the study, any current enrichments being used were removed to allow behaviours to return to baseline. The schedule was as follows. The

experiment consisted of five enrichment (E) treatments with pre-enrichment (PE, baseline) and post-enrichment (PO) observations. The study took place over a 6 week period. Each week consisted of 1 day PE (Monday), E (Tuesday) and PO (Wednesday) observations. A randomized study design (by introduction of enrichments) was used. One enrichment treatment was administered once a week to avoid cumulative effects of multiple treatments as well as allowing behaviours to return to baseline. Days and observation times were predetermined before the start of the study and kept constant to avoid any bias; however, during the last treatment, observations took place Tuesday to Thursday due to a bank holiday Monday. Bank holiday visitor numbers were too high to carry out the study and may have affected the results.

The enrichment treatments during this experiment were as follows. (i) Boomer balls 3 × 30 cm diameter solid balls of various colours, i.e. red, blue and purple. The balls were thrown out of the keeper's car. They were administered in this way so as to attract the dogs' attention by movement of the balls down the slope of the enclosure, rather than just placing the balls on the ground. (ii) Scents, i.e. chopped lemons (*Citrus limon*), dried herbs (*Origanum vulgare*, *Ocimum basilicum* and *Thymus vulgaris*) soaked in water overnight, cumin (*Cuminum cyminum)* powder and lavender (*Lavandula*) leaves/flowers. The chopped lemons were placed in various locations around the enclosure. Cumin powder was placed on and under the log, lavender leaves/flowers were placed on the play platform and the herbs in water were poured outside the night pen, on termite mounds, scratching post and various other locations across the enclosure. (iii) A sandpit (8 ft by 8 ft) was placed inside the enclosure and filled with bags of play sand.

Chunks of horse meat were buried under the sand and was also placed inside the concrete blocks. (iv) For the blood trial, animal blood was placed inside a spray bottle and sprayed in a line across one-half of the enclosure. The end of the trail led to the top of the play platform, to which dried pigs ears and a 10-inch rawhide ring was placed and (v) all the foregoing (i–iv) enrichments introduced simultaneously.

All enrichment items were placed in the enclosures before 1000 h, which was the time the dogs were let out of their night enclosure and the opening time to the public. The enrichment was left inside the enclosure for the remaining of the day and remainders of items were removed from the enclosure before the following morning.

Data collection

Behavioural observations

All analyses were conducted using Minitab 15 software for Windows. Counts for each behaviour category, i.e. resting, locomotion, etc. were totalled for each dog across PE, E and PO observation days. A mean value for the proportion of scans categorized as active and inactive behaviours was calculated for all individuals. Differences between active and inactive behaviours were explored using non-parametric tests due to relatively small sample sizes and the data counts were in categorical and nominal scale of measurements.[20]

An *ad libitum*[19] approach to sampling was used during the first week over one full day in order to develop an ethogram[20] (Table 1). Observations for the study were collected from the 23 July 2008 to the 28 August 2008. Data were recorded between the hours of 10:00–17:00. One hour observations were recorded at predetermined times, at

Table 1. Ethogram for African wild dogs at the West Midland Safari and Leisure Park in July/August 2008

Behaviours observed	Description
Active behaviours	
Locomotion	Walking, trotting, running or rolling on back
Social interactions	Engaging in friendly or aggressive behaviour with another or mating
Sniffing	Sniffing the environment
Scanning	Quadrepedal stance and actively scanning the environment
Engaging with enrichment	Engaging with or investigation of enrichment
Inactive behaviours	
Resting	Lying down, head up or sitting
Sleeping	Lying down, head down
Other	Self-groom, licking or scratching itself or defecate/urinate
Abnormal/undesirable behaviours	
Biting visitor car tyres, tow bar covers or other parts of the vehicle	
Rubbing body against the back of visitor's vehicle bumpers/exhausts	
Sniffing/licking car exhausts	

10:00–11:00, 12:00–13:00, 14:30–15:30 and 16:00–17:00 h. All 14 dogs were observed using instantaneous scan sampling,[19] at 5 min intervals for a total of 4 h per observation day. During each 5 min scan, every animal was observed from left to right and their behaviour at that instant was recorded. The 4 h observation sessions gave a total of 48 sample points. A total of 60 h of observational data were collected (20 h × PE, 20 × E and 20 × PO).

Data were recorded using a data check sheet, pencil and stop watch. Data were collected from inside the animal keeper's car, which allowed the observer to follow the dogs in order to obtain a full view. In some instances, the animals were recorded as being out of view, due to hiding down in the den. Counts where animals were 'out-of-view' were removed from the data set and were not analysed. Behaviours of interest were predetermined according to the ethogram and allocated to active and inactive behaviours (Table 1). Active behaviours included locomotion, social interactions, smelling, scanning, engaging with enrichment and abnormal behaviours. Inactive behaviours included resting, sleeping and behaviours categorized as other. A Kruskal–Wallis test was used to compare the active and inactive behaviours across PE, E and PO observations (in all cases, $n = 14$, DF = 2), a Kruskal–Wallis multiple comparisons test[21] was then used to analyse the significant differences in activity between paired comparisons: PE and E, PE and PO and E and PO.

Results

Activity levels

The statistics reported with the *P*-value for multiple comparisons[21] are the difference in average ranks (D_{rank}) and the critical value that needs to be exceeded (D_{crit}) for significance. The mean percentage of time the dogs spent in active behaviours was determined and significant differences identified were outlined below.

Boomer ball enrichment

There was no significant difference between PE, E and PO observations for the boomer balls in activity ($H = 5.13$, DF = 2, $P > 0.05$; Fig. 1A).

Scent enrichment

There were significant differences in activity levels across the PE, E and PO observations (Kruskal–Wallis $H = 27.59$, DF = 2, $P < 0.05$). Subsequent paired comparisons showed that scent enrichment significantly increased activity levels ($P < 0.01$) between PE and E as well as E and PO observations. There were no significant differences ($P > 0.05$) between PO and PE activity levels (Fig. 1B). Scanning increased ($P < 0.001$) during the scent enrichment from 4.2% median PE to 20.8% when E was provided ($D_{rank} = 21.7$, $D_{crit} = 16.6$, $P < 0.001$; Fig. 2). Scanning decreased in the PO period ($P < 0.01$), from 20.8% median to 8.3% when enrichment was removed ($D_{rank} = 18.8$, $D_{crit} = 13.5$, $P < 0.01$). Locomotion increased ($P < 0.01$) from PE levels (10.4% median) when the enrichment was provided (19.7% median) ($D_{rank} = 14.9$, $D_{crit} = 13.5$, $P < 0.01$) and decreased ($P < 0.001$) from E to PO (8.3 median; $D_{rank} = 23.5$, $D_{crit} = 16.6$, $P < 0.001$). Sniffing increased ($P < 0.01$) from 0% at PE, to 2% median during the E treatment ($D_{rank} = 15$, $D_{crit} = 13.5$, $P < 0.01$). The day after enrichment, sniffing had significantly ($P < 0.01$) decreased to negligible levels ($D_{rank} = 14.8$, $D_{crit} = 13.5$, $P < 0.01$).

Sandpit enrichment

Activity levels increased ($H = 24.55$, DF = 2, $P < 0.01$) between PE and E as well as between PE and PO (Fig. 1C). During the sandpit enrichment, locomotion increased ($P < 0.01$) from spending 4.2% median during PE to 8.3% of locomotive behaviours during enrichment ($D_{rank} = 14.9$, $D_{crit} = 13.5$, $P < 0.01$; Fig. 3). Locomotion increased ($P < 0.001$) from PE to PO (14.6% median; $D_{rank} = 20.8$, $D_{crit} = 16.6$, $P < 0.001$). Scanning also increased ($P < 0.001$), from 6.2% during PE to 17.7% of the time spent scanning during PO ($D_{rank} = 17.3$, $D_{crit} = 16.6$, $P < 0.001$). However, scanning did not increase ($P > 0.05$) from PE to when E was provided ($D_{rank} = 10.6$, $D_{crit} = 11.1$, $P > 0.05$).

Blood trail

Significant differences were found ($H = 29.65$, DF = 2, $P < 0.01$) between activity levels for PE vs. E and between PE and PO during the blood trail enrichment. However, there was no difference ($P > 0.05$) between E and PO activity levels (Fig. 1D). Locomotion increased ($P < 0.01$) from PE (6.2% median) to 11.4% during enrichment ($D_{rank} = 14.1$, $D_{crit} = 13.5$, $P < 0.01$). Sniffing increased ($P < 0.001$) to 6.2% when enrichment was provided ($D_{rank} = 18.6$, $D_{crit} = 16.6$, $P < 0.001$; Fig. 4). Sniffing decreased ($P < 0.01$) from when E was provided to PO. Scanning increased ($P < 0.001$) from PE (6.2% median) to E (15.6%), and also from PE to PO ($P < 0.01$ $D_{rank} = 16.5$, $D_{crit} = 13.5$, $P < 0.01$).

All enrichments

When all the enrichment treatments were presented to the dogs simultaneously, activity levels significantly ($P < 0.01$) decreased during the E period compared with the PE levels (Fig. 1E). Activity levels also significantly ($P < 0.01$) decreased from PE to PO and from E to PO. Sniffing decreased ($P < 0.05$) during PE ($D_{rank} = 11.3$, $D_{crit} = 11.1$, $P < 0.05$; Fig. 5). The percentage of time spent sniffing during E was 4.2% median but decreased ($P < 0.001$) to 0% during PO ($D_{rank} = 19.6$, $D_{crit} = 16.6$, $P < 0.001$). Sniffing did appear to slightly increase when enrichment was provided; however, not significantly so ($P > 0.05$). Scanning decreased ($P < 0.001$), from PE (12.5%) to PO

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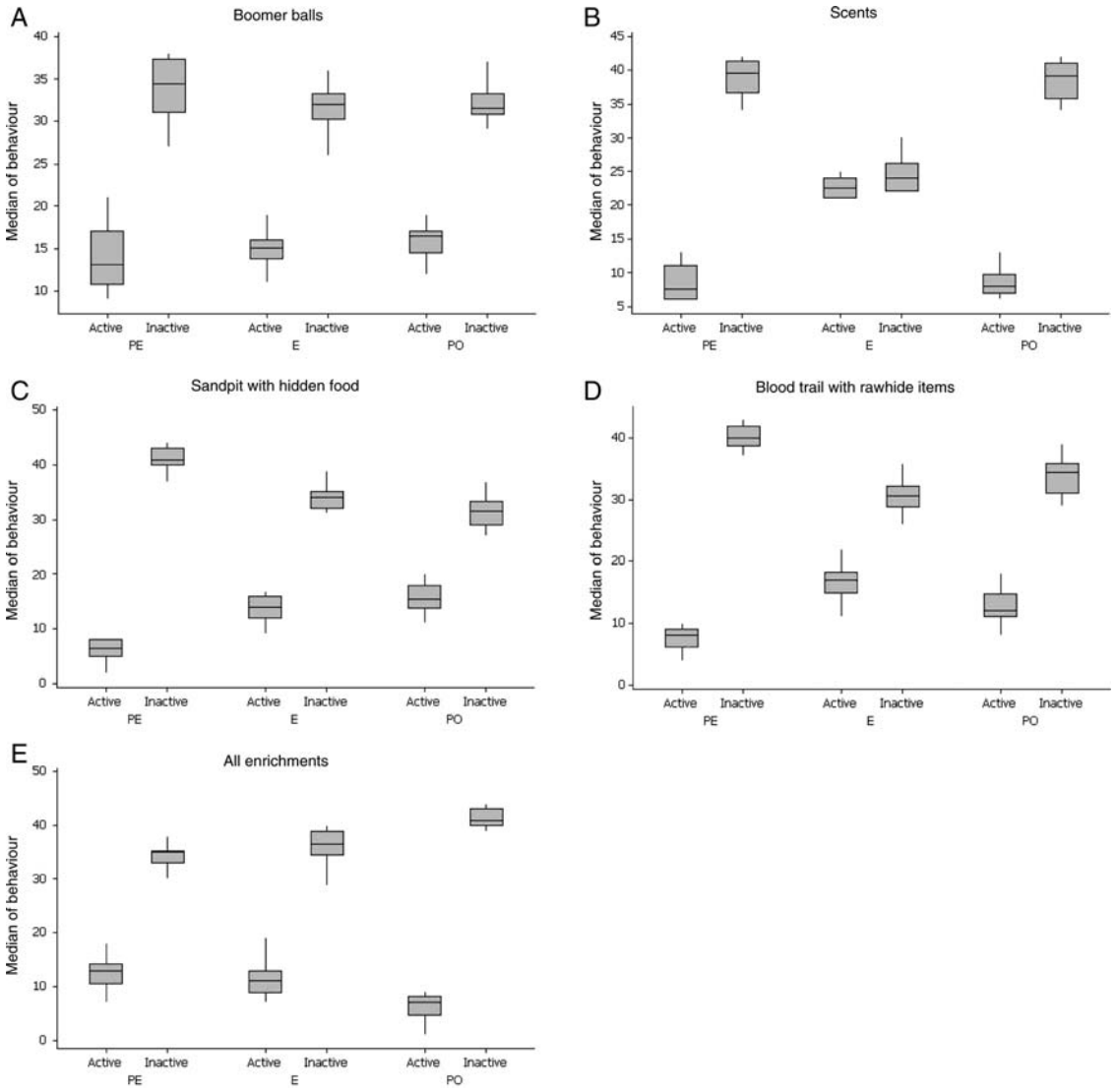

Figure 1. (**A**–**E**) Box plots illustrating medians, 25th and 75th percentiles for different enrichment treatments during PE, E and PO observations. (A) Boomer ball enrichment; (B) scent enrichment; (C) sandpit with hidden-food enrichment; (D) blood trail enrichment; (E) all enrichments (A–D) presented simultaneously.

(4.2%; $D_{rank} = 20.3$, $D_{crit} = 16.6$, $P < 0.001$), and from E to PO ($P < 0.01$) declining from 8.3% on the enrichment day to 4.2% during PO ($D_{rank} = 14.2$, $D_{crit} = 13.5$, $P < 0.01$). Scanning also decreased ($P < 0.01$) from 8.3% on the enrichment day to 4.2% the day after enrichment was taken away ($D_{rank} = 14.2$, $D_{crit} = 13.5$, $P < 0.01$). Locomotion decreased from PO to E and also from E to PO; however, not significantly ($P > 0.05$).

Analysis of abnormal behaviours

A Kruskal–Wallis test was used to compare any differences for abnormal behaviours across PE, E and PO observations. There were no significant differences ($n = 5$, DF = 2, $P > 0.05$) between PE, E and PO observations. When enrichment treatments were provided, abnormal behaviours increased, however, not significantly ($P > 0.05$) and were sustained the day after enrichment was removed (Fig. 6).

Discussion

It was hypothesized that enrichment would increase activity levels and reduce the occurrence of abnormal/undesirable behaviours in captive African wild dogs. The results showed no significant increases in activity levels during the boomer ball enrichment. Providing the dogs with novel enrichments such as balls stimulated no instinctive or sensory behaviours, thus indicating that this may not be a suitable enrichment item for captive African wild dogs. In

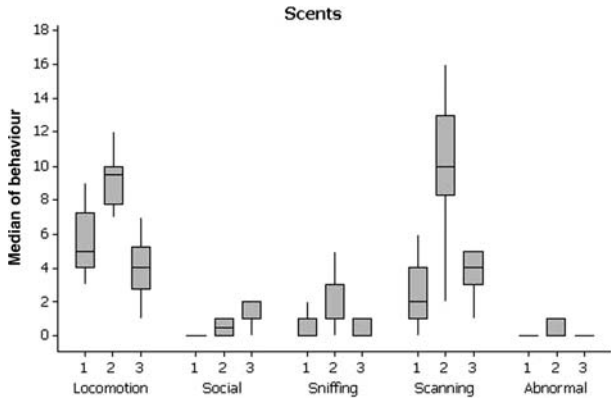

Figure 2. Box plots showing the percentage of time spent in behaviours for scent enrichment during PE (1), E (2) and PO (3) observations, illustrating medians, 25th and 75th percentiles.

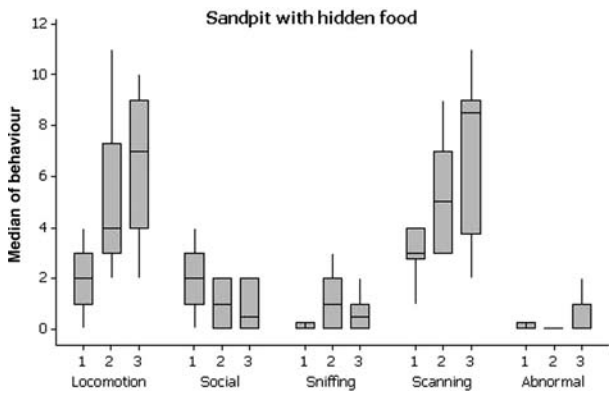

Figure 3. Box plots showing the percentage of time spent in behaviours for sandpit with hidden-food enrichment during PE (1), E (2) and PO (3) observations, illustrating medians, 25th and 75th percentiles.

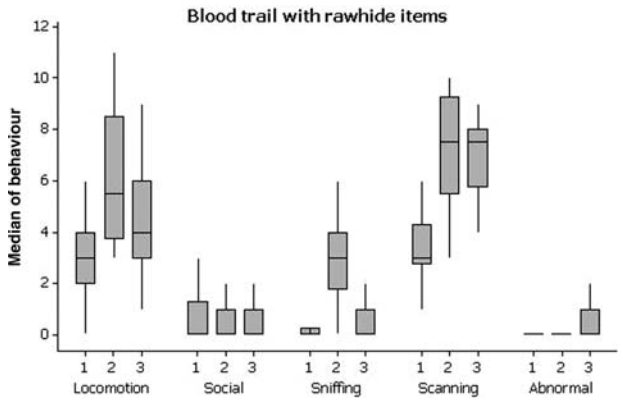

Figure 4. Box plots showing the percentage of time spent in behaviours for blood trail with rawhide items enrichment during PE (1), E (2) and PO (3) observations, illustrating medians, 25th and 75th percentiles.

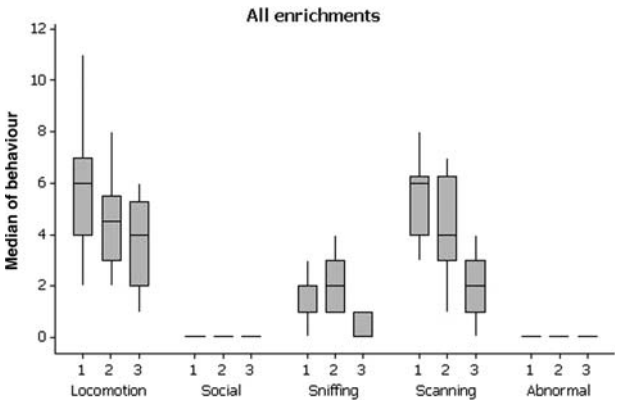

Figure 5. Box plots showing the percentage of time spent in behaviours for all enrichments presented simultaneously during PE (1), E (2) and PO (3) observations, illustrating medians, 25th and 75th percentiles.

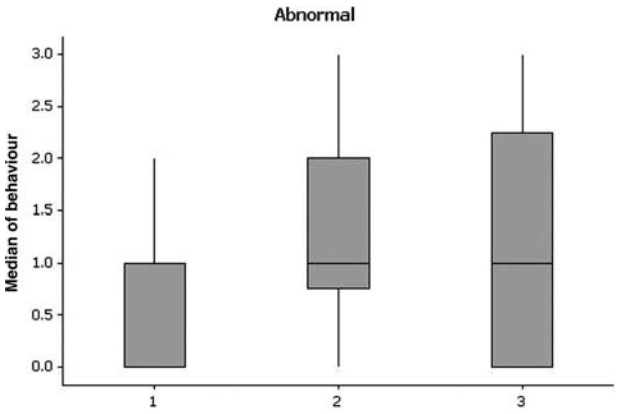

Figure 6. Box plots illustrating medians, 25th and 75th percentiles for abnormal behaviour during PE (1), E (2) and PO (3) observations (for all five enrichment treatments).

a similar study, it was found that the hiding of food was more effective than providing captive Maned wolves (*Chrysocyon brachyurus*) with boomer balls.[6] Presenting different scents to the dogs stimulated their olfactory senses and may have increased their activity levels when comparing baseline to enrichment levels. As sense of smell is well developed in the Canidae family,[16] the provision of this type of enrichment is likely to be successful, as shown by the use of spices that increased activity levels in captive felids.[8] During the scent enrichment, in this study, scanning, sniffing and locomotive behaviours increased from PE levels to the day of enrichment. The use of olfactory enrichment has been used to increase the scanning and moving in domestic dogs housed in a shelter.[22] Scanning and social behaviours increased from PE to PO observations. As the lemons and lavender were the only components of the scent enrichment that could be taken out the day after, the cumulative

effects of the enrichment left behind may have caused the sustained levels of activity during PO. However, locomotive behaviours decreased from the day of scent enrichment to PO.

The introduction of a sandpit that contained buried meat was provided to encourage the dogs to work for their food, as African wild dogs spend most of their time travelling and searching for food in the wild.[16]

The presentation of hidden food can increase exploratory behaviour and increase diversity of behaviours in captive animals.[23] Species-specific behaviours may be restricted in captive carnivores due to feeding regimes that do not fulfil the specific needs of an animal, thus it may become inactive or prone to particular behavioural problems.[24] Feeding enrichment has been used to address such problems. Artificial feeding devices were presented to a group of captive red foxes (*Vulpes vulpes*), to stimulate food searching behaviour and increase time spent feeding.[24] Their results indicated that opportunistic carnivores, such as the African wild dog,[25] natural foraging and feeding behaviours can be stimulated through the use of feeding enrichment. Increases in activity levels were seen during the sandpit treatment. Locomotion increased from PE to the day enrichment was provided, which may have been stimulated by searching for food. Locomotion and scanning also increased from PE to PO, suggesting that active behaviours were sustained the day after enrichment had been removed.

The blood trail that led to rawhide items and pigs ears was successful in stimulating more activity. Locomotion, sniffing and scanning increased from PE to the day of enrichment. Scanning was the only active behaviour with a sustained activity level after enrichment was removed. Providing rawhide items and pigs ears were aimed at simulating the chewing of bones. The idea was to discourage the dogs from chewing the public's vehicle parts and car tyres. Wild dog's canine teeth are narrow and have large premolars, which suggest they eat bone regularly.[15] As the dogs were only fed a diet of chunks of meat, they had no or little opportunity for whole carcass feeding. In one study the provision of bones to captive lions (*Panthera leo*) and tigers (*Panthera tigris sumatrae*) increased their feeding behaviours[26] and whole carcass feeding is said to benefit oral health and psychological well-being of captive animals.[27]

The last treatment consisted of putting all of the enrichments simultaneously. This was aimed at providing a choice of enrichments, stimulating the dogs for a longer period of time throughout the day and increasing the activity. However, this enrichment regime resulted negative effects on activity, whereas most individual enrichments caused a higher amount of active behaviours. Explanations to why this enrichment led to lowered activity may have been due to environmental factors, such as weather. The study took place in summer, some days were hot and others were overcast/rainy, in the wild African wild dogs may hunt on cooler, overcast days.[16] The dogs may have become confused by all the enrichments or been stimulated by them initially; however, becoming uninterested once they had been investigated. Therefore, the dogs may have habituated to their presence. As the dogs were observed to be extremely easily distracted and become bored quite quickly, attention to enrichment may have not lasted as long as predicted. Studies have shown how enrichment can wane over time.[11] Thus attention to time scales of the effects of enrichment should be considered in environmental enrichment research when trying to assess its effectiveness.

Abnormal/undesired behaviours

There were no significant differences found for abnormal behaviours between PO, E and PE observations. Abnormal behaviours increased slightly, albeit not significantly, from PE to the day of enrichment and the day after it had been introduced. Abnormal behaviours were highest during PE on the day scent enrichment was provided (Fig. 2). Not all scents may achieve their desired goals and may cause an increase in undesirable behaviours.[28] Some studies have shown observed increases in stereotypic behaviour when enrichment was provided.[10, 29] Scents are likely to be a key stimulus for rubbing,[30] which might explain why the dogs rubbed up against visitors vehicles. The sniffing of car exhausts may have been due to a lack of olfactory stimulation, as low stimulating environments can create sensory deprivation, which may lead to abnormal behaviours.[31] The scent and blood trail enrichment may have stimulated the dogs thus causing them to be more alert to their environment, which may have contributed to a slight increase in abnormal behaviours.

Another possible reason for the increase in abnormal behaviour during enrichment and post- enrichments days may be attributable to differing environmental factors, such as weather and visitor numbers. It was observed that on busier days visitor traffic caused queues in the dog reserve, which the dogs sensed, and halted traffic provided time to chew vehicle parts and tyres. Observations of a group of zoo housed primates (*Mandrillus sphinx*) indicated that with increasing numbers of visitors the monkeys displayed an increase in attention to visitors, activity and in stereotypic behaviour.[32] It has also been shown that the behaviour of captive leopards (*Panthera pardus*) is influenced by the presence of visitors.[3, 33]

Stereotypic behaviours are defined as regularly repeated and without an obvious function.[12] However the dogs' abnormal behaviours may have served a particular function, that of 'boredom', which is the concept of a lack of behavioural opportunities.[34] It is based on the idea that animals need to have something to do. Stereotypies or unwanted behaviour, such as that displayed by the African wild dog, may simply be replacing general behaviours in order for self-stimulation, thus reaching a level of physiological

arousal.[31] Indeed it could be said that visitors vehicles provide a type of enrichment for the dogs, as they are satisfying some need that they have in order to 'cope' with challenges in their environment,[35] although visitors vehicles could be a source of stressful excitement rather than of enrichment.[32] Enrichment that had been used previously may have affected the dogs behaviours at present, through learning. Car tyres had been put into the enclosure to try to prevent the dogs from from chewing visitor's car tyres and rope had been tied to the back of the keeper's car for the dogs to chase. This may have in fact exacerbated problems and driven the dogs to become attracted to the movement of visitor vehicles and encouraged the chewing of visitor's car tyres. A recommendation to prevent such abnormal/undesirable behaviours could perhaps be remedied by using positive reinforcement training as an enrichment strategy, by rewarding the dogs with food for desired behavioural responses.[36]

Recommended future enrichment programmes for this species may include a change in feeding regimes, i.e. regular but unpredictable whole carcass feeding to replicate the experience of a kill in the wild; an enrichment form which allows the animals to work for their food; the use of various and alternating olfactory enrichment; and as Canids are intelligent,[16] using a type of training to prevent undesirable behaviours may prove effective.

As African wild dogs occupy such a large territory in the wild, in the confines of a limited territorial captive area they may become frustrated through lack of stimulation, thus unwanted behaviours may occur in order to amuse themselves. Further environmental enrichment studies on captive wild dogs should aim to work with, not against the specific animals instinctual behavioural patterns. By doing so it can encourage natural fulfilment via allowing natural behaviour that would be experienced in the wild. Further research into environmental enrichment regimes of captive African wild dogs should include using larger sample sizes in order to evaluate the effects on wider captive populations, since enrichment research on this species in captivity is lacking; as no replicates of treatments were able to be tested in this study, due to time restraints and funding, confirmation of findings is needed; and finally evaluate the impact of climatic factors on behaviour, as weather may affect activity levels.

Conclusions

Boomer balls are not considered as a suitable enrichment item for captive African wild dogs in the present study. The use of scents, sandpit and blood trail as enrichment increased the dogs' activity levels and can provide a more stimulating environment for this species. The percentage of time the dogs' spent in active behaviours demonstrated that the provision of scents, sandpit and the blood trail enrichment elicited an increase in scanning, sniffing and locomotive behaviours. All enrichments when presented simultaneously did not have any effect upon behaviour. In this study, enrichment was unsuccessful in decreasing abnormal/undesirable behaviours. The effects of enrichment on the behaviour of captive African wild dogs must be treated with caution as other factors, i.e. environmental and visitors may affect behaviours. This study has shown promise for the use of enrichment to provide a more stimulating environment and elicit positive behaviours in captive African wild dogs. It is recommended that keepers produce and implement an enrichment plan, in order to promote natural behaviours and discourage abnormal or undesirable behaviours in this species.

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