Applied Animal Behaviour Science xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Ferrets' (*Mustela putorius furo*) enrichment priorities and preferences as determined in a seven-chamber consumer demand study

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ARTICLE INFO

Article history:
Received 16 February 2016
Received in revised form 22 April 2016
Accepted 24 April 2016
Available online xxx

Keywords:
Animal welfare
Behavioural priorities
Consumer demand
Enrichment
Ferret
Maximum price paid

ABSTRACT

Knowledge of species-specific motivation and preferences for enrichment options is necessary to put in place an appropriate enrichment plan. This knowledge is currently lacking for ferrets. Therefore, seven female ferrets were consecutively housed in a seven-chamber closed economy consumer demand set-up consisting of a corridor that was connected to six enrichment chambers (EC) and an empty control chamber (CC) via weighted doors. In each EC, enrichments from the categories tunnels, balls, water bowls, foraging, sleeping and social enrichment were placed in random order. Motivation to reach EC was measured by daily increasing the doors' weight until the ferret no longer entered EC (the maximum price paid, MPP). Preferences within a category were evaluated by comparing interaction times with the enrichments. Ferrets pushed the highest weights for sleeping enrichment (MPP 1450 ± 120 g). MPPs for water bowls (1075 ± 153 g), social enrichment (995 ± 267 g), foraging enrichment (950 ± 228 g) and tunnels (940 ± 393 g) were also significantly higher than for CC. Compared to other enrichments, inter-individual variation in motivation for access to tunnels was very high. Ferrets preferred the hammock (9.2 ± 5.9 h) over the Savic Cocoon® (0.6 ± 0.8 h; $P = 0.011$) within the category sleeping enrichment; the large (5.8 ± 1.7 min) over the small water bowl (3.1 ± 0.8 min; $P = 0.014$) within the category water bowls; the flexible (6.1 ± 2.6 min) over the rigid tunnel (0.3 ± 0.2; $P < 0.001$) within the category tunnels; and the ferret ball (0.9 ± 0.5 min) over the golf ball (0.3 ± 0.3 min, $P < 0.001$) within the category balls. Within the category foraging enrichment, no preference for one over the other item was found ($P = 0.144$). Results of this study show that a hammock, conspecifics, foraging enrichment and a large water bowl are preferred enrichment options for ferrets.

1. Introduction

Ferrets (*Mustela putorius furo*) are commonly used for research purposes (e.g. influenza research) (Boyce et al., 2001) and are kept as pets, but research on behaviour and behavioural priorities of these animals is scarce (for a review, see Vinke and Schoemaker, 2012). It is believed that ferrets could benefit greatly from environmental enrichment (Fisher, 2006), which is demonstrated by their use of three-dimensional environments containing toys and multilevel shelves (Wolfensohn and Lloyd, 2003). In addition, ferrets used a barren cage 6–12 times less than any of three enriched cages in a preference test (Cruden, 2011). Moreover, ferrets in barren cages showed signs of stereotypic behaviour (bar chewing and head swaying) and quickly became lethargic, whereas the ferrets in an enriched isolation cage were active and curious and remained so throughout the study (Cruden, 2011).

The aforementioned studies did not investigate the preference and/or motivation for specific enrichment options. However, enrichments for which ferrets show a high motivation could possibly allow for performance of behavioural priorities and a lack of opportunity to do so could lead to the development of abnormal behaviour and stress (Jensen and Pedersen, 2008). This in turn is detrimental to animal welfare as well as the reliability of study results, as inter-individual variation might increase due to stress (e.g. Verwer et al., 2009). A validated method to assess the motivational strength and value of resources is measuring the price an animal is prepared to "pay" for (unlimited) access to these resources

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http://dx.doi.org/10.1016/j.applanim.2016.04.022
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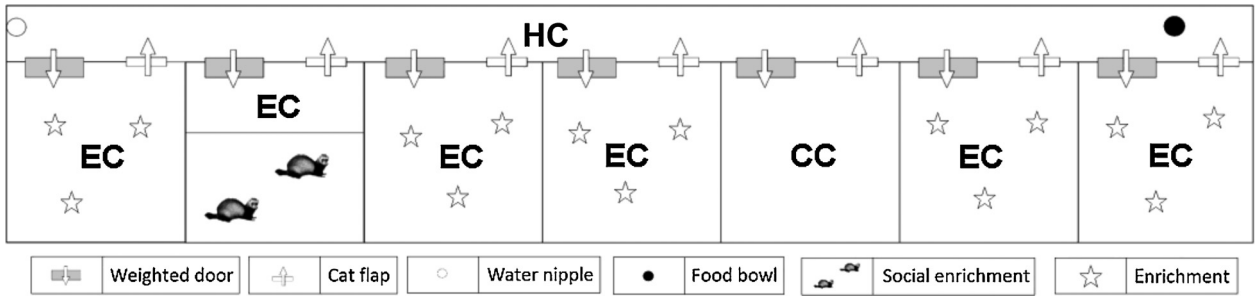

Fig. 1. Schematic representation of the experimental housing (HC = home corridor with a water nipple and food bowl, CC = control chamber, EC = enrichment chambers with, in randomised order, foraging enrichment, sleeping enrichment, tunnels, balls, conspecifics and water bowls).

(Cooper, 2004; Cooper and Mason, 2001; Mason et al., 1998). Such studies, referred to as consumer demand studies, involve imposing a strenuous task on the animal in order for it to gain access to a specific resource in a closed economy set-up. The task that the animal has to perform to gain access to the resource preferably involves an action that is considered a naturalistic task for the animal. Such a task requires the least amount of training and is also less prone to operant-reinforcer biases than unnatural tasks (Dawkins, 1990). In mink, a weighted door has been used for this purpose with success (Cooper and Mason, 2001).

By gradually increasing the effort that is needed to gain access to the resource, the maximum price paid (MPP) can be determined: the price at which the animal is no longer willing or able to perform the task. Compared to other indices used for measuring motivational strength, the MPP-index is believed to have the greatest internal validity (Houston, 1997), because 1) it is relatively insensitive to external cues (Warburton and Mason, 2003); 2) it can be applied to 'all-or-none' goods (Jensen and Pedersen, 2008; Olsson et al., 2002); and 3) an increase in price only has to be qualitative, so no assumptions about the subjective value of a task have to be made (Cooper, 2004).

Consumer demand studies often involve two-chamber set-ups that consist of a home chamber and one enrichment chamber in which the enrichments and an empty control are tested consecutively, as opposed to a three- or multi-chamber set-up, in which one or multiple resources and a control are tested concurrently. However, a recent study showed that a two-chamber set-up using a push door was unsuitable for ferrets, as they would push almost to their maximum push capacity for an empty compartment (Reijgwart et al., 2015). Thus, alternative set-ups (three- or multi-chamber) needed to be considered (e.g. Hovland et al., 2006; Mason et al., 2001; Seaman et al., 2008). In a three-chamber set-up, however, the enrichments are still tested consecutively, which might not solve the problems encountered in the two-chamber set-up. Therefore, a seven-chamber consumer demand study using a push door was used in this study to determine the maximum price ferrets paid for six enrichment categories (with different options per category) and one control chamber.

2. Animals and methods

2.1. Ethical note

This study was ethically approved by the Animal Care and Use Committee of Intravacc, Bilthoven, The Netherlands (DEC 201400137).

2.2. Animals, housing and husbandry

For the study, seven female, approximately 1 year old (range: 8–15 months), ferrets were used. Ferrets were obtained from Schimmel B.V., were surgically neutered (ovariectomized) at an age of 5 months and weighed 1011 ± 137 g at the moment of testing. Throughout the study, the ferrets were housed indoors in a room that was kept at a temperature between 19° C and 25° C. They were exposed to a 8:16 h light:dark schedule using artificial lighting (light bulbs) that switched on at 9:00 h and off at 17:00 h. In addition, auditory stimulation was available in the form of a radio to mask environmental noises, which automatically switched on and off concurrent with the light phase. Before and after the experiment, the ferrets were group-housed in phenolic faced plywood floor pens of 163 × 94 cm. In this pen, ferrets were provided with sawdust, a hiding place in the form of a flexible plastic bucket and *ad libitum* water (from a nipple) and food (Hope Farms® ferret balance pellets, Hope Farms, Woerden, the Netherlands). Refreshing of the food and water, as well as cleaning of the cages, took place daily at 9:30 am Prior to and throughout the study, the ferrets' health and overall condition were monitored on a daily basis.

2.3. Experimental housing

During the experiment, the ferrets were successively individually housed (24 h per day for a total of 26 days) in a closed economy, seven-chamber set-up consisting of one long corridor (692 cm long, 54 cm wide) connected to seven phenolic faced plywood floor pens (ground surface 107 × 94 cm; Fig. 1) with sawdust bedding. Between the corridor and each chamber, a 70 cm high, 6 mm thick phenolic faced plywood divider was present. The divider contained a wire mesh window through which the ferrets could see what was in the chamber, a non-transparent one-way cat flap (Petsafe® 4 Way Locking Deluxe Cat Flap, PetSafe, Ochten, The Netherlands); and a one-way horizontally hinged weighted door (Tecnilab-BMI, Someren, The Netherlands), similar to those used in the two-chamber study (Reijgwart et al., 2015). The weighted doors allowed the ferrets to move from the corridor, where *ad libitum* food and drinking water (via a nipple drinker) were provided, to the control chamber (CC), with only sawdust bedding, or the enrichment chambers (EC), where options from one of the enrichment categories (foraging toys, social contact, sleeping enrichment, water bowls, tunnels, balls) were placed in random order for each ferret. The one-way unweighted cat flaps, in contrast, could be used to return to the corridor. To push open the unweighted door, ferrets needed to exert a force of 200 g. Similar to the two-chamber study (Reijgwart et al., 2015), weights were added to the doors on a daily basis to gradually increase the effort needed to open the doors, starting with 250 g/day up to 1500 g, following which weights were increased with 125 g/day. The mechanism would transfer 50% of the added weight to the actual force needed for the ferret to open the door. Thus, a weight of 250 g translated to a push force of 325 g (200 + 50% of 250 g), a weight of 500 g to a push force of 450 g (200 + 50% of 500 g), etc. Under the doors, a wire mesh strip was

Please cite this article in press as: Reijgwart, M.L., et al., Ferrets' (*Mustela putorius furo*) enrichment priorities and preferences as determined in a seven-chamber consumer demand study. Appl. Anim. Behav. Sci. (2016), http://dx.doi.org/10.1016/j.applanim.2016.04.022