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A novel set of behavioural indicators for measuring perception of food by cats



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ABSTRACT

Behavioural indicators provide a promising approach for objective assessment of the perceptions of animals. In cats, the frequency of specific behaviours as indicators of perception has been studied in connection with food palatability. The aim of this study was to expand that knowledge by identifying behavioural indicators correlating with three degrees of palatability. Thirty-four pet cats were presented with three types of items: favoured food (FF), favoured food with a placebo mini-tablet hidden inside (TFF) and non-favoured food (NFF). The items were presented in a pseudo-randomised sequence, with six trials per item and 18 trials per cat. The behaviour of cats before, during and after eating, or refusing to eat, was video-recorded. Two trained observers, blinded to the types of food items, independently determined the frequency of 16 behavioural patterns on the video recordings. The data were analysed using a mixed logistic regression model. Five behavioural patterns differentiated FF from NFF; 'flick ears backwards', 'lick nose, not eaten', 'flick tail' and 'groom body' were more frequent with NFF, whereas 'lick lips' was more frequent with FF. One indicator, 'drop item', was more frequent with TFF than FF. These findings provide evidence of new behavioural indicators for objective assessment of food perception in cats. The findings also have practical applicability in designing a novel palatability test to be utilised in developing veterinary pharmaceuticals with improved palatability for cats.

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Introduction

To acquire information on the perceptions of animals, one approach is the use of behavioural indicators, which are behaviours occurring at differing frequencies during different physiological or emotional states. In cats, behavioural indicators have been identified for immune function impairments after arrival at a rescue shelter (Gourkow et al., 2014) and for perceived palatability of food (Bradshaw and Cook, 1996; Van den Bos et al., 2000). Further investigation is needed to develop veterinary pharmaceuticals with improved acceptability. Voluntary consumption of tablets in cats is typically below 50% (Ahmed and Kasraian, 2002). Studies have been performed to assess palatability, ease of administration (Litster et al., 2007; Gunew et al., 2008; Giraudel et al., 2010) and compliance with formulations (Traas et al., 2010; Khor et al., 2012). However these were only assessed by owners, or by recording whether the

cat ate a drug in food. The former method is subject to bias, while the latter does not measure whether one formulation is less aversive than another.

Palatability is related to a combination of odour, taste, mouth feel and temperature (Bradshaw et al., 1996; Hullár et al., 2001; Zaghini and Biagi, 2005). The individual taste preferences of cats vary (Bradshaw et al., 2000; Hullár et al., 2001; Thombre, 2004) and can have a learned component affected by the owner's preferences or the cat's earlier experiences (Bradshaw et al., 2000; Stasiak, 2002; Thombre, 2004). A correlation has been found between palatability and post-eating behavioural indicators associated with a pleasant taste. These include licking and/or sniffing the feeding bowl, licking the lips and grooming the face (Van den Bos et al., 2000). An aversive behavioural indicator includes licking and/or sniffing the food, and licking the nose (Van den Bos et al., 2000). Post-eating behaviour in general includes walking away with the tail down, licking the lips, grooming and occasionally shaking the head (Bradshaw and Cook, 1996). The aim of this study was to determine whether a novel set of behavioural indicators correlated with palatability of food and with food containing a placebo pharmaceutical.

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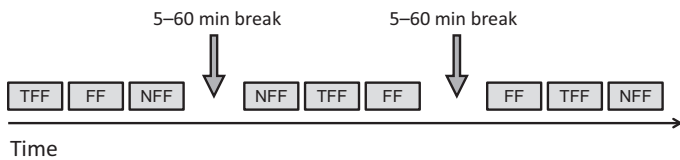


Fig. 1. The test protocol for each day consisted of three blocks of three trials. In each trial, the cat was presented with either favoured food (FF), FF with a hidden placebo mini-tablet (TFF), or non-FF (NFF). The items were presented in a pseudo-randomised order. Each cat was subjected to two consecutive days of testing, totalling 18 trials per cat. The figure shows an example of one trial for one cat. In the overall design of the study, the order of the food was balanced across cats and within individual cats. The latter was to also prevent the cat from learning what to expect next in the sequence.

Materials and methods

Cats

The study was carried out on privately owned pet cats in their homes. The owners were recruited from students and personnel of the Faculty of Veterinary Medicine at the University of Helsinki and their friends. No restrictions were set on the age or breed of the cats, or on the number of cats in the household. Exclusion criteria were severe gingivitis and a clinical illness, since these can affect appetite and/or taste perception. The health status of each cat was checked by a brief physical examination, carried out by a veterinarian before the experiment. Of the 46 cats enrolled, two were excluded because of severe gingivitis and 10 were excluded after enrolment due to owners following the instructions on camera placement or handling of the cat incorrectly. A total of 34 cats belonging to 17 owners were included. Age, breed and other characteristics are given in [Supplementary Table S1](#) (see [Appendix](#)).

Experimental design

All cats were subjected to all treatments in a pseudo-randomised cross-over study. Three types of edible items were used: favoured food (FF), non-favoured food (NFF) and a placebo mini-tablet inserted in the middle of the favoured food (TFF). For each cat, FF and NFF were selected by the owner according to the cat's known individual preferences (see [Appendix: Supplementary Table S2](#)). FF was defined as food preferred by the cat and with a consistency allowing a tablet to be hidden in it. NFF was defined as something edible the cat was unlikely to eat, such as a vegetable, but not irritating the mouth, respiratory system or eyes. In each trial, the quantity of food was approximately 1 cm³ and served at the temperature at which the cats were accustomed to receiving their food. The placebo mini-tablet was round, with a biconvex shape and a diameter of 3 mm; it was a novel formulation under development and none of the cats had prior experience of it. Ingredients are given in [Supplementary Table S3](#) (see [Appendix](#)).

The experiment was carried out on two consecutive days for each cat (except for cats number 29 and 30, which were only tested on one day). Each day included three blocks of trials, with a 5–60 min break between blocks. Each block consisted of three trials, carried out immediately one after another. In each trial, the cat was presented with one of the three types of edible items (FF, NFF or TFF), one of each in every block. The order of items was pseudo-randomised and balanced between blocks. Instructions on the order were given to the owner in writing. [Fig. 1](#) shows an example of a sequence of tests on one day for one cat.

All trials were carried out at the homes of the cats. To prevent behavioural effects of the presence of strangers, only owners were present in the trials. The number of

family members present was not limited, but the trials were always carried out by the same family member.

Behaviour was recorded for analysis with an HDC-SD600 video camera (Panasonic) and with the software HD Writer AE 2.1 (Panasonic). The video camera was delivered and the owners were instructed by the first author on the day before the first trial. The trials were carried out on a table or on a similar elevated surface familiar to the cat. A standard location for the edible item was marked with adhesive tape on the table. The camera was mounted at a distance of 70 cm from the tape mark, either on a low tripod on the table or on a high tripod near the table ([Fig. 2](#)). Illumination was provided with a Lersta standard lamp (IKEA) and a 53 W incandescent bulb (IKEA).

Each item was presented in a separate disposable paper bowl. The edges of the bowl were high enough to blind observers to the type of item. Adhesive tape was attached to the bottom of the bowl to fasten it onto a standard location on the table. Before the experiment, the cats were habituated to the table, paper bowl and camera by feeding them with FF in paper bowls on the table. Owners were instructed to not feed the cat overnight (for cats normally fed in the morning) or for 6 h before the trials (for cats fed at other times of the day). Water was provided ad libitum. To reduce residual odours from the previous item, owners were instructed to wash their hands between each trial and, if the cat dropped food on the table, to wipe that part of the table with a wet cloth before the next trial. Owners were instructed to ensure that no other animals were in the room during the trial. It was emphasised to each owner that the cat must not be forced to participate and was free to move about the table.

In each trial, the video recording was started, the bowl with the item was attached onto the table and the cat was called or lifted onto the table near the bowl. After the cat had either eaten the item or left the table after sniffing the item without eating it, the camera was turned off and the trial was completed. If the cat left the table without sniffing the item, the cat was lifted back onto the table and coaxed to sniff the item by pointing with a hand. If the cat again left the table without sniffing the item, the trial was registered as completed with no sniffing.

The hypothesis was tested that the frequency of 10 selected behaviours would correlate negatively with palatability and that the frequency of six other selected behaviours would correlate positively with palatability.

A statement of ethical approval, based on a pre-evaluation of the study, was obtained on 18 November 2010 from the Research Ethics Committee of the Viikki Campus of the University of Helsinki (minutes of meeting 6C/2010).

Data collection

Data were collected from the video recordings by two trained observers (the first and second author) independently registering the occurrences of 16 behaviours. The behaviours were selected during the pilot phase of the study; the ethogram is given in [Table 1](#).

The video recordings were analysed in a random order. The registering of behaviour commenced when the cat first sniffed the plate and finished at the end of the video recording. The collected data represented the occurrence of the 16 behaviours, recorded as yes/no for each trial. In addition, the following parameters were registered in each trial: (1) whether, at the beginning of the trial, the cat struggled vigorously in the arms of the owner and/or tried to leave the table immediately ('refuse in beginning'); (2) whether the cat did not sniff the bowl at all ('no approach'); and (3) whether the recording was stopped by the owner before the cat had left the testing table.

For analysis of video recordings, the first author used VLC Media Player software (VideoLAN) with normal playback speed as default. Slow-motion playback, usually half the normal speed, was used when necessary. The second author used Windows Media Player software (Microsoft) with normal playback speed. These playback speeds were established during the pilot phase as the optimal speeds for each observer. During the pilot study, it was verified that the observers consistently



Fig. 2. Layout of the trial. Each edible item was presented in a separate paper bowl. The video camera, mounted on a low tripod, and the light source are on the left in the photograph.

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