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The effects of social interaction and environmental enrichment on the space use, behaviour and stress of owned housecats facing a novel environment

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ABSTRACT

Every day, millions of domestic cats are held temporarily in captive environments, such as boarding catteries and rescue shelters. Being in confinement can potentially invoke high levels of stress for these animals. Therefore, there is a need to develop appropriate strategies to reduce these effects. Here, we investigated the effect of physical (inclusion of different objects) and social (extended social interaction with carers) alterations to the environment of owned neutered cats in confinement on their level of stress. To assess stress levels we used behavioural stress scoring (Cat Stress Score: CSS), faecal glucocorticoid metabolite analysis and CCTV recordings. We examined how cats used objects/space in confinement, if spatial preferences and behaviour were related to stress load, and if stress load was affected by social interaction. We calculated an electivity index, which measures utilisation of features in proportion to its availability in the environment, to show that cats displayed a preference for concealed areas and raised vantage points over large open spaces and owner-scented resting areas. Results of linear mixed models indicated that cats with the highest behavioural stress scores spent less than half as much time in open areas as cats with the lowest stress scores ($P = 0.023$). Furthermore, cats with the highest behavioural stress scores spent 10% more time in passive behaviours ($P = 0.008$), suppressed essential maintenance behaviours ($P < 0.001$) and exhibited approximately half the number of different behaviours ($P = 0.008$) compared with cats with the lowest stress scores. Extended social interaction with carers reduced behavioural stress scores from day 1 to day 2 (CSS 3.22–3.00; $P = 0.028$). Individual characteristics of cats affected stress, as cats with no previous experience in confinement (CSS for inexperienced cats 1.75 points higher than experienced cats of the same age; $P = 0.033$), older cats (0.21 increase in CSS for each year; $P = 0.022$) and male cats (CSS 1.17 points higher than female cats of the same age; $P = 0.037$) were more stressed. Our results show that cats with particular attributes are more vulnerable to experiencing stress in confinement and highlight that certain behaviours in confinement indicate more stressed individuals. However, stress may be effectively reduced through extended interactions with carers, and enriching the captive environment through addition of hiding spots and vertical climbing structures.

1. Introduction

The popularity of the domestic cat is increasing worldwide, and so is the concern for its welfare (Bernstein, 2007; Slater, 2007), particularly when housed in boarding catteries and rescue shelters as these environments could potentially invoke high levels of psychological distress (Jongman, 2007; Levine, 2008; Morgan and Tromborg, 2007). Given that millions of domestic cats are held under these challenging conditions (Marston and Bennett, 2009; New et al., 2000), there is a need to identify ways to reduce stress and thus improve the welfare in confinement of these animals. A potential solution is to incorporate environmental enrichment; alterations to an animal's environment that produce a measurable welfare improvement to the individual, at a behavioural or physiological level (Benefiel et al., 2005; Carlstead and Stepherdson, 2000). However, there remains only limited knowledge of which enrichment attributes provide an improvement in the welfare for most species, including cats.

Studies with domestic cats have demonstrated noticeable welfare improvements resulting from different enrichment regimes.

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Physical alterations, including provision of retreat areas and climbing structures (Newberry, 1995; Rochlitz, 2000), toys (Dantas-Divers et al., 2011) and olfactory stimulants (Ellis and Wells, 2010) can potentially reduce stress by adding extra security and cognitive stimulation. Social alterations, including extended human contact and housing according to socialisation type, have been particularly efficient at reducing stress resulting from social isolation, unfamiliar caretakers and conspecifics (Bradshaw and Hall, 1999; Kessler and Turner, 1999a; Ottway and Hawkins, 2003; Rochlitz et al., 1998). Reduced stress load has in turn resulted in lower incidence of disease, higher activity levels and more favourable adoption outcomes in rescue shelters (see for example Carlstead et al., 1993a; Gourkow and Fraser, 2006; Kry and Casey, 2007). A common assumption in previous studies is, however, that all cats benefit from the same enrichment strategies and react similarly under stress, although recent evidence suggests this might not always be the case (Ellis, 2009; Iki et al., 2011). Individual differences in stress responses of cats can result from socialisation experiences, previous experience in confinement, age and genetic factors (Lee et al., 2007; Lowe and Bradshaw, 2001; Reisner et al., 1994). Consequently, given the increasing prevalence of environmental enrichment for welfare improvement, it is important to understand how these factors might influence individual responses to enrichment, to ensure the best possible welfare gains.

The present study investigated enrichment strategies for owned housecats in the initial phases of confinement. Our first aim was to determine how cats used the space within their enclosure, and which areas were most frequented or avoided. Preference tests like these may be useful in identifying good welfare (Broom, 1988), but no such test has yet been performed in domestic cats. We aimed to investigate whether a concealed resting area, a raised vantage point, or a resting area containing the owner's scent profile would be preferred over other, more neutral areas within the enclosure. We expected a large number of cats to favour the concealed resting area or the raised vantage point, since the ability to hide and perch may serve as important coping strategies while adjusting to a new environment (Carlstead et al., 1993b; Rochlitz et al., 1998), and welfare commonly improves with the addition of physical alterations such as hiding spots (Carlstead et al., 1993a; Kry and Casey, 2007; Rochlitz, 2000). To our knowledge, provision of a familiar scent profile has not yet been validated as an enrichment strategy despite being used in many catteries. We expected a preference for the owner scented resting area as cats are strongly affected by olfactory cues (Crowell-Davis et al., 2004; Feldman, 1994) and many housecats have an intricate bond with their owner (Edwards et al., 2007; Karsh and Turner, 1988).

The second aim of our study was to investigate relationships between space use, behaviour and stress during confinement. We hypothesised that highly stressed individuals would prefer the concealed resting area and engage in behaviours indicative of high stress, including reduced activity levels and suppression of feeding, grooming and elimination (Barnett and Hemsworth, 1990; Ellis, 2009; Moberg, 2000). Conversely, we expected cats with lower stress to prefer more exposed areas such as the raised vantage point, and spend more time in active exploration and essential maintenance behaviours. Our final aim was to investigate whether extended human interaction, as well as individual attributes including temperament, age, sex and breed, would influence stress during confinement. Given that the involuntary separation from the owner is a significant stressor in owner-surrendered shelter cats (Dybdall et al., 2007), social enrichment may be highly effective at alleviating stress in companion cats (Carlstead et al., 1993a). We hypothesised, therefore, that cats receiving extended social interaction would have significantly lower stress levels compared to cats with a standard interaction regime.

2. Methods

All animal procedures were approved by the Animal Ethics Committee of La Trobe University (LTU AEC 12-54). In addition, a brief questionnaire used to survey cat owners in relation to their pets was approved by the Human Ethics Committee of La Trobe University (LTU HEC 12/R90).

2.1. Subjects

Twenty domestic cats were recruited from pet owners in the greater Melbourne region in Victoria, Australia. There were 11 males and nine females aged between 1 and 11 years, all were neutered (Table S1). Sixteen cats came from multi-cat households and 12 cats had regular access to the outdoors. Only three cats were not acquired by their current owner as kittens (median age 3 months). Prior to participation, seven cats had spent at least 1 week as adults in a confined setting and were classified as experienced boarders. Subjects were randomly assigned to a standard (SI) or extended (EI) interaction treatment group.

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2.2. Feline temperament profile

One week prior to trial, each cat was assessed in their home environment and assigned a feline temperament profile (FTP) score (Lee et al., 1983) according to methods outlined by Siegford et al. (2003). Briefly, the FTP test comprises 10 non-invasive challenges and evaluated the general temperament of the cat by assessing friendliness, playfulness, aggressiveness and fear (Lee et al., 1983). Each cat received a tally of positive (FTP^+) and negative (FTP^-) responses, and the total score was calculated as $(FTP^+)–(FTP^-)$. A high total FTP score was indicative of a bold and outgoing temperament, whereas a low total score indicated a shy temperament. The same member of the research team (LR) conducted all FTP tests, and with the same assistant present to record the results.

2.3. Experimental procedure

The experiment was conducted in a test room (Fig. 1a) at the Department of Zoology, La Trobe University, Melbourne, between December 2012 and August 2013. Each cat was boarded for 2 days in the test room, and the experimental procedure followed a standardised protocol where subjects arrived at the facilities at 09:00 h on Day 1, and departed at 17:00 h on Day 2. Upon arrival, cats were allowed 2 h to adjust to the surroundings before any measures were taken (McCune, 1992). Cats received either one (standard interaction group – SI) or three (extended interaction group – EI) 20 min sessions of social interaction per day, at 12:00 h (SI and EI), 14:00 h and 16:00 h (EI only). All cats were also visited once in the afternoon on Day 1 and once in the morning on Day 2 for room maintenance.

2.4. Layout of test room

The experimental room was 3.85 m × 3.65 m, included a food station with food and water available *ad libitum*, a litter tray, commercial cat toys, a resting basket with bedding material (Jaxtal Pet Bed, 50 cm × 40 cm × 12 cm, Jaxtal Imports, Victoria, Australia), and three physical objects as follows:

- Cat igloo (Jaxtal Cat Cave, 36 cm × 36 cm × 41 cm, Jaxtal Imports, Victoria, Australia), offering full concealment (Fig. 1b).