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Will a hiding box provide stress reduction for shelter cats?

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ABSTRACT

Domestic cats (*Felis sylvestris catus*) can experience serious stress in shelters. Stressful experiences can have a major impact on the cats' welfare and may cause higher incidences of infectious diseases in the shelters due to raised cortisol levels causing immunodeficiency. Though several studies showed preference for hiding places and stress reducing effects of hiding boxes on cats in combined studies, none of these studies determined if proper hiding enrichment would be effective in a quarantine cattery. These stress reducing effects are crucial in the first weeks after admission in which novelty stress is highest. The aim of the present study was to determine the effect of a hiding box on the stress levels of newly arrived cats in a Dutch animal shelter. Therefore, 19 newly arrived shelter cats were randomly divided into two groups, with ($N = 10$) and without a hiding box ($N = 9$). To determine the stress levels of recently admitted cats, behavioural observations were done during a 14-day period according to the Kessler and Turner Cat-Stress-Score (CSS).

The main results of this study are, that: (1) a significant difference was found between groups in the mean CSS on observation day 3 and 4, whereby the hiding box group had a lower mean CSS ($p < 0.01$); (2) the mean CSS of the hiding box group showed minimal variance, meaning that the hiding box had its effect on most experimental cats, whereas, high variance could be seen in the group without hiding boxes; (3) the mean CSS for both groups was equal at day 14, but this level of recovery was already reached around day 3 in the hiding box group.

These findings suggest that cats provided with a hiding box were able to recover faster in their new environment compared to cats without a hiding box, as measured by the CCS.

In summary, the hiding box appears to be an important enrichment for the cat to cope effectively with stressors in a new shelter environment the first weeks after arrival. Further research is needed to study the effect of a hiding box for group housed cats, its long term effects, and correlation with outbreak frequencies of infectious diseases.

1. Introduction

In the Netherlands about 34% of families keep cats as pets, resulting in 2.9 million cats in total and 1.7 cats per household on average (Borst et al., 2011). Despite this popularity, a large number of cats ends up as stray animals or become unwanted and are relinquished. Animal shelters of the Dutch Society for the Protection of Animals alone take in around 35,000 cats per year (Dierenbescherming Nederland, 2013) and the numbers are increasing.

The shelter environment contains many stressors, e.g. contacts with unfamiliar people, animals and objects in an

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unknown environment, which can be extremely stressful for cats in particular (e.g. McCune, 1992; Carlstead et al., 1993; Kessler and Turner, 1997; Neilson, 2002 Bradshaw et al., 2012). Chronic stress affects the stress physiology (e.g. increase of cortisol) with consequences for the animal's health due to immune suppression increasing the susceptibility to infectious diseases (e.g. feline upper respiratory tract infection [FURI]: Gaskell and Povey, 1977; Tanaka et al., 2012) with the risk for outbreaks of infectious diseases within the shelter (Speakman, 2005; Tanaka et al., 2012). This relationship between stress and immunodeficiency emphasises the importance of stress reduction in shelter cats and it is crucial to reduce stress as fast as possible after admission. The estimated length of a regular acclimatisation period to a new environment is about two weeks period (e.g. laboratory animals: van Ruiven et al., 1996; dogs: Kis et al., 2014).

Environmental enrichment is often used as an intervention to improve the complexity of the environment of captive animals and to meet their behaviour needs (Ellis, 2009), eventually reducing stress. Hiding behaviour is an intrinsic part of the biology of the cat and provisions to execute this behaviour in a shelter cage has earlier been studied in domestic cats in more detail. Results of Carlstead et al. (1993) showed that cats that were exposed to stressors increased their attempts to hide. This study additionally showed a significant decrease in urine cortisol if the cat was able to hide as compared with no hiding opportunities. In a study of Rochlitz et al. (1998), it was found that the experimental cats spent most of their time in their hiding box during the first two weeks after being housed in a novel environment. The urine cortisol creatinine ratio and the time spent hiding by the cats in this study gradually decreased during the observation time. Apparently, Gourkow and Fraser (2006) and Rochlitz et al. (1998) observed that animals without hiding boxes, made efforts to hide by turning their litter box upside down, creating an alternative hiding place. Kry and Casey (2007) emphasize the importance of hiding opportunities for cats, however, they concluded in their introduction that none of the available studies determined if proper hiding enrichment would decrease stress beyond that of conventional housing designs.

An example of a practical hiding enrichment is the BC ASPCA Hide and Perch box® originally designed in Canada. While a hiding box might be particularly useful in the stressful first weeks after admission, many Dutch shelters reject its use during this period due to arguments of limited cage space and hygiene. So far, no specific studies in quarantine catteries have been found available in the literature and we argue that a hiding box can be a stress reducing application, also in space limited quarantine conditions.

Therefore, the aim of the present study was to determine the potential effects of a hiding box on the stress level of newly arrived cats in cages used in quarantine situations, during the first two weeks in a Dutch shelter (which includes the time for quarantine). It was hypothesized that newly arrived cats that were able to hide in a hiding box would have significantly lower stress levels as based on the Kessler and Turner Cat-Stress-Score (CSS) and would adjust faster compared to the cats that were not able to hide in a box.

2. Material and methods

The study protocol was approved by the representatives of the University of Utrecht Institutional Animal Care and Use Ethical Committee.

2.1. Study site, housing and standard procedures

Data were obtained in a Dutch animal shelter. This shelter was of a medium size and accepts between 600 and 800 cats on a yearly basis. In general, new cats entering a Dutch shelter facility are held in a holding area for the legally required two weeks (Burgelijk Wetboek: art.5, lid 8) before being moved to an adoption area. Cats in holding areas are typically not on display and are not available for adoption.

The holding area was divided into several smaller quarantine rooms with traditional shelter design: upper and lower rows of metal cages lining one wall per room, preventing visual contact between the cats. The rooms featured natural day light from roof windows, combined with fluorescent lighting lit between 0800h and 1700 h daily. The ambient temperature was manually regulated by means of a central heating system and natural ventilation through the windows. During the study, the mean ambient temperature in the quarantine room of the hiding box group was 19.1 °C (±0.36SD) and for the control group it was 19.6 °C (±0.39SD). The ambient temperature of the two quarantine rooms did not drop below 15 °C during the observation period (no index observations if temperatures drop below 15 °C: advice of Kessler and Turner, 1997).

The study was conducted in two similar adjacent quarantine rooms in the holding area, which could be entered from the main facility through a small portal room. Direct contact with other employees, the public and dogs was thus prevented. Only the observer and the caretaker of the cats had access to the animals. As a standard, all cats were provided with a solitary cage [L × W × H: 70 × 74 × 72 cm] containing a water dish, a food bowl, three towels, a litter tray and a perching shelf [L × 74 cm] on 35 cm height. One towel covered the shelf, the other two covered the bottom of the cage. When the cage had a hiding box, one or two towels covered the cage floor inside the box.

Daily care for these cats was delivered by only one shelter staff member who was specifically assigned to this task. The cats received a high quality dry kibble cat food (VitalCare®, produced by Prins) and fresh water twice daily. The cages of the cats were cleaned daily after feeding in the morning. During cleaning cats were kept in transport boxes and returned to their cleaned cages.

2.2. Subjects

For this study 19 cats were selected on the basis of the following criteria:

(1) Breed: European short hair cats.
(2) Age: between 1 and 10 years of age. The age of stray cats was estimated at intake by the shelter veterinarian with an assessment of teeth and body condition.

The majority of the cats used in this study were strays taken in by the shelter, except for two cats whose owner had passed away. As Kessler and Turner (1997) and Kry and Casey (2007) found no significant differences in stress related behaviour between male and female cats, therefore, both males and females were included in the present study. The life history of most cats was unknown due to their stray background, so no selection based on individual life history of the animals could be made.

When admitted to the shelter, the cats were randomly appointed to each of the two research groups: one group provided with a hiding box ($N = 10$: 8♀ and 2♂) and a control group without a box ($N = 9$: 5♀ and 4♂). The age of the animals within the hiding box group ranged between 12 and 84 months (mean age: 24.1 months [±SD 22.2]; median: 18.0 months). The age of the animals without hiding box ranged between 18 and 72 months (mean age: 39.3 months [± SD19.9]; median: 36.0 months). Upon admission, all individual information of the cats, e.g. age, weight and sex, was registered by the shelter's veterinarian.

2.3. The hiding box

The hiding box used in this study was produced by the Dutch Society for the Protection of Animals and resembled the British Columbia SPCA Hide and Perch® box from Canada, except for the perching area on top. The Dutch box had no perching platform and was made of cardboard and offered a hiding place [L × W × H: 39 × 30 × 26 cm] with two possible entrances on two sides of the box. Hiding boxes were placed at the back of the cage at the right side before new cats were housed in these cages.

2.4. Behavioural assessment

The stress levels of shelter cats, either housed with or without a hiding box, were assessed with the help of the Cat-Stress-Score (CSS) as developed by Kessler and Turner (1997).

Conforming to the method used by Kry and Casey (2007), all cats were given an adjustment period of 24 h (= day 1) before the behavioural observations started. To avoid interferences with the daily cleaning and feeding procedures (before 13.30 h), behavioural observations took place after 14.00 h. The behaviour of the cats was recorded with a video camera (H.264 DVR), which was positioned in front of a cage. After installation of the camera, all cats were given two minutes to become accustomed to the presence of the equipment before the recording and behaviour scoring started. The observer was not present in the room and not visible for the cats to have least disturbance during observation times (Fig. 1). All behavioural observations were done by one and the same observer.

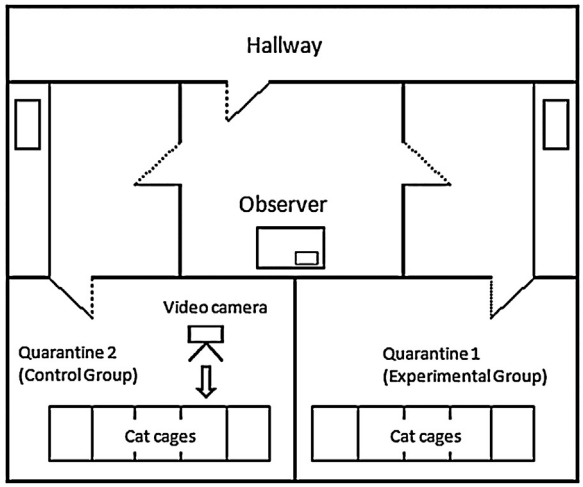

Fig. 1. Diagram of the experimental set up and observer and camera positions in the animal shelter.

2.5. Data collection

2.5.1. Scoring behaviour by the Cat-Stress-Score (CSS)

Except for the 24 h of adjustment after being admitted, every cat was observed for the next 6 successive days and at day 14 conforming to the study of Kry and Casey (2007). Observations and recordings per animal were done between 14.00 h and 17.00 h. Each animal was observed with a scan sampling method (Lehner, 1998) in which the CSS was scored 4 times for each individual cat during a 20-min observation period (the first observation at 5 min; the 2nd at 10 min; the 3th at 15 min and the 4th at 20 min). If some of the behavioural components could not be scored due to the position of the animal (e.g. the cat crouching with its head in one of the corners of the hiding box), or if details could not be captured by the video camera (e.g. pupil size), this was noted as a missing value.

The behaviour of the cats was scored according to the CSS of Kessler and Turner (1997). The component 'vocalization' was excluded from this index, because the recordings were not conclusive as the recorded vocalization did not necessarily correspond with the observed animals. Except for the vocalization the remaining ten behavioural components were scored with respect to postures of body, belly, legs, tail, head, eyes, pupils, ears, whiskers and activity. For ratings with comparable descriptions, components based on the median of the other components were scored (e.g. the rating for the component 'whiskers' is described as "lateral or forward' for scores 2, 3 and 4. If the median of the other scores was 3, subsequently score 3 was given for the component 'whiskers'). If the frequency of two scores were equal (e.g. the median is between 2 and 3), the lowest score had been given for the component (e.g. score 2).

To minimize observer drift and observer bias while improving intra-observer reliability (Lehner, 1998) definitions for behaviours and postures of the CSS were used according to the UK Cat Behaviour Working Group (Anonymous, 1995).

All data of the daily CSS observations were collected per cat by means of scoring all 10 components (e.g. body, belly,

etc.) for 7 different stress levels. The combination of a component and a particular stress level received a score of "1" if the animal expressed this behaviour at this stress level. All other combinations received a score of "0". Per sampling, the CSS of all 10 components were averaged to get a mean stress score of the individual cat. Subsequently, the four samplings (the observation at 5, 10, 15 and 20 min) of one day were averaged to generate a mean daily CSS per cat.

2.6. Scoring place preference

In order to determine the precise preference of cats for a place in the cage, e.g. hiding boxes or perching shelves, place preferences were scored. Place preference can give additional information on the potential functions of a hiding box (e.g. a hiding place versus an attractive place to sleep or to lie on).

Cats in their cage could either stay on the perching shelf [situation 1], in the hiding box (which only applied to the hiding box group) [situation 2] or elsewhere [situation 3]. Situation [1] and [2] were defined as: *the animal has more than two paws or more than 50% of its total body in that part of the cage.*

When not in situation [1] or [2], the position of the cat was scored as *elsewhere* [situation 3]. For the control group, *elsewhere* [situation 3] was divided into two groups: lying *behind their litter box* [3a] or *somewhere else* in their cage [3b]. Lying behind the litter box has been defined in the same way as for the hiding box group: *the animal has more than two paws or more than 50% of its total body on that part of the cage.* The purpose for this differentiation was to detect if alternative hiding activity could be seen in absence of proper hiding opportunities, as mentioned by Carlstead et al. (1993), Gourkow and Fraser (2006) and Kry and Casey (2007).

The time spent in situation 1, 2, 3a or 3b was registered as a percentage of the total observation time (i.e. 20 min). The mean daily scores of one research group on the six observation days were averaged to get a mean place preference of the total observation period per group.

2.7. Statistical analyses

Data were stored in a spreadsheet software program (Microsoft Excel 2003, Microsoft Corp, Redmond, Wash.) and the data analysis was done with the help of the statistical software program SPSS (IBM SPSS Statistics, version 20).

Firstly, a Spearman's R Correlation Test was carried out to control for correlations between mean daily CSS and the independent variables like age; weight; sex and medical treatment of the animals, respectively. The Spearman's Test showed no significant correlations for each of the mentioned independent variables. Consequently, the data of all cats within one group were combined.

Secondly, a Kolmogorov-Smirnov Test was performed on all data (place preference of the cats in their cage; the mean CSS and the frequencies of occurrence for each CSS) to control for normal distribution. This statistical test showed that the mean CSS of both groups were not normally distributed (hiding box group: $D\,(57) = 0.30$, $p < 0.01$, $N = 10$; control group: $D\,(53) = 0.15$, $p < 0.01$, $N = 9$). No normal distributions were found in the data of the mean CSS frequencies (hiding box group: $D\,(70) = 0.32$, $p < 0.01$, $N = 10$; control group: $D\,(63) = 0.29$, $p < 0.01$, $N = 9$). Due to non-normal distribution of both data sets and the relative small sample size ($N_{1,2} = 10{,}9$) non-parametric statistics were used for further statistical analysis.

To examine if the daily mean CSS of the two research groups differ significantly from each other, a Mann-Whitney U test was used. A Friedman test and *post hoc* Wilcoxon signed-ranks tests were used to examine for significant differences in the mean CSS over time between sets of two days within one research group. All inferential statistics were performed as two tailed. Bonferroni corrections were performed when multiple testing was applied in the Wilcoxon signed-ranks test in order to prevent chance capitalization.

3. Results

3.1. The mean Cat Stress Score

In Fig. 2 the differences in the mean CSS is presented between the two research groups on each observation day (day 1–5, and day 14). A Mann Whitney U test was performed to evaluate significant differences in the mean CSS between the two groups. Overall, the two groups differed significantly on observation day 3 ($U = 7.5$, $z = -3.2$, $p < 0.01$, $N_{1,2} = 10{,}9$) and on observation day 4 ($U = 10.0$, $z = -2.8$, $p < 0.01$, $N_{1,2} = 10{,}9$).

Fig. 2 shows differences between the two research groups in the extent of the S.E.M.'s, which was significant ($P = 0.03$). The S.E.M.'s of the hiding box group greatly decreased till almost zero on day 3 (0.04), 4 (0.03) and 5 (0.08). In contrast, the S.E.M.'s of the control group did not decrease, and relative higher standard errors were found over the different observation days (day 1: 0.26, day 2: 0.34, day 3: 0.31, day 4:0.27, resp. day 5: 0.30) until observation day 14 (0.09).

Significant differences of the mean CSS over the 14 days period of the two research groups were tested by the use of a Friedman Test. The results showed an overall significant difference in the mean CSS over the six observation days (day 1–5, and day 14) for both groups (hiding box group: $X^2(5) = 31.8$, $p < 0.01$, $N = 9$; control group: $X^2(5) = 27.0$ $p < 0.01$, $N = 8$). Subsequently, a post-hoc analysis was done with Wilcoxon signed-rank tests. Using a Bonferroni correction for multiple testing, however, no significant differences could be found after correction ($p = (0.05/15)$ 0.003) for both research groups on none of the data.

Fig. 3 shows the distribution of the mean frequencies of each CSS category (1–7) during the observations as expressed in percentages. The CSS categories with the highest frequency were the scores 2, 3 and 4. Together, they covered 98% of all the scores that were given in the hiding box group. For the control group this was 95% of the total scores.

Stress Score 6 was found exclusively in the control group, consistent with only 1.5% of the scores given in this

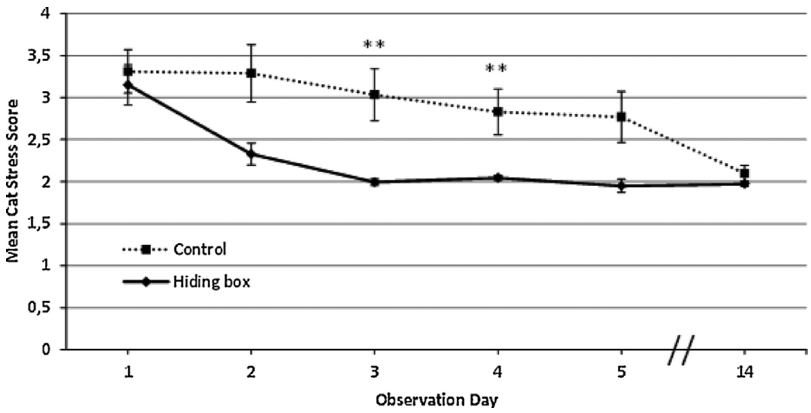

Fig. 2. Mean Stress Scores (± SEM) of the cats in the hiding box group (solid line) and the control group (dotted line) on each observation day (i.e. day 1–5 and day 14) (** significant $p < 0.01$, Bonferroni corrected).

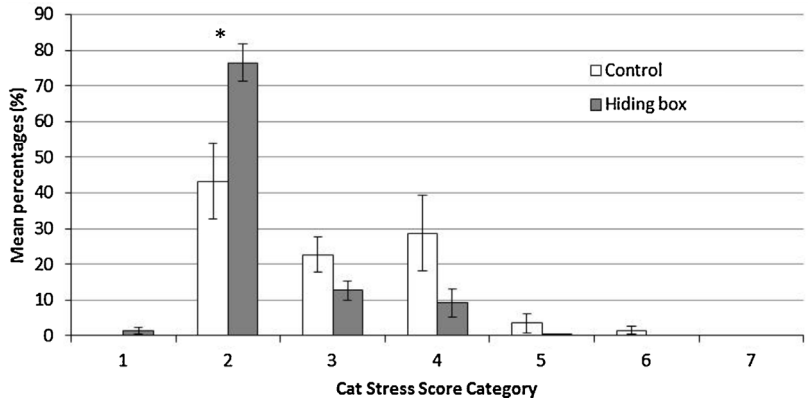

Fig. 3. Mean frequencies of each Cat Stress Score category in percentages of the total (± SEM) for the cats in the hiding box group and the control group.

group. For both groups, stress score of 7 was not assigned during the observations.

A Mann-Whitney U test was applied to look for significant differences in the occurrence of CSS categories between the two research groups. A significant difference between the groups with and without a hiding box was found for Stress Score 2 ($U = 15.0, z = -2.4, p < 0.05, N_{1,2} = 10, 9$), however, after application of the Bonferroni correction, no significant differences could be found ($p = (0.05/7)$ 0.007).

3.2. Place preference

In Fig. 4, time spent in different places in the cage is depicted for the hiding box group as well as the control group. Cats in the control group spent most of their time (45% of the total observation time) *behind their litter box*, whereas the cats in the hiding box group, spent most of their time (55% of the total observation time) *in their hiding box*. The amount of time spent *elsewhere* appears to be comparable between the two groups, with the control group spending 30% and the hiding box group spending 32% of their time *elsewhere*. The duration of time spent *on the shelf* varies between the groups (hiding box group: 13%; control group: 25%).

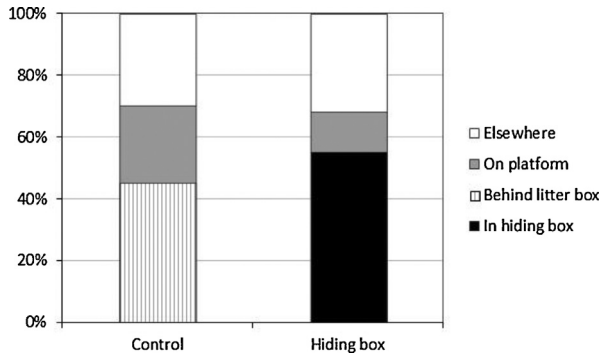

Fig. 4. Time spent in different locations in the cage by the cats in the hiding box group and control group expressed as percentages of the total observation period (120 min).

4. Discussion

The main purpose of the present study was to determine the effects of a hiding box on the stress levels of newly arrived cats housed in a Dutch animal shelter. It was hypothesized that newly arrived cats that were provided with a hiding box would show significantly lower stress levels in comparison to cats without a hiding box as

measured by the mean CSS and would adjust faster. The most important findings of the present study are, that:

(1) Overall, cats with hiding boxes showed lower mean CSSs as compared to the control group without a hiding box. More specifically, significant differences between the two groups were found on observation days 3 and 4;
(2) The mean CSS of the hiding box group decreased faster over a 14 days observation period, stabilizing on observation day 3, whereas, the control group needed at least a 5 days period. On observation day 14 both groups had an equal CSSs;
(3) Cats in the hiding box group showed less variance in their CSS outcomes as compared to the cats without a hiding box as showed by the lower S.E.M.'s;
(4) The cats of the control group showed "replacement hiding" behaviour within the possibilities they were provided, in this case hiding behind their litter boxes.

These results suggest that the presence of a hiding box has an important stress reducing function for cats in a novel situation such as the small quarantine cage in animal shelters at least the first two weeks after arrival. The finding is in line with the previous results in the studies of Carlstead et al. (1993), Rochlitz et al. (1998), Gourkow and Fraser (2006), Kry and Casey (2007). Some of the topics will be discussed in more detail below.

Stress levels of the cats of this study were assessed with the help of the CSS as developed by Kessler and Turner (1997). In general, the use of stress indices is discussable as they are hardly validated, so inclusion of physiological parameters is advised for a better validation (Ottway and Hawkins, 2003). However, this suggestion has the disadvantage that the collection of physiological parameters, like cortisol levels, are mostly more invasive and imply at least a short handling procedure, raising the stress levels of the newly arrived cats. The CSS was chosen for this research, without inclusion of physiological parameters, due to the following reasons: the non-invasive way of collecting data, no handling, the index is easy and quick to use, and it's an inexpensive method (Dybdall et al., 2007): all important considerations for shelter medicine research. The fact that Kessler and Turner (1997) found minimal inconsistencies between different components (e.g. a cat with exposed belly, but dilated eyes was not found) proves the robustness and reliability of the index as a measuring instrument (personal communication Kessler, 2013). Moreover, Gourkow et al., (2014) expect that behavioural parameters can be helpful indicators for stress in domestic cats in shelter as based on their study results on associations between some behavioural patterns, faecal cortisol and immunoglobulin A. Tanaka et al. (2012) found a relation between stress levels in cats and the reduction in body weight. Measurement of a cat's body weight (minimal handling, non-invasive and mostly already included in the intake procedures of shelters) might be a good alternative if additional parameters are necessary next to the behavioural data.

Overall, lower mean CSSs were found in cats with a hiding box. These findings are in agreement with the results of Kry and Casey (2007), wherein the cats provided with a hiding box also showed lower CSSs compared to cats without a hiding box. Moreover, the present study showed significant differences between the two research groups specifically on observation day 3 and 4, with lower CSSs in the hiding box group (days 3: CCS of 2 versus 3), suggesting a faster recovery. Due to the chosen observation schedule (behavioural observations on day 1, 2, 3, 4, 5 and 14), however, it is unknown at which precise day between observation day 5 and 14, the mean Stress Score level reached the level of "2" for the control group. The findings of Gourkow and Fraser (2006), who estimated the stress levels of individual cats for ten consecutive days with the CSS score of Kessler and Turner (1997), give additional insight. Their cats were divided into four research groups with different housing conditions: one group reflecting the typical conditions in a shelter (solitary housing, inconsistent care and no enrichment) and three alternative housing conditions (solitary or group housing, positive handling and different enrichment). Until observation day 9, a clear difference was seen between the groups, whereby the solitary group without enrichments showed much higher mean CSSs compared to the solitary and communal enriched groups. Speculatively, but based on the study of Gourkow and Fraser (2006), the mean CSSs of the control group in the present study most likely reached a CSS score of "2" before observation day 14, but not earlier than day 5. This result suggests that the cats with hiding boxes recover at least four days earlier than the control group without hiding boxes.

It is also important to consider how the CSS relates to the assessment of overall welfare of the cats. To this aim, Ottway and Hawkins (2003) developed a table in which the CSSs of Kessler and Turner was compared against key indicators of animal welfare. This table has been based on Broom and Johnson (1993), who described the potential consequences of stress and the corresponding influence on animal welfare. Kessler and Turner (1997) considered a stress score less than "3" as an "acceptable stress level", whereby, following the Ottway and Hawkins table (2003), the animal welfare status should be classified as "not impaired". A stress score of "5" is classified as "fearful, stiff", 6 as "very fearful" and 7 as "terrorized" with higher welfare impairments. These higher scores (>4) were rarely assigned in the present study. This relative lower CSSs in the present study might be explained by the fact that this animal shelter only takes in stray animals which are supposedly socialized (based on their behaviour and reaction on handling by people). Despite this selection of animals adapted to human presence, the research groups in this study, represent an average shelter cat, since the use of these criteria is common practice in almost all Dutch animal shelters. As a standard policy, feral cats are treated in a TNR project ("Trap, Neuter and Return") and thereafter returned to the place where they were captured to control the feral cat population (Dierenbescherming Nederland, 2012). Hence, these feral cats were not included in this research.

The incidence of a stress score of 4 (activity: "defensive sleep": Kessler and Turner, 1997), demonstrates the effect of the hiding box on the animal welfare. According to Ottway and Hawkins (2003, p.184) a stress score of 4 represents "*compromised welfare, since the animals have difficulty to cope with their environment*". In the present study, the

frequency of a stress score of 4 was highest in the control group (9% for the hiding box group versus 29% in the cats without hiding box), which was comparable with the study of Rochlitz et al. (1998). This implies that the animals in this group experienced a longer period of affected welfare. Intergroup difference in the frequency of stress score 4, however, was not significant which might be due to a type II error (high variation and small sample size). Considering situations in which the welfare was categorized as *not affected* (Ottway and Hawkins, Table 2; 2003), the two research groups role out in different ways. The incidence of a stress score of 2 ("weakly relaxed": Kessler and Turner, 1997) was 77% in the hiding box group versus 43% in the control group. Since a "2" score implies that the welfare of the animals is not affected (Ottway and Hawkins, Table 2; 2003), it can tentatively be concluded that the cats with the hiding boxes experienced better welfare during the observation period compared to the cats without hiding boxes.

In a previous research, (Roy (1992); cited in Rochlitz, 1999, p.8)) showed that "cats prefer material that maintains the same temperature" (e.g. a towel). Consequently, it was decided in the present study to provide the animals of both groups three towels in their cage to create similar living conditions and a comfortable place. One towel was placed on the shelf, one on the part of the cage left free and for the enriched group the third towel was placed inside the hiding box. Moreover, this provision controlled for the influence of the additional incentive value of the towel in the box. In this way the effect of the hiding value of the box could be shown more exclusively. Consequently, a more pure conclusion can be drawn that the meaning of the hiding box is not just an attractive or a pleasant place to sleep or to lie, but has a main concealing function for the cat.

The hiding box was used by the cats 55% of the total observation time. In the studies of Carlstead et al. (1993), Gourkow and Fraser (2006) and Kry and Casey (2007) it has been shown that cats that were deprived from resources whereby they were able to hide themselves, showed a behaviour that was described by Carlstead et al. (1993, p.1) as "an attempt to hide". The animals tried to hide from the stressors in their environment by "crouching behind their beds" (Kry and Casey, 2007, p.380) or litter pan (Gourkow and Fraser, 2006) in absence of a proper hiding place. This behaviour has also been seen in the control group in the present study: the animals within this research group spent 45% of the total observation time *behind their litter box* (Fig. 4). The fact that cats try to perform these kinds of alternative hiding suggests a high motivation to perform hiding behaviour, although there was no adequate opportunity.

5. Conclusion

The present research addressed the effect of hiding boxes on the stress level of solitary housed cats in quarantine rooms of a Dutch animal shelter during the first two weeks after arrival. The main findings show that *hiding* is an important behaviour for cats to adapt to their new environment. A simple device such as a hiding box might improve the welfare of shelter cats and is easy to use in a quarantine situation as well. As it is legally required to house shelter cats in social groups, most Dutch animal shelters relocate their cats after these 14 days of quarantine to a group housing room, from where they can be adopted by new owners. The stress reducing effects of the hiding box for group housed cats will therefore be a topic for future research. Moreover, we are interested in the correlation between the use of a hiding box and the frequencies of outbreaks of infectious diseases.

Websites

British Columbia society for the prevention of cruelty to animals (BC SPCA), Hide and Perch box®, website: http://www.spca.bc.ca/welfare/professional-resources/catsense/CatSense-Hide-Perch-Go-Box.html. Accessed July 4, 2014.

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