Changes in the behaviour of sheltered cats when coping with a new environment: focus on individuality and effects on sickness behaviour

Beteendeförändring hos katt på katthem vid byte av hemmiljö: en undersökning av individuella skillnader samt påverkan på ”sjukdomsbeteende”

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Skara 2014

Etologi och djurskyddsprogrammet

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Abstract

Environmental change, such as an arrival to a cat shelter, is something that has been seen to affect the domestic cat by increasing stress levels and sickness behaviours e.g. food deprivation and diarrhoea, and thereby jeopardise its welfare. Measuring stress and welfare is of importance when evaluating a cat's habituation and wellbeing in different situations. The invasive methods, such as measuring plasma cortisol as an indicator of stress, often cause discomfort to a cat. In this study, the method of observing behaviour when examining stress in cats is investigated. The first aim of this study was to see if cats' behaviour changes between two periods where one is supposed to be more stressful. The second aim was to see if measuring sickness behaviours might work as an indicator of psychological stress. In this study 11 sheltered cats were observed in a cat shelter in Sweden. Behaviour elements and sickness behaviours were observed during cats' first three days after their arrival to a new home environment. These behaviours were compared with behaviours observed during days when they had been in the new environment for longer than three days. The results showed that the relative frequency of observed behaviour elements such as body postures and activity, differs between the two periods suggesting that observing behaviour might be a valid method when investigating stress and welfare, although, the validity of the Cat-Stress-Score test used in research today could be questioned. The average amount of sickness behaviours decreased after the first three days after environmental change suggesting adaptation and that measuring sickness behaviour might be a valid method when investigating stress in sheltered cats. In this study sheltered cats were observed to hide 85 % more during the first three days after environmental change. A higher frequency of hiding behaviour was during this time period associated with a lower score of sickness behaviour. All cats except one were observed on a higher position, such as on top of a shelf or in a climbing-tree. The cats were observed to spend an average of 60 % of the time to be on higher positions during both periods. This might show that this is both a preferred coping strategy as well as a highly preferred position during everyday life for cats. Individual differences of strategies when coping with a new environment were shown. As a conclusion, this study shows that observing behaviour and measuring sickness behaviours such as diarrhoea, disruption of cage and food deprivation is useful when investigating cats' welfare. Individuality should be considered when judging their welfare based on their behaviour and methods for doing so should be investigated further. Hiding places along with a complex enrichment and elevated surfaces should be provided to cats, especially during stressful situations such as environmental changes, in order to increase their welfare.

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1. Introduction

The domestic cat (*Felis silvestris catus*) is one of the most popular companion animals in Western Europe as well as in the United States (Iki *et al*., 2011). 1.2 million cats are estimated to be housed with an owner in Sweden (SCB, 2012). Not all of the cats in Sweden live in family homes. Each year it is estimated that around 7.400 unwanted or homeless cats arrive to one of Sweden's approximate 62 cat shelters (Eriksson *et al*., 2009). Homelessness is stated to be the most common background of these cats, according to the study by Eriksson *et al.* (2009). In other parts of the world cats are commonly relinquished due to the owner experiencing behaviour problems with their cat (Salman *et al*., 2000). House soiling is stated to be the main behavioural reason in the U.S. for relinquishment of cats (Salman *et al*., 2000). The definition of house soiling in this study will signify urination and defecation outside the litter box. Among relinquished cats handed in for euthanasia in the U.S. 20% of the owners

claim that inappropriate elimination behaviour is the main reason behind the decision (Kass *et al*., 2001). Around 74 million owned cats are living in the U.S. (AVMA, 2012). According to the Humane society of the United States (HSUS, 2014), there are no data reporting system comprising sheltered cats in the U.S. but it is estimated that around 6-8 million cats and dogs enters a shelter each year. Among the Swedish shelters, 80 % of them have experienced abnormal behaviours in sheltered cats, such as fearfulness, aggression, feeding disorders and inappropriate elimination behaviours (Eriksson *et al*., 2009). According to Eriksson *et al.* (2009), abnormal behaviours were seen to make it more difficult to find new homes for the cats. Also it can be assumed that cats expressing abnormal behaviours like these are not experiencing good welfare. Newly arrived cats have been shown to experience a high level of stress during the three first days in a cat shelter because of the environmental change (Dybdall *et al*., 2005; Kessler & Turner, 1997). Even a small change in daily husbandry routines in a cat's life has been seen to increase signs of stress in the cat, both physiologically and behaviourally, like a higher urinary cortisol level and a supressed play behaviour (Carlstead *et al*., 1993). It is possible that the abnormal behaviours reported among relinquished and sheltered cats are related to stress.

1. 1. Sickness

Changes in cats' environment and daily routines have been seen to cause behaviours commonly related to sickness, called "sickness behaviours" (SB) (Stella *et al*., 2011; Seawright *et al*., 2014). SB's have been shown to increase in clinically healthy cats during changes of their environment including changes in husbandry, unfamiliar caretakers, feeding delays and withdrawal of playtime (Stella *et al*., 2011). The most commonly shown SB during the changes was decrease in food intake and increase of house soiling (Stella *et al*., 2011).

Behaviour changes in a sick animal are thought to be an evolved strategy to best fight disease (Hart, 1988). Fever, depression, reduction in eating and/or drinking, sleepiness and reduction in grooming activity, are common behaviour changes in a sick animal, and could enhance the animal's chance of surviving an illness (Hart, 1988). For example, an increase in body temperature and a reduction in plasma iron can inhibit bacterial growth (Kluger & Rothenburg, 1979). The immune system has been shown to be responsible for triggering the changes in behaviour, perception and mental state of a sick individual (Dantzer *et al*., 2008). Dantzer *et al.* (2008) describes that the same mechanisms for sickness caused by diseases and infections could be active in individuals with psychological illness. Stress affects the immune system (Black, 1994) and might be responsible for the presence of SB's in an animal.

Seawright *et al*. (2008) found that events that change a cat's life situation, such as changing home, can be stressful events that alone can cause physiological problems such as feline idiopathic cystitis (FIC). This study were only a case study so conclusions of the rest of the cat population is impossible to make, although, every bout of FIC in the cat could be linked to specific stressful events such as moving to a new house, and/or being shut into a room with other cats not part of its social group. Also, when presenting a home environment with separate resources and lot of hiding space the signs of FIC were absent (Seawright *et al.*, 2008).

Gourkow *et al*. (2014) were able to identify individuals in a cat shelter with behaviours indicating bad welfare such as freezing, crawl, startle and retreat from humans. Individuals displaying these behaviours were found to have reduced resistance against infections in the upper respiratory tract (Gourkow *et al*., 2014). This supports the view that behaviour elements and activities could be connected to bad health and valuable when investigating welfare in cats.

1. 2. Measuring stress

Being able to measure stress is of importance when trying to measure welfare in an animal. Measuring cortisol levels is something that many scientists have used in research when investigating stress in an animal (Hellhammer *et al*., 2009). According to Gourkow *et al*. (2014) cortisol level might not always be a correct indicator of stress in sheltered cats. Since the responses in the brain related to stress is caused by a number of factors and cortisol only affects it indirectly (Hellhammer *et al*., 2009). Gourkow *et al*. (2014) found that cats with varying health status showed the same cortisol levels and gives indications that cortisol might not be a reliable or valid measurement of stress and wellbeing in cats.

Measuring behaviour is a non-invasive method that might give a more accurate indication of stress (Gourkow *et al*., 2014). This also enables an observer to get information of what might be causing the potential stress (Jensen & Toates, 1997). Reduced activity and withdrawal behaviour may in cats be indicators of persistent stress and exploratory behaviour could indicate adaptation to a new environment (Carlstead *et al*., 1993).

McCune (1992) made a scale based on behaviour elements, which allowed an observer to study a cat and provide a score that describes how well this cat has adapted to a situation. Kessler & Turner (1997) further developed McCune's scale to a Cat-Stress-Score scale by adding some behaviours and posture elements. The Cat-Stress-Score (CSS) test from Kessler and Turner has been used in several studies where stress in cats has been estimated. Dybdall *et al*. (2007) found an association between a high stress score with illness, which supports the validity of the CSS. But Gourkow *et al*. (2014) found higher cortisol levels connected to behaviour elements that according to the CSS test have the lowest level of stress, i.e. friendly to humans and walking. This share light that two stress indicators, the CSS test and cortisol measurement, used in research today is contradictive and may reflect other factors than stress.

1. 3. Coping styles

Coping styles has been identified in research of a number of species (Koolhaas *et al*., 1999). An animal that responds with a behaviour to a stimulus, that is a potential stressor, is said to be coping (Jensen & Toates, 1997). If an animal is not able to cope it will enter a state of stress (Jensen & Toates, 1997). An animal should be provided the opportunity to cope and when coping successfully, physiological stress levels decreases (Wechsel, 1995). An unsuccessful and non-functioning coping behaviour can result in abnormal behaviours and worst a passive state – known as "learned helplessness" (Wechsel, 1995). Even the development of stereotypies is seen to be a coping strategy that lowers stress levels (Wechsel, 1995). In dogs, three coping styles have been identified during social stress but in general only two styles are considered, the reactive and the proactive (Horváth *et al*., 2007). The proactive coping style seems to be related to more action while the reactive is related to more passivity (Koolhaas *et al*., 1999; Horváth *et al*., 2007). An individual's coping style has been demonstrated to be stable both over time and across situations and originates from genetic and epigenetic factors during early life (Koolhaas *et al*., 1999; Koolhaas, 2008). Each style is considered to have advantage to an individual's fitness in different types of situations and therefore existent in animals because of evolutionary selection (Koolhaas, 2008). The two different coping styles seem to affect an individual's health and have different physiologic and neuroendocrine characteristics (Koolhaas *et al*., 1999; Koolhaas, 2008).

Iki *et al*. (2011) saw differences in how cats behave when exposed to a mild stressor and interpreted cats coping style based on their plasma cortisol response. All cats in the study of Iki *et al*. (2011) were of the same age and sex and were raised during similar conditions, which support the suggestion that the different responses could be due to cats' different coping styles. The type of coping style has seen to influence the plasma cortisol level during

stressful situations (Koolhaas *et al*., 1999; Horváth *et al*., 2007). In the study of Iki *et al*. (2011) cats expressing no change in behaviour or more locomotion during a mild stressor also showed a low cortisol response. These cats were interpreted as cats with a proactive (active) coping style. The cats that showed higher plasma levels in the same study were noted to show more vocalisation and were defined as cats with a reactive (passive) copings style (Iki *et al*., 2011).

If there are differences in how cats behave when experiencing stress this would be of relevance when using behaviour elements, such as activities and body postures, as indicators of stress.

2. The purpose of this study

The aim of this study was to examine if and how observations of behaviour elements could be a valid and reliable measurement when examine stress in sheltered cats. To do these specific behaviour elements in cats were investigated if they were expressed more frequently during a period when presumably experiencing a high level of stress because of environmental change. Individual differences in behaviour during this time were accounted to see if there were signs of certain behaviour styles among the individuals, as shown in the study of Iki *et al*. (2011). The behaviour styles in this study would indicate existence of coping styles among sheltered cats during stress caused by environmental changes.

The other aim of this study was to examine if SB could be a possible and valid measurement when investigating stress and welfare in cats. If SB's were associated to certain activities in cats during the stressful period it could indicate of more or less successful strategies in cats during environmental change.

2. 1. Research questions

- Is there a difference in frequency of certain expressed behaviour between the first three days at the shelter or in a new cage compared to days later on?
- Are there signs of different individual coping strategies among the cats at the shelter during the first three days at the shelter or in a new cage?
- Are SB's affected by the time housed at the shelter?
- How does SB's relate to certain behaviour elements during the first three days?

3. Material and methods

3. 1. Subjects

In this study 37 domestic cats were observed at a cat shelter in Sweden in their existing home-environment. Two observers studied all the cats housed in the shelter during three weeks in April 2014. The origin of the cats were mostly unknown, some were found in the streets, homeless, and some came from homes where the owner had died or in some other way were incapable of taking care of their pets. The police and the County administrative board of Stockholm took the decision of handing over the cats to the shelter. The age of the cats varied between seven months and 14 years (mean=5.3 years). The veterinarian at the shelter often estimated the age, since the origins of the cats were mostly unknown. The time housed at the shelter varied among the cats during the study (mean=33 days). Some cats were observed

from their first day while some cats had been at the shelter for four months when the first observation took place.

3. 1. 1. Husbandry

To lower the amount of changes in the husbandry of the cats during the study, a cat shelter with a staff establishment and set routines was chosen. This enabled more accurate results when investigating the effect of the time stayed at the shelter. The part of the shelter where observations took place contained five different areas; four adoption rooms and one quarantine area. Newly arrived cats were first placed in quarantine where they were housed singly or in pairs if they came from the same home. During the quarantine the cats were vaccinated, castrated and health checked. After around one month in quarantine the cats were moved to the adoption part and the staff decided eventual group compositions.

In each adoption room there were four cages with an area of approximately $3m^2$ and a height of 2.5m (Fig. 1). There was one bigger cage with an area of around $10m^2$ and a height of 2.5m high which housed six, later seven cats. In the smaller cages the cats were kept alone, in pairs or in threes. The cages were equipped with carpets, tables, climbing trees, shelves, blankets and pillows, some cages had a window. All cats, except one, had access to outdoor rooms of approximately 6 m^2, during some part of the day (8am to 3pm). The outdoor rooms were connected to each adoption room so that the cats could walk there on their own when the staff opened their cage. In the quarantine there were seven cages of approximately $1.5m^2$. These cages were more sparsely equipped with blankets, a table and a shelf. The temperature in the adoption area was on average 21°C and in the quarantine area 22.6°C on average.

During the study there were no changes in the routines of the cats husbandry executed by the staff at the shelter. All cages in both the quarantine and the adoption part had litter boxes that were cleaned at one time in the morning and after that in case of need in the afternoon. Between 7am and 12am the staff cleaned all cages. Feed was given in bowls after the cleaning of each cage. For one cat there were only one bowl of feed but more bowls with feed were presented in cages with more than one cat. Often the bowls of feed were placed at different heights in the cage, both on shelves and on the floor. Water was presented *ad libitum* in bowls on the floor.

Figure 1. The cages in the adoption area were equipped with blankets, shelves and hiding space (Skånberg, 2014).

3. 2. Observation methods

The aim was to observe the cats during their first days at the shelter and when moved to a new cage to see if and how their behaviour changed during their stay. The cats were studied in different time periods since they arrived and changed cages at different times. Cats studied during their first, second and third day at the shelter or in a new cage is counted as observations during period 1. Observations on day 4 and forward were counted as observations during period 2. Cats in period 1 along with cats in their day 4 were prioritized when making the observation scheme. Observations took place between 08:00 and 16:00.

All cats were given an individual ID so that all registration could be traced to an individual. Cages were numbered so that SB's could be traced to specific cages and

individuals. Cats in group- or pair housing were given numbers within every group, i.e. cat 1, cat 2 and cat 3, which were always the same at the different occasions of observation of that group.

If cats lived in pair or in bigger groups there were two observers for each observation, otherwise there were one observer per observation. Each observation lasted 30 minutes. During one minute at the start of each observation and during one minute after 15 minutes of observation, the observers registered behaviour elements based on elements from GAS and CSS (Appendix. 1) on one focal animal. If there were two observers they observed one individual each, which gives separate data from two individuals per cage and observation. Between the 10^{th} and the 30^{th} minute, use of space (UoS) (Appendix. 2) was registered using scan sampling where activity and positions of all individuals in the cage where registered. The registration method for UoS was time sampling and instantaneous registration with five minutes sample intervals and five sample points. When there were two observers, only one registered UoS.

Newly arrived cats were observed after two hours and after every observation the observers left the room for at least 15 minutes, before a new observation took place to give all cats the same conditions during the observations. The observers never interacted with the cats and always wore white costumes in the rooms during the three weeks for more accurate results with less affects from the observers. The registration of UoS did not start until after 10 minutes in the observation for the same reason.

The staff registered presences of SB's (Appendix. 3) in every cage between 7 and 12am every day. One cage got one registration of each SB so in cages with more than one cat there were no individual recordings of SB.

The presence and absence of body positions and sickness behaviours were coded with 0/1-coding. If a behaviour element were hard to define, or if the animal was not visible the registrations was left out for the concerned element.

3. 3. Statistical analysis

Statistical analyses and the processing's of the data were executed using Microsoft® Excel® 2011 (Version 14.3.8) and Minitab® 16.2.4.

Data from cats that were observed during both period 1 and period 2 in quarantine or in an adoption cage were separated from the rest of the data. Cats were given two individual average percentages of expressed behaviour, one average during period 1 and one during period 2. Data of body positions from the focal sampling were used to give the individuals the relative frequency of the expressed behaviour per observation and data of activity from the scan sampling were used to give each individual an average percentage in each sample point of period 1 respective of period 2. Body positions and activities that seemed relevant from my purpose and behaviours with more than one registration were analysed further (Tab. 1). The difference in average frequencies of behaviours between period 1 and 2 were compared with a 1-sample Wilcoxon test (n=11).

Behaviours that were hypothesized could be connected to coping strategies were analysed for possible correlation. The behaviour elements analysed were "active", "passive", "withdrawal behaviour", "F1 (front of the cage)", "F2" (back of the cage) and "higher position. The element "passive" was hypothesized to connect to "withdrawal behaviour" and "active" were hypothesized to connect to "F1 (front cage)". There were also an attempt to see how "higher position" might be correlated with the two hypothesized groups ("active" versus "passive"). Correlations of individual frequencies of these behaviours during period 1 were analysed using Pearson correlation and p value (n=17). The predetermined significant level of $p<0.05$ were chosen. Since there were five correlation attempts on the same data set there was a correction of the p-value using the Bonferroni method ($p'=k\times p$).

When comparing SB, the numbers of present SB were counted. One score of SB were given if the feeds were not eaten, if there were no presence of urine or faeces, when there were presence of vomit or diarrhoea, if there were no presence of faeces but presence of diarrhoea, when there were urine or faeces outside the litter box and when cage had been disrupted in some way. That means that a cage with both diarrhoea and a disruption of cage in 24 hours got two scores of SB that day. The average scores of SB's per day in period 1 and period 2 were then calculated. In cages with more than one individual, SB scores were divided with the number of individuals in the cage except the score for not eating their feeds. Differences between average SB's during period 1 and 2 were compared with a 1-sample Wilcoxon test (n=9). Associations between SB and average percentage of "F1", "F2", "Higher position", "hide", "visibly hiding", "not visible" and "active" were analysed by giving cages an average frequency of expressed body positions and activities. SB were reworked into a qualitative variable, "High SB" and "Low SB", divided the quantitative data at the median. Relationships were investigated using box plot graphs and the statistical significance was tested with Wilcoxon rank-sum test (n=9).

Table 1. Ethogram of selected relevant behaviours from the focal and scan sampling in this study where the behaviour of sheltered cats were observed.

Element categories	**Behaviour**	**Definition**
Body elements	Pupils – Normal	Pupils not dilated
	Pupils - Dilated	More than half of the iris consists of the pupil, but not the whole eye (fully dilated)
	Ears – Normal	Ears are relaxed and not tense
	Ears – Erect to front	Ears are tense and the opening to the auditory canal are turned forward
	Ears – Partially (slightly) flattened	Ears are somewhat tense and slightly flattened
Active behaviours	Vocalization -Purring	A purring sound is coming from the cat
	Vocalization - Meow	The cat is making a noise when closing its mouth
Passive behaviours	No vocalization/quiet	The cat are making no sound
	Motionless alert	Very awake and aware of things around but with no movements.
	Sleeping	Eyes are closed and there are no conscious movements.
Other	Hide	Hidden behind something in the cage and either partly visible or not visible.
	Visibly hiding	Hiding but visible for the observers outside the cage.
	Not visible	No part of the cat is visible for the observer.
	Withdrawal behaviour	The sum of the behaviour categories "hide" and "F2".
	Active	There are movements of any body part.
	Passive	There are no movement of any body part
Position	F1	On the front side of half of the floor closest to the opening to the cage and the observer.
	F2	On the side furthest in of half of the floor furthest away from the opening to the cage and the observer.
	Higher position	Higher position – cat is on a higher than 1dm above the floor level such as on shelves, trees and tables.

4. Results

4. 1. Differences between average percentages of expressed behaviour during period 1 and 2.

The mean of every individual's relative frequency of observed behaviour element during period 1 differed to period 2 (Tab. 2). The element that differed the most was "hide" that were observed 85 % more during period 1 than during period 2. The changes between behaviours the two time spans, period 1 and 2, were not significant ($p>0,05$). The element "higher position" showed a very minor difference between the average of the two time spans but a very high frequency during both periods.

Table 2. The mean of the 11 individuals' relative frequency in observed behaviour elements during period 1 and period 2. The cats are presumed to experience more stress during period 1 than period 2.

Behaviour element/Body position/Activity	**Average percentage during period 1**	**Average percentage during period 2**
Pupils – normal	0.11	0.42
Pupils – dilated	0.35	0.04
Ears – normal	0.28	0.50
Ears – erect to front	0.40	0.34
Ears – partially (slightly) flattened	0.31	0.11
Vocalization – none/quiet	0.85	0.70
Vocalization – purring	0.11	0.09
Vocalization – meow	0.05	0.19
Body position – motionless alert	0.28	0.03
Activity – passive (no movement)	0.66	0.78
Activity – active (movement)	0.34	0.22
Activity – sleeping	0.23	0.35
Activity – hide	0.49	0.08
Activity - visibly hiding	0.28	0.15
Activity – not visible	0.10	0.06
Activity – withdrawal behaviour	0.56	0.34
Position – Front floor (F1)	0.09	0.16
Position – Back floor (F2)	0.27	0.22
Position – higher position	0.63	0.62

Individuals' relative frequencies of observed behaviours were used to investigate the individual change from period 1 to period 2 (Tab. 3). The only thing that were common for all cats was that no one was observed to perform "hide" more during period 2 than during period 1. Individuals that were observed on "higher positions" more frequently during period 1 were never observed to perform "hide".

Table 3. Increase or decrease of individuals' relative frequency of observed behaviour during the three days at the shelter or in a new cage (period 1) compared to the rest (period 2). The negative numbers show that this behaviour increased in this individual after period 1 and vice versa for the positive.

	Changes in:					
Individual no.	**Activity**	**Hide**	**Higher position**	**F1-Front floor**	**F2-Back floor**	**Ears – Partially flattened**
1	*	+75%	0%	*	*	-25%
2	*	+25%	-75%	*	+75%	+100%
3	+70%	+17%	0%	*	*	*
4	-10%	+100%	0%	*	*	-25%
5	0%	*	+60%	-60%	*	*
6	*	0%	0%	*	*	*
7	*	*	0%	*	*	+100%
8	+20%	*	+40%	+13%	-53%	+25%
9	+7%	*	+27%	-27%	*	+50%
10	+13%	+100%	*	*	0%	-25%%
11	*	+50%	-33%	*	+33%	*

**No registration of this behaviour in the individual during period 1 and 2.*

4. 2. Correlations between behaviours

Individual frequencies of relevant behaviour elements were investigated further for signs of significant correlation. Positive significant correlations were found between "active" and "F1" (r^2=0.60, p=0.010) along with "passive" and "withdrawal behaviour" (r^2=0.48, p=0.045). Negative significant correlation was found between "higher position" and "F2" (r^2=0.66, p=0.000). No correlations were found between "higher position" and the elements "withdrawal behaviour" or "active".

When investigating behaviour elements expressed among individuals during the observations, cats were sometimes found to express behaviours from different scales of the CSS test on the same point in time. During one observation, a cat was observed with the behaviour elements "motionless alert", "half open eyes", "normal ears" and "normal whiskers". The behaviour element "crouched" was observed in cats showing all different categories of eyes, pupils, and ear positions.

4. 3. Sickness behaviour

All cages in the quarantine where cats had just arrived to the shelter showed SB's during the first 24 hours with a mean of 1.58 number of SB's. Cages during period 1 showed an average presence of 0.71 number of SB's per 24 hours. Cages during period 2 showed an average of 0.53 number of SB's per 24 hours. The differences in SB's between the two periods were not statistically significant ($p>0.05$) and randomness could not be left out as a factor.

When examining relationships between SB's and frequencies of activities some tendencies were found (Fig. 2). Higher scores of SB's seemed to be associated with cages showing higher frequencies of "hide", and with cages showing lower frequencies of "F1" but the associations were not significant ($p>0.05$).

a) b)

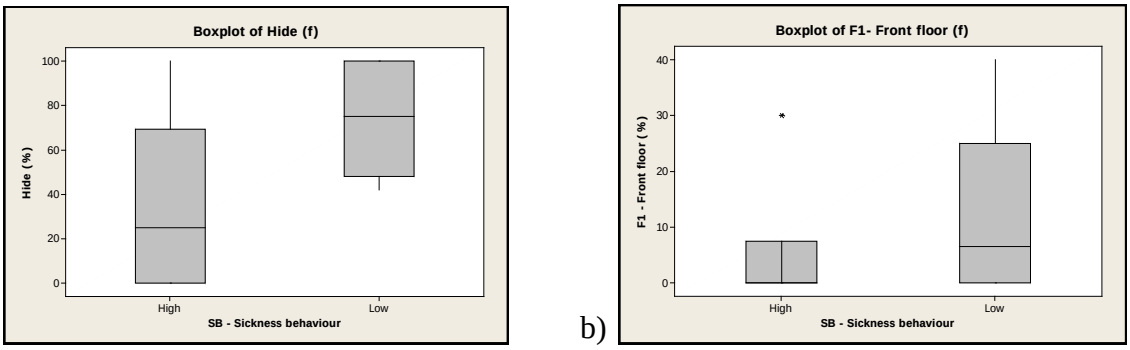

Figure 2. Relationships between high or low average score of SB with average frequencies of behaviour element a) Hide and b) presence in F1- front floor, during period 1.

5. Discussion

The aim with this study was to see if there were differences in cats' behaviour between two periods, where one is assumed to be cause higher stress levels, which there were. The average frequency of the behaviour "hide" differed the most and the behaviour "higher position" showed on the highest of frequency during both periods. The average number of sickness behaviour differed between the two periods. Individual differences were found when investigating behavioural strategies during the period where individuals were presumed to experience stress. During the same period, level of SB's seemed affected by frequencies of certain behaviour elements.

5. 1. The behaviour differences between the two periods

The changes in the behaviour among cats after period 1 support the idea of a behaviour test like the one developed by Kessler & Turner (1997) and that the behaviour of cats is affected by situations and emotions. The fact that the frequencies of behaviour changed suggest adaptation during period 2 and that behaviours observed more frequently during period 1 might be related to stress and attempts to cope with a new environment. Period 1 had a higher frequency of observed "dilated pupils", "ears erected to front", "partially flattened ears", "no vocalization/quiet", "motionless alert", "activity, "hide", "not visible" "visibly hiding", "withdrawal behaviour", and "F2 (back floor)". Perhaps these behaviours could be of value when determining welfare in cats and if a cat suddenly expresses more of these behaviours it might be disturbed by something in the environment. During period 2, there were higher

frequencies of observed “normal pupils”, “normal ears”, “meow”, “passivity”, “sleeping” and “F1 (front floor)”. These behaviours might be indicators of adaptation in cats when confronted with novel situations.

According to Carlstead *et al*. (1993) sleeping behaviour is suppressed during changes of environment. In a study of Rochlitz *et al*. (1998) cats slept more after one month in quarantine, while sleeping in cats during this study were seen to increase already after three days. The percentage of inactivity of the cats was high (94 %) in the study of Rochlitz *et al*. (1998) even if it decreased a bit after five weeks. The percentage of activity of the cats in this study was higher (average 28 %). The cats in the study of Rochlitz et *al*. (1998) had more sparing housing conditions and received a smaller amount of human contact than the cats in this study. Perhaps the different results show that cats more easily relax and are more positively active when the housing conditions are more complex and when they get more human contact. This is supported by Kry & Casey (2007) which noted that cats housed in more enriched cages slept more (20 % compared to 11 % of their time).

Four out of 11 individuals (36 %) showed more activity during period 1. Decrease in observed activity after period 1 (34 % during period 1 versus 22% during period 2) could counter Carlstead *et al*. (1993) results that lower activity is related to cats in pressed situations. Perhaps the higher activity during period 1 indicates a presence of an active coping strategy in the cats.

The fact that the observed differences in frequencies weren’t significant between period 1 and 2 could show of individual differences between the cats; that they handle same situations differently. When measuring stress and coping by observing behaviour, one same scale might not be true for all individuals.

5. 1. 1 Observing behaviours when addressing stress scores

The results of this study support the idea of the CSS test and that behaviour and body expressions could hold information of a cats stress level. Observing behaviour elements might tell us if a cat is adapting better or worse to a situation.

Observations during this study showed that behaviour elements (the foundation for the stress scores) corresponding to the different stress scales of the CSS, could occasionally be present in an individual at the same time point. For example “motionless alert”, a behaviour element exclusive for stress score 6 were observed together with elements that were at both the 1st and 2nd stress score level. The behaviour element “crouched”, categorized as being related to the highest level of stress in the CSS scale described as “terrorised”, were shown together with behaviour expression belonging to all of the other scales. This was not investigated further since these results might be enough to question the reliability of the stress score test and to show that it either need to further developed or that another way to measure stress in cats might be required.

5. 2. Hide

The behaviour “hide”, that meant hiding behind something in the cage either visibly hiding or not visible, was expressed of a much higher average frequency during period 1 than during period 2. Seven out of 11 individuals (64 %) were observed hiding during period 1 and all except one decreased in observed frequency of hiding during period 2. This shows that hiding might be a common behaviour shown when trying to cope with a situation of lost control, which is supported by Broom (1991).

According to Carlstead *et al*. (1993) “attempts to hide” increases along with higher cortisol levels when cats are experiencing changes in daily husbandry routines and with no possibility to hide. When cats get more hiding spaces sickness behaviour has been seen to

decrease (Seawright *et al.,* 2008), stress level has shown to decline and social and relaxed behaviours has seen to increase (Kry & Casey, 2007). A higher frequency of "hide" during period 1 was related to a lower average score of SB's during these days, which supports the case study of Seawright *et al*. (2008). The results of this study supports the view that the motivation to hide increase when cats experience stress and when getting possibility to perform the behaviour a cat can cope more easily and thereby decreasing its stress level (Jensen & Toates, 1997).

When housed in a cage with no hiding possibility the cats were observed to spend 36% of the time trying to hide behind a basket (Kry & Casey, 2007). The motivation for hiding behaviour seems to be broad among the domestic cat during new situations. Since no correlation was found between "hide" and "active" or "passive" this behaviour might be highly motivated even if the cat has an active or a more passive behaviour style. Giving opportunity to hide might be essential for increasing a cat's welfare.

5. 3. Higher position

The cats were on average observed on elevated positions, such as shelves, climbing trees and tables, more than 60 % of the time both during period 1 and 2. All of the cats except one were observed on higher positions. The results demonstrate a high motivation for the cats to be positioned on elevated surfaces. Higher positions allow cats to observe and perhaps get some control over their environment. This type of enrichment should be considered when housing cats, both during stressed situations and during their everyday life.

Some individuals (27 %) spent more time on higher position during period 1, some did the opposite (18 %) and some didn't change in frequency between the two periods (45 %). Some cats might have been trying to cope when positioning themselves on higher position while some preferred a higher position after adaptation to a new environment. Rochlitz *et al*. (1998) found that cats newly arrived to a quarantine spent a lot time hiding in the cage during the first two weeks and after that more time higher up on elevated surfaces. What was different to the results in our study were that cats didn't change in frequency of higher positions and is most likely because of their possibility to both be hiding and be on elevated surfaces in the same time. Competition among cats housed together might have influenced the choice of positions (Kry & Casey, 2007).

5. 4. Patterns among individuals

By observing individual differences in the changes of observed behaviour between period 1 and 2, indications of patterns in different strategies could be found.

Three out of 11 individuals (27 %) spent more time on elevated surfaces during period 1 compared to period 2. They all showed activity and no hiding during both periods. These three individuals were also the only ones spending time on the front floor position. Perhaps these individuals could be categorised as having a more active strategy when coping with new situations. The behaviour active and F1 (front floor) showed a significant positive correlation (r^2=0.60) during period 1 and could be further evidence that 27 % of the observed cats showed on an active coping strategy.

Passivity and withdrawal behaviour (hide and back floor) showed a significant positive correlation (r^2=0.48). Three out of 11 individuals (27 %) spent more or the same time on the back floor during period 1 while hiding and showing no or very little activity during the both periods. Perhaps these individuals are examples of a passive strategy when confronted with new situations. After the third day two of the individuals increased their percentage of higher positions, this relationship was also significant that back floor was negatively correlated with

higher positions (r^2=0.66) and higher position among these individuals might be a sign of adaptation.

The rest of the cats (46 %) showed no clear common pattern and this might share light that the active and passive coping strategies are likely to be masked, depending of situation and type of species (Wechsel, 1995).

5. 4. 1. Coping strategies or personality?

Some scientists believe that a lot of the behaviour expressed by an individual is affected by their personality (Wilson *et al*., 1994). The shy-boldness dimension is thought to be a fundamental axis of behaviour variation in many animal species, including humans (Wilson *et al.*, 1994). The personalities on the shy-boldness axis are thought of being evolutionary favourable such as the coping strategies because of the more risk-prone and more risk-averse individuals (Wilson *et al.,* 1994). An individual could have a personality in the extreme end of the axis or in the middle and the ones in the middle are seen to have more plasticity than the ones in the extremes (Wilson *et al*., 1994). Perhaps the six individuals observed with behaviour patterns in the active or passive strategy had personalities out in the extremes and that the rest of the cats had personalities in the middle of the shy-boldness axis with more plasticity and no clear pattern or strategy.

McCune (1995) demonstrated the effect of the father's interpreted friendliness on the offspring's behaviour. She found that friendly fathers got offspring who more quickly explored, touched and approached novel objects, were less likely to hide and handled novel situations better than the others (McCune, 1995). The feature "friendliness" was concluded to relate to the personality "boldness" and that this might be an inherited tendency (McCune, 1995). The response to humans and the vocalisations of the cats were affected by socialisation and in a new environment the cats that had both friendly fathers and were socialised were more likely to emerge than the others (McCune, 1995). Perhaps the three individuals in our study that spent time on the front floor, closest to the observers, were more socialised and offspring of a friendly father and the others offspring of a non-friendly father and were less socialised.

5. 5. Sickness behaviour as an indicator of stress and adaptation?

During cats first 24 hours at the shelter there were a presence of SB's among all. This suggests that all cats are finding the situation of entering a cat shelter tough and they all may experience a great deal of stress (Black, 1994; Dantzer *et al*., 2008). The average presence of SB's decreased with time stayed in a new cage, since it was lower in period 2 than during period 1. This could indicate that these cats are starting to adapt to the environment and that SB might be a possible way to measure stress and adaptation in sheltered cats. McCobb *et al*. (2005) found that cortisol levels decreased with time among cats housed in enriched shelters and this supports our results since the cats in this study lived in enriched cages. In non-enriched shelters the amount of time housed at the shelter did not seem to affect cortisol levels among cats (McCobb *et al*., 2005). Perhaps the decrease of SB would be left out among cats in our study if they had non-enriched cages with no possibility to hide or be on elevated surfaces.

5. 6. Factors affecting the result

The cat's background can affect the level of stress when arriving to a shelter (McCobb *et al*., 2005; Dybdall *et al*., 2007). Cats coming from a home environment given up by their owner have seen to show significantly higher stress levels than stray cats (Dybdall *et al*., 2007).

Some individuals might easily adapt to the new environment and not experiencing stress during period 1, some may still experience stress during period 2 and the stress should be confirmed from more than just the behaviour before making conclusions of the role of behaviour in assessment of stress.

Ottway & Hawkins (2003) claimed with reference to the CSS that cats living in groups with unfamiliar conspecifics were significantly more stressed than cats living alone or with a familiar conspecific in cat shelters. Since the used data for period 1 came from cats during their first three days at the shelter and in a new cage with or without unfamiliar conspecifics might have affected the result and that some cats were confronted with a more stressful environment. For further research identical stress inducing situations for the cats should be beneficial for more accurate results or a greater sample size.

Feaver *et al.* (1986) found that cats might be less active in the afternoon, which might have affected the results, since observations took place both in the mornings and afternoon with no direct schedule.

5. 6. 1. General discussion of the chosen methods

A lot of the cats used in the commentated researches in this study where behaviour elements and cortisol levels have been examined, have been housed in steel cages of around $1m^2$ and were very sparsely modified i.e. during the research of Carlstead *et al*., (1993), Dybdall *et al*., (2007) and Gourkow *et al*., (2014). If these cats were able to use their whole behaviour spectra can be discussed. This housing style is against Swedish legislation, probably with that as an argument. In Sweden, a sheltered or boarded cat must be housed in a box of at least $1.5m^2$ (SJVFS 2008:5, chapter 3, section 12). The cats in this study were housed in bigger and more enriched cages with more ability to express a variation of behaviours, than cats in research mentioned above, in attempt for more accurate results and should be provided for cats in future research. It can also be doubted that the results of these studies are comparable to the results of this study.

The results of this study showed that the observation methods used is useful when examine behaviours in sheltered cats. It was easy to use the methods and there were no obvious effects of the cats or the routines of the shelter during this study. The methods enabled a lot of registrations in a relatively short time period where a lot of different questions could be investigated. Therefore, these observation methods are recommended for further research of the behaviour among sheltered cats. Although, the small sample size useful in this study shows that a three weeks observation period might be too short. The conclusions of this study have, because of the small sample size, only week indications but the results could be useful for further discussion and research.

The fact that different observation methods were used for the different behaviour elements affected the average scores of expressed behaviour among individuals. For example the behaviour “hide”, registered with the focal sampling showed higher average than the merge of the behaviours “not visible” and “visibly hiding” from the scan sampling. For future research perhaps same behaviour elements should be observed by the same observation method.

A factor concerning the investigation of coping styles is that the behaviour element “passive” or “active” used in this study might not fully be translatable with passivity or activity as a coping strategy since the passive coping style might not be fully motionless and vice versa. Perhaps other definitions are needed for a direct translation.
The small sample size and the fact that there were more registrations during period 2 than 1 might have affected the results. For more accurate results should the number of observations in the two periods be equal. The presence of the observers might have, even if they didn’t interact with the cats and observed from outside the cage, affected the behaviour of the cats. A

video camera would have eliminated this factor of error and were used in the studies of Carlstead *et al*. (1993), Rochlitz *et al*. (1998) and Gourkow *et al*. (2014) which support the accuracy of their results. A video camera would also enable individual scores of SB's, which were impossible in this study when cats were housed in pairs or groups.

A common human error when observing animals is that behaviours easily can be missed out or that behaviours can be hard to define, for example to define body positions when a cat is hiding, and observers might define behaviour elements differently.

5. 7. Conclusion

This study shows that cats behaves different when arriving to a new environment compared to four days and more after the move, suggesting perceived stress during the first period and adaptation with less stress during the second period. To hide behind an object, visible or not visible, was the behaviour with greatest change between the two periods and was observed 85% more during the first period when cats were assumed to experience more stress. The average of observed body postures also differed in the cats between the periods. Pupil definitions or ear positions might be valuable for further research of a valid observation method when investigating stress levels in cats.

The variation among the individuals in expressed behaviours between the two periods should be investigated further in order to understand whether the differences are caused by different stress levels or by individual differences in behaviour when experiencing stress. With support by Broom (1991), Wilson *et al*. (1994) and Koolhaas *et al*. (1999), individuality in personality or coping style might have affected the behaviour and further investigations on how to account this in a reliable observation method should be carried out.

All of the newly arrived cats showed sickness behaviour during the first 24 hours and the average amount of sickness behaviour decreased with the time housed at the shelter, suggesting adaptation with time and that sickness behaviour might hold information of a cat's psychological state. There were tendencies that sickness behaviour might relate to certain behaviour elements expressed during the first assumed stressful period suggesting that some strategies among cats is more advantageous or that these behaviors' occurs more frequently among cats that experience less stress.

5. 7. 1. Usability of this study

Eriksson *et al*. (2009) made an assessment that each cat stays an average of three months in cat shelters in Sweden. Even if you might see that as a short period it is still as important to provide the cat with an environment that can enable good welfare. To enhance welfare is among other things, to give a possibility to easily cope with the environment (Broom, 1991). Where and how an animal spend their time could show indications of how to offer a good environment for the animal.

The results of this study suggests that cats in shelter-like-conditions should be provided with elevated surfaces and hiding spaces, at least one resource per individual, especially during environmental changes for enhancing welfare in cats. According to Swedish legislation, cats should be housed in enriched environments and have the possibility to hide and be on elevated surfaces (SJVFS 2008:5, chapter 3, section 2). What the regulation doesn't implicate is that all cats in a group should have possibility to hide at the same time. This is something that should be added to this regulation with referral to Kry & Casey (2007), who saw that cats compete of hiding and shelf space since they never used the same resource at the same time. The ability to hide has not been seen to affect the probability of adoption (Kry & Casey, 2007) so there is really no reason to why this shouldn't be provided to sheltered cats.

Welfare can be measured in many different ways (Broom, 1991). This study has investigated cats' behaviour and activities in a cat shelter and the results support the methods of observing behaviour elements and sickness behaviours when investigating welfare in sheltered cats. The results from this study along with other studies support the view that individual differences should be investigated when constructing a behaviour scale when measuring stress levels. The investigation of SB in this study showed that this is a possible, relatively easy and non-invasive way to measure welfare in cats and that SB's might be caused by psychological factors. The method is recommended both among staff at cat shelters but also in further research when welfare of cats is examined. The fact that there were no significant changes of SB's can either be because of the small sample size or that SB's are expressed individually or that some cats were experiencing higher stress than others.

5. 8. Future research

Using SB's when evaluating a cat's stress level is a relative new measurement and further evaluations are needed to make assumptions if this measurement is valid. Since this is a non-invasive method it is advantageous for cats' welfare and decreases the amount of discomfort when stress levels in cats are to be measured.

Observing behaviour is also a non-invasive method and more research should be performed on how the CSS scale could be reconstructed for increasing its validity and reliability. The type of chosen behaviour elements should be evaluated in order to understand whether they really are connected to stress.

Perhaps the behaviours expressed in cats are depending on the type of stressful situation and maybe a scale for each type of situation is needed when investigating stress levels in cats.

This study gave indications that scales might need to consider individual differences in expressed behaviours during stress. A valid and reliable behaviour scale would enable a correct examination of stress levels and enhance the possibilities of increasing welfare in cats.

With the arguments above, four questions for future research are raised:

- Is SB a valid measurement when investigating stress in cats?
- Which behaviours are always connected to stress in cats?
- What behaviours are cats expressing when experiencing stress in other stressful situations are they the same as the behaviours expressed more frequently during environmental change?
- How could a CSS scale with regards to individuality be designed?

6. Populärvetenskaplig sammanfattning

Forskning har visat att katter är känsliga för förändringar i sin miljö, både vad gäller större förändringar såsom en flytt till ny hemmiljö och vid mindre förändringar såsom nya utfodringsrutiner. Dessa förändringar har visat sig tillföra katter stress och sjukdomsbeteenden såsom kräkningar, matdepression och onormala elimineringsbeteenden.

Katter som befinner sig på katthem har troligtvis utsatts och kanske ständigt utsätts för en hel del miljöförändringar med nya kattgrannar, besökande intressenter och nya skötare. Det är möjligt att katthemskatter därmed är utsatta för en hög stressnivå. Vid upplevd stress ökar

kattens behov av att utföra beteenden som tillåter en hantering av stressen och därmed sänka sin stressnivå. Denna studie syftade till att undersöka hur katter beter sig och använder sin miljö vid en större miljöförändring på ett katthem. Undersökningen skedde på katter som just anlänt till katthemmet samt de som flyttats från karantän till en ny bur där det ofta redan befann sig främmande artfränder. Katterna levde i berikade burar som bland annat tillät dem att gömma sig och befinna sig på olika höjder. Sjukdomsbeteende tillsammans med kroppspositioner och aktiviteter undersöktes för att få indikationer om dessa element kan vara användbara vid slutsatser om katters välfärd.

Studien visade att katter ändrar sitt beteende efter de tre första dagarna från ankomst till ett katthem eller i en ny bur med främmande individer. Under de tre första dagarna då katterna antogs uppleva högst stressnivå var det exempelvis betydligt mer förekomst av vidgade pupiller, delvis tillplattade öron och en passiv klarvaken ställning hos katterna, jämfört med övriga dagar. Detta visar att man skulle kunna använda beteende vid mätning och bedömning av katters tillstånd som indikationer på stress eller anpassning.

Under de första tre dagarna så gömde de sig betydligt oftare, 85 % mer än under övriga dagar. Detta tyder på att det finns ett stort behov av ett tillbakadragande beteende just när en katt försöker hantera eventuell stress av en ny miljö och bör tillgodoses, särskilt när de är utsatta för miljöförändringar för att undvika dålig välfärd. Ju mer en katt gömde sig i genomsnitt desto lägre förekomst av sjukdomsbeteenden noterades hos denne katt i genomsnitt under de första tre dagarna. Detta visar att ”gömsel” kan vara en lyckad metod vid hantering av stress hos katt.

Att befinna sig på en högre position var något som observerades hos alla katter i studien utom en. I genomsnitt befann sig katterna 60 % av den observerade tiden på en högre position, såsom i ett klösträd eller på en hylla. Motivationen till denna förhöjda position tycks vara stor och bör tillgodoses vid hållning av katt för att öka dess välfärd.

7. Thanks

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8. 1. Pictures

Skånberg, L. 2014

Appendix 1.

***Ad libitum* observation**

Date:_____ **Time:**_____ **Protocol (1 or2):**_____ **Site:**_____ **Cat name/ID#:**_____ **Cage ID#:**_____ **Scorer:**_____

Body laid out (on back/on side/on stomach) sitting standing moving crouched (all fours) shaking flattened
Comments:_____

Belly exposed not exposed slow/normal vent. fast vent.
Comments:_____

Legs fully extended/stretched out front legs laid out hind legs laid out standing, extended standing, bent bent near surface paws turned in
front legs straight & hind legs bent against surface
Comments:_____

Tail extended loosely wrapped round body up loosely downward twitching tense downward close to body
Comments:_____

Head laid down (on surface) chin upward near surface over body moving on plane of body (somewhat crouched) lower than body (crouched)
flattened Comments:_____

Eyes pressed together closed ½ open slow blink normal (open) wide open (partially dilated) fully open (dilated)
Comments:_____

Pupils normal partially dilated dilated fully (very) dilated
Comments:_____

Ears normal erect to front (forward) erect to back partially (slightly) flattened fully flattened fully flattened & back on
head Comments:_____

Whiskers lateral forward normal back
Comments:_____

Vocalization chirp/'greet' none/quiet purring meow yowling growling
Comments:_____

Activity sleeping/resting awake alert/look around playing cramped sleeping trying to escape actively exploring prowling motionless
alert
hide groom allogroom knead rub
Comments:_____

Other drool eating drinking not visible
Comments:_____

Interval observation

Appendix 2.

Date:_____Room/Box ID:_____Obser.:_____Start:_____Stop:_____

	Cat name, ID# (noted before obs start)									
Tid										
10										
15										
20										
25										
30										

Position (room/box divided into positions before obs takes place) eg F1 (floor 1), Sh1 (shelf 1)	Behaviour
	S stand (only paws touch surface) Si sit (behind of cat in touch with surface) L lay (side, stomach or back of cat against surface)
	A active (moving any part of body) P passive (no movement)
	H hide (visibly hiding)
	NV not visible
	G groom
	AG allo-groom

Example:

A cat that is sitting on a shelf and grooming will be noted as;

Time	Mirre (ID 31)			
10	Sh1	Si	A	G

Appendix 3.

Sickness behaviour (last 24 h) (circle for present) placed outside of room/box. Noted before cage cleaning and morning feeding, noted on box/room level.

Room ID:_______________

Date:____________**Obs:**_________ **Eaten:** nothing ¼ ½ ¾ all **Presence of:** urine faeces diarrhoea | vomit | urine or faeces [outside litter pan]
Disruption of cage:____

Date:____________**Obs:**_________ **Eaten:** nothing ¼ ½ ¾ all **Presence of:** urine faeces diarrhoea | vomit | urine or faeces [outside litter pan]
Disruption of cage:____

Date:____________**Obs:**_________ **Eaten:** nothing ¼ ½ ¾ all **Presence of:** urine faeces diarrhoea | vomit | urine or faeces [outside litter pan]
Disruption of cage:____

Date:____________**Obs:**_________ **Eaten:** nothing ¼ ½ ¾ all **Presence of:** urine faeces diarrhoea | vomit | urine or faeces [outside litter pan]
Disruption of cage:____

Date:____________**Obs:**_________ **Eaten:** nothing ¼ ½ ¾ all **Presence of:** urine faeces diarrhoea | vomit | urine or faeces [outside litter pan]
Disruption of cage:____

Date:____________**Obs:**_________ **Eaten:** nothing ¼ ½ ¾ all **Presence of:** urine faeces diarrhoea | vomit | urine or faeces [outside litter pan]
Disruption of cage:____

Date:____________**Obs:**_________ **Eaten:** nothing ¼ ½ ¾ all **Presence of:** urine faeces diarrhoea | vomit | urine or faeces [outside litter pan]
Disruption of cage:____

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