THE EFFECTS OF GROUP-HOUSING ON THE BEHAVIOR OF DOMESTIC CATS
(*FELIS SYLVESTRIS CATUS*) IN AN ANIMAL SHELTER

Honors Thesis

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ABSTRACT

This study investigates the effects of group housing on the stress and behavior of domestic cats in an animal shelter. Twenty-four cats one-year of age and older were observed in the Tompkins County SPCA for three consecutive days. All behavior was continuously recorded. Density of cats in the room and length of stay at the shelter were also recorded. To measure the effects of group housing on a cat's behavior in relation to humans, a temperament test was performed each month for four months on a separate group of twenty-nine cats from the Tompkins County SPCA.

A reduction in stress was noted in cats staying in the shelter for over 8 months. These cats had a reduced ratio of negative (aggressive or defensive) interactions to total interactions, slept a more normal amount, and did not have inhibited grooming or movement. The number of cats in the room was correlated with an increased activity level and decreased sleep, because larger rooms had more human traffic. Negative interactions were positively correlated with time spent eating, indicating that cats had to stop avoidance behavior in order to reach the communal food bowl. The score the cat received on the temperament test did not vary significantly between test months.

Results indicate that the entry to the shelter environment is stressful, and the adjustment to group housing takes over 8 months. A four month stay in group housing did not seem to affect the temperament of a cat in relation to its behavior towards humans.

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1. INTRODUCTION

To improve the welfare of homeless animals, efforts have been made to enrich the housing in animal shelters. One of the major changes in housing cats has been a switch from single cages to rooms with colonies of cats. This change was thought to be enriching to the cat by providing more space and conspecifics with which to interact. However, group housing may be more stressful than enriching. Cats in groups are usually related or brought together as juveniles. This poses a major problem for the average shelter colony made up of unrelated adults of varying socialization backgrounds. Furthermore, the group is constantly in flux, as cats are adopted or added, and a stable group with dominance hierarchies cannot be formed. This study investigates the effect of group housing on the welfare of cats in a shelter through analysis of their behavior. It is hypothesized that cats would adjust over a course of months to shelter environment, but prolonged stays in group housing of over 8 months would result in signs of chronic stress such as lethargy and anorexia. It is also hypothesized that a stay in group housing at a shelter would affect the cat's temperament in relation to people. In addition, cats that were well socialized to humans are predicted to become less friendly the longer they stayed in the shelter, and cats that were poorly socialized are hypothesized to improve through the volunteers who worked daily to socialize them.

2. REVIEW OF THE LITERATURE

Domestic cats are gaining popularity as a pet, with 32.4% of United States households owning an average of 2.2 cats. There are currently an estimated 81,721,000

cats in the US, according to a census from the American Veterinary Medical Association. However, the unfortunate side effect of this popularity is the growing number of homeless cats and kittens that flood animal shelters every year. Older and other less desirable cats may face a significant amount of time in the shelter prior to adoption. The longer the animal stays in the shelter the higher the risk it has for disease and death (Gourkow & Fraser, 2006). Therefore every effort should be made to enhance the shelter design for adoption, while at the same time not compromising the welfare of its tenants.

Broom (1988) defines the welfare of an animal as its condition in relation to its ability to cope with its environment. Physical pain and reduced health are not the only factors in poor welfare. One major issue influencing the welfare of an animal which may not be plainly recognizable is stress. Stress occurs when an animal's environment over-taxes its control systems, thereby reducing fitness. Stress and general welfare can be precisely assessed through physiological and behavioral measurements. This study focuses on the behavioral measurements of stress and welfare. Some behavioral results of compromised welfare are stereotypic behavior, misdirected behavior, attacks on conspecifics, and the inhibition of normal behavior. Stereotypic behavior is a highly repetitive, apparently functionless, behavior (Houpt, 2005). While this can be a good measure of stress in other species, such as tongue rolling in cows, cats usually do not express stereotypic behaviors. Instead, inhibition of normal behavior is an indicator of compromised welfare in the cat (Ottway & Hawkins, 2003). This degree to which normal behavior is inhibited can also give an indication as to the extent of the welfare compromise (Broom, 1988).

When assessing the welfare of an animal, it is important to consider all aspects of its biology. The Five Freedoms are guidelines for optimum welfare of a farm animal (Farm Animal Welfare Council, 2007). These freedoms can be applied to domestic feline welfare (Rochlitz, 2005) and are as follows:

1. Provision of a balanced diet and water

2. Provision of a suitable environment

3. Provision of health care

4. Provision to express most natural behaviors

5. Protection from conditions likely to lead to fear and distress

Every point is essential to the welfare of the cat and affects the other points. For example, even the most comprehensive health care may be futile if the cat is stressed and its immune system compromised. Furthermore, most shelter situations are innately distressing for cats, making point five difficult to avoid. Therefore a shelter cat's housing should strive to provide the most optimal environment in accordance with the Five Freedoms; one which reduces stresses and allows expression of most natural behaviors.

One impediment in following the Five Freedoms for cats is that there has been much debate over what the cat's natural social behavior and structure actually is. It was believed previously that the domestic cat prefers solitary living, but will live in groups in order to utilize a food source (Laundre, 1977). It was also thought no dominance hierarchies were formed within these groups (van den Bos, 1998), and if they were it was only among females (Laundre, 1977). It is now believed that the domestic cat is a social species, and will only live solitarily if there are insufficient food resources. Cats that live in colonies have improved fitness through combined care for young (Bradshaw, 1992),

and males have improved fitness by more opportunities to mate through shared female partners. Cats within these social groups are able to recognize each other and have an internal structure based on matrilineal bonds (Crowell-Davis *et al*, 2004). Males have also been shown to form stable dominance hierarchies (Podberscek *et al*, 1991) and even form strong, non-competitive bonds. Because of this hierarchy and recognition, outside cats are not tolerated and the group will act aggressively towards them. Three to fours cats are likely to have a simple, linear hierarchy, while larger groups will have a more complex one, typical of most mammalian social groups (Crowell-Davis *et al*, 2004). Knowledge of the cat's natural biology is important in designing a shelter system that follows the Five Freedoms. While conditions in the feral or free-living environment are far from ideal welfare states, they do provide an insight into the animal's preferences (Broom, 1988), which is important knowledge for designing a welfare-friendly captive situation.

Traditionally, shelters for stray, unwanted, and relinquished cats were designed with easy cleaning and disease prevention in mind. In North America, cats were typically housed in stainless steel cages with limited enrichment. However, it is now recognized that these types of barren environments not only reduce the welfare of the cats, but also may inhibit disease prevention by compromising its immune system through stress. Furthermore barren environments have been shown to decrease adoption rates when compared to enriched environments. This is because a majority of owners see playful, happy and relaxed as their reasons for adopting a cat (Gourkow & Fraser, 2006). Cats which are less stressed may be friendlier and thus appeal more to potential adopters (Turner & Bateson, 2000). Many factors play a role in the stress level of the shelter cat.

Consistent and predictable handling by familiar personnel was found to be the most important factor in minimizing stress in a study on laboratory cats (Carlstead *et al,* 1993). Another important factor in minimizing stress is improvement of the housing conditions themselves. Various efforts have been made to enrich the cages in a shelter and make them more "cat-friendly". One specific form of enrichment extremely important in any cat's housing is a place to hide. Hiding was found to significantly reduce stress in cats housed alone, while, contrary to popular belief, the ability to hide did not have a negative effect on their adoption rate (Kry & Casey, 2007). Other forms of enrichment include windows with natural light, elevation of the cages above ground level, and soundproofing (McCobb *et al,* 2005).

One of the major changes undertaken to enrich shelter housing for cats has been a switch from single cages to rooms with colonies of cats. This change was thought to be beneficial to the cat by providing more room and conspecifics for interaction. It is also thought to improve adoption rates by creating a more appealing atmosphere and allowing potential owners to interact directly with the cats. However, group housing may be more stressful than enriching to some cats. The most obvious problem with group housing is that it forces cats into an unnatural social arrangement. Colonies of cats have established bonds through relatedness and early socialization. If another cat was to be accepted into the group it would be slowly through established familiarity (Crowell-Davis *et al,* 2004). Even in cats that have lived their entire lives together in the same home, littermates spend more time in contact with each other, grooming sleeping and feeding together, than unrelated cats (Bradshaw & Hall, 1999). This poses a major problem for the average shelter colony made up of unrelated adults of varying socialization backgrounds. The

group is also constantly in flux, as cats are adopted or added. Cats have not been found to have post-conflict mechanisms of reconciliation, and since a stable group with dominance hierarchies cannot be formed, avoidance and tolerance become the most important coping mechanisms (van de Bos, 1998). These behaviors may not always be possible in a crowded shelter, resulting in negative interactions and further stress.

In a study on group versus single housing conditions, Ottway and Hawkins (2003) looked at cats kept in groups of 33 to 65 individuals. These cats lived in a typical shelter atmosphere with cats constantly coming in and out of the groups. They found that cats in this type of housing were on average more stressed than those in single houses. Furthermore, only the cats that were previously housed together showed bonding signs, such as sleeping in the same bed. In another study on cats that were kept in a stable group over time, density was found to be a factor in determining stress level (Kessler & Turner, 1999a). Stress in this study was measured through analysis of posture, and all cats were "weakly tense" when the density of the group reached above 0.6 animals/m^2. The socialization level of cats was also an aspect in the success of group housing. The critical period for a cat's socialization to conspecifics and humans is between two to eight weeks postpartum (Jongman, 2007). Cats that do not have adequate interactions with conspecifics during this time period become socially dysfunctional and have inappropriate reactions towards other cats. These reactions may be hyper-aggression or extreme fear (Crowell-Davis *et al,* 2004) toward conspecifics and humans. These poorly socialized cats were more stressed than socialized cats in group-housing and have a negative affect on the rest of the group members by increasing their stress levels (Kessler & Turner, 1999b).

Despite these detriments of group housing, many shelters and behaviorists remain in favor of it. Not all group housing situations have been found to be detrimental to the welfare of the cat. Using the Cat-Stress-Score developed by Kessler and Turner (1997), Gourkow and Fraser (2006) found that cats in communal housing had a lower stress level than those in a barren single cage and a similar stress level to those in enriched single housing. However, negative encounters were noted in the communal groups. Kessler and Turner (1999a) found that stress decreased after the first two weeks at the same rate for cats in a group and cats in single cages. However, non-socialized cats were removed prior to the study and the groups remained the same throughout the study period. These conditions are unlikely to be found in most shelters, where the constant influx of cats and the desire to adopt out as many as possible would inhibit the formation of stable groups.

The purpose of this study was to determine if shelter cats' welfare is affected by prolonged stays in group housing, and how their behavior in the groups changes over time. The effect of density, gender, and number of roommates was measured in relation to the behavior of the cat. It was hypothesized that on initial entry to the shelter, cat's normal time budgets would be altered, marked by decreased activity and inhibited maintenance behaviors. Over time the behavior was hypothesized to return to a normal level; however, cats housed for 8 months or more were predicted to have a decrease in activity as a result of chronic stress. Finally this study investigated if a stay in group housing at a shelter affected the behavior of a cat towards humans. It was hypothesized that time in the shelter would improve the behavior of cats that were poorly socialized to human handling by habituation; however, it would negatively affect socialized cats due to stress by inconsistent handling and caretakers.

3. MATERIALS AND METHODS

Animals and Environment

Twenty-four domestic cats were observed at the Tompkins County SPCA for the behavioral observation portion of the study. A separate group of 29 cats from the Tompkins County SPCA were used in the Temperament Test study. All cats used were admitted to the shelter after being relinquished by their owners or found as strays; however, these two different groups were not distinguished between in either study. After a variable quarantine period in single cages, all cats in the shelter were randomly distributed to one of 20 group-housing rooms. The room they entered was chosen at random based on vacancies. Later movements among rooms were either deliberate or accidental. Cats may were purposely moved to reduce conflict or to be showcased; however, often cats would be moved accidentally during cleaning or visitor activity. Cats observed in the rooms were unrelated and brought together in adulthood.

The group-housed rooms ranged in size from 1.78 m^2 to 6.51 m^2 and housed anywhere from three to nine cats (see appendix for layout of group-housing rooms). The cats could move freely within the room and interact with one another. All rooms had at least two litter boxes, two beds, a food dish, and a water dish. Varying types and numbers of objects were placed in the room for enrichment. In the larger rooms there was always a tree with perches. Other enrichment objects were boxes for hiding, chairs, additional beds, scratching posts, and toys such as balls. These varied from room to room, but were not measured and not included in this study.

While the exact age of most cats was unknown, they ranged in age from one to 11 years. 16 females and eight males were observed. The cats had varying levels of

socialization to humans and conspecifics prior to admittance to the shelter. Cats were chosen for observation at random based on amount of time in shelter and in which room they were located. Cats were chosen completely at random for temperament testing based on room and location of identification card on door to room.

Observations

Live observations were done over the course of three consecutive days for each cat. Each observation occurred for one hour at a set time in the afternoon each of the three days. The cat was observed at a different time each day. Generally, cats were observed around 12 PM the first day, 2 PM the second day, and 4 PM the third day. Visitors frequently came in during this time and interactions were observed. This could not be avoided since the research site was a working shelter. The observer remained outside of the room, far enough away to be unnoticed by the cats. The observer did not interact with the cats or enter the room during observation.

The technique for the live observations was a continuous recording of the cat's location, activity, position, and interactions minute by minute. Every behavior exhibited by the cat was recorded using an abbreviation (see appendix for Ethogram developed by Dr. Katherine Houpt, Cornell University). If a behavior was instantaneous, the event was recorded during the minute in which it took place. If the event was lasting for more than 10 seconds it was considered a state. The time during which the state occurred was recorded by drawing a straight line through the number of minutes in which the behavior took place. Figure 1 is an example of the recording sheet used.

***Figure 1** – Example of the sheet used in continuous behavior observations of the group-housed cats*

Time	Posture	Activity	Location	Interactions	Notes
0:00					

While posture was generally described in these observations, it was not systematically analyzed and should not be confused with methods like the Cat Stress Test (Kessler & Turner, 1999). Posture was only used as a component to defining behaviors that were then used to measure stress.

Temperament Tests

Cats were temperament tested using the Feline Behavioral Assessment sheet developed by Kelley Bollen, Tompkins County SPCA (see Appendix). Cats were tested initially at 0 months, then again at 1 month, 2 months, and 3 months. Cats that were adopted or fell ill were not available for retest. Therefore for the initial month 29 cats were tested, then at month one 20 cats were tested, month two had 10 cats, and finally on month three only five cats were available for testing.

The same experimenter tested all cats in a consistent, systematic pattern. First, she entered the room and crouched down silently. If the cat did not approach in 10 seconds,

she called to the cat. If the cat still did not approach after 10 seconds of calling, she approached the cat. If the cat tolerated being picked up, it was transported to a private room where the remainder of the test occurred (see appendix for complete list of procedures). All tests were performed in exactly the same way on each cat, with the same private room and equipment.

Quantifying the Data

Time budgets

Minutes per hour of grooming, sleeping, eating, and time spent on the floor were all calculated by adding the total minutes from each of the three observation sessions and then dividing by three to obtain an average number of minutes per hour.

Interactions

The total number of interactions was added for each of the three observation sessions. Because this number was low, it was not divided to obtain the number of interactions per hour. Since an interaction was an isolated incident, rarely lasting longer than a couple of seconds, the total number of interactions was measured, not the total minutes of interactions.

To obtain the number of negative interactions, all the interactions that involved aggressive or submissive behavior were included. The behaviors that counted as "negative" are as follows:

- Avoid

- Swipe (with front paw)

- Retreat

- Piloerect

- Hiss

- Crouch (defensive)

- Pounce onto other cat

- Bite

- Chase

- Stare (mutual gaze) – This was only included if it was accompanied by another
   negative interaction for accuracy. Staring has previously been shown to
   accompany both offensive and defensive interactions in a study on behavioral
   patterns in female cats living in a group (van den Bos & de Vries, 1996).

Movement Score

The movement score was based on each of the three sessions. If the cat got up and switched locations in the room at least once during the hour observation it was given a one. If it did not move once during the entire hour observation session it was given a 0. At the end of the observation period, the three scores were totaled. The scores ranged from 0, never moved from its bed once during the three days, to 3, moved at least once each session. This reflected the cat's basal activity level.

Room Measurements

The number of cats in the room for each observation was counted. Usually the number stayed the same through all three sessions. If the number changed, an average

number of cats for all three days was used instead. The density of cats in the room was calculated using the number of cats in the room divided by the square meters of that room, giving the number of animals per square meter.

Temperament Tests

Each criterion on the "Feline Behavioral Assessment" sheet was turned into a numeric score. The scores could range from 0 (most anti-social) to 20 (the most friendly and outgoing). Lower scoring cats were less socialized to humans, while higher scoring cats were more socialized. The specific scoring system can be seen in the appendix.

Statistical Analysis

Data was analyzed using the program Statistix 8. A p-value of < 0.05 showed significance. Graphs were made using Microsoft Excel.

Observations

Single linear regressions (SLR) and multiple linear regressions (MLR) were used for investigation of behavior related to stay at the shelter, number of cats in the room, and density of the rooms. Since the data was not normally distributed, Mann-Whitney U tests were used to analyze behavior in relation to gender.

It was hypothesized that cats initially entering the group housing would be highly stressed, and therefore their maintenance behavior and activity would be inhibited. Simple linear regression was used to test this using time in shelter as an independent variable. Multiple linear regressions were also used to include the number of cats in the

room and density of cats in the room. Correlations between different behaviors such as eating and negative interactions were also investigated.

Cats were divided into four groups based on how long they had been in the shelter at the time of observation for graphical analysis. These groups consisted of cats that had been in the shelter for less than two weeks, 2 weeks to 3 months, 3 months to 8 months, and cats that had been in the shelter for over 8 months. An ANOVA test for variance was used to determine if these groups were significantly different.

Temperament Tests

It was hypothesized that cats who scored low on the temperament test would improve their score over time in the shelter, because they would eventually become habituated to continual human presence. It was also hypothesized that those cats that scored well would lower their score over time, because of stress and inconsistent interactions with a variety of people. To test these hypotheses, the cats were divided into three groups based on their original temperament test score. Group A was comprised of cats that were poorly socialized to humans, scoring a 10 or less on the temperament test. Group B was the middle range of scores from 11 to 16. Finally Group C was the most socialized to humans; this group was comprised of cats that scored greater than 16. An ANOVA test was applied to determine if there was a change in test score over time. Cats were also divided into three groups based on the amount of time they had been at the shelter on their initial temperament test date (Month 0). These groups consisted of cats that had been in the shelter for less than two weeks, cats that had been there from two weeks to three months, and finally cats that had their first temperament test after they had

been in the shelter for more than three months. An ANOVA test was again used to see if their scores varied over test month and time spent in the shelter.

4. RESULTS

Behavior Observations

Autogrooming

The correlation between time spent self-grooming and length of stay at the shelter was positive and approached significance (SLR, $P = 0.06$). Grooming was not associated with time spent in shelter and number of cats in the rooms (MLR, $P = 0.18$).
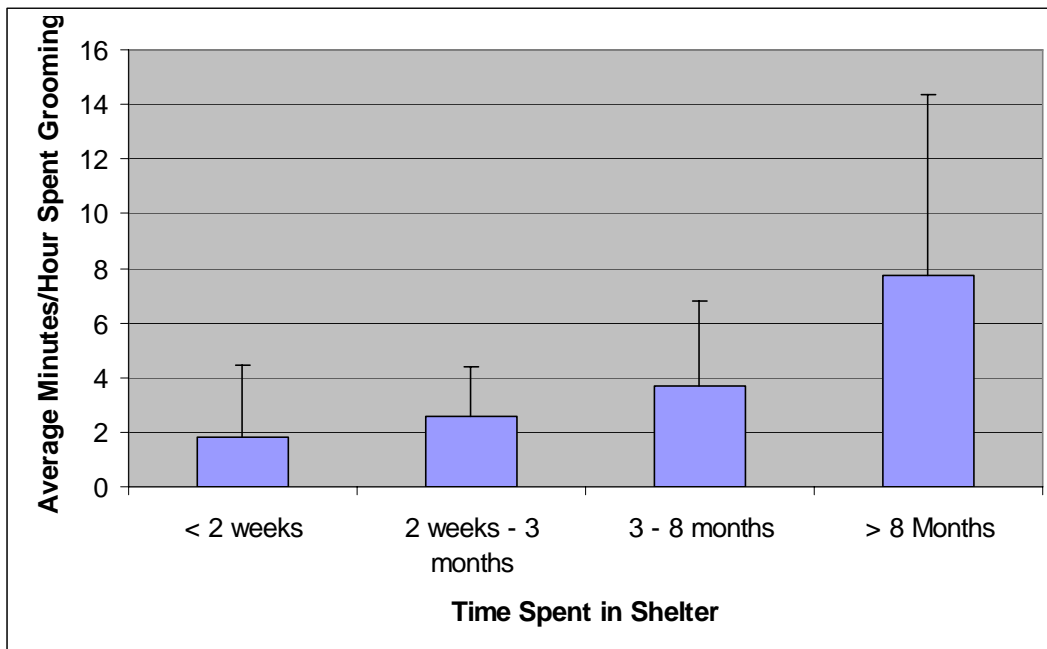
Figure 2 – Average minutes per hour spent grooming grouped based on the amount of time the cat had been at the shelter at the time of observation (n=24).

Sleeping

Sleeping behavior was defined as recumbent with eyes closed. There was a significant inverse relationship between time spent sleeping and time spent in the shelter (SLR, $P = 0.04$). Time spent in the shelter and the number of cats in the room were inversely correlated to time spent sleeping (MLR, $P = 0.00$).
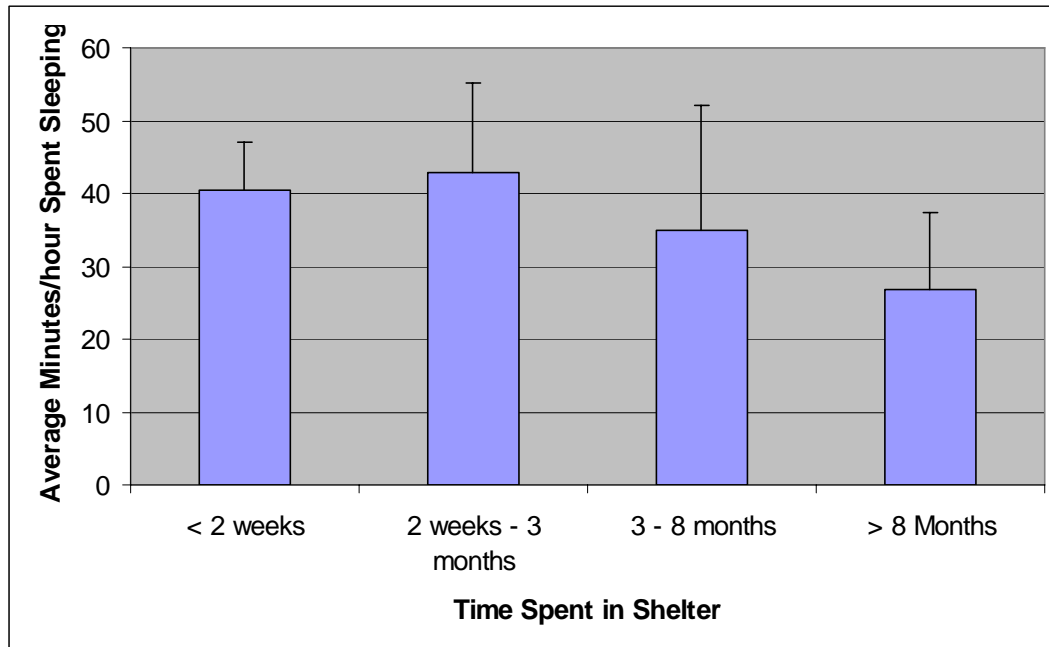

Figure 3 – Average minutes per hour spent sleeping grouped on the amount of time the cats had been in the shelter at the time of observation (n=24).

Eating

Time spent eating was not significantly correlated with the length of stay in the shelter (SLR, $P = 0.33$). However, time spent eating did have a significant positive correlation with number of cats in the room (SLR, $P = 0.03$). Finally, time spent eating was positively correlated with negative interactions (SLR, $P = 0.03$).

Movement Score

The correlation of the movement score and the amount of time the cat had been in the shelter was positive and approached significance (SLR, $P = 0.08$). The movement score was significantly positively correlated with the time spent in the shelter and the number of cats in the room (MLR, $P = 0.05$).
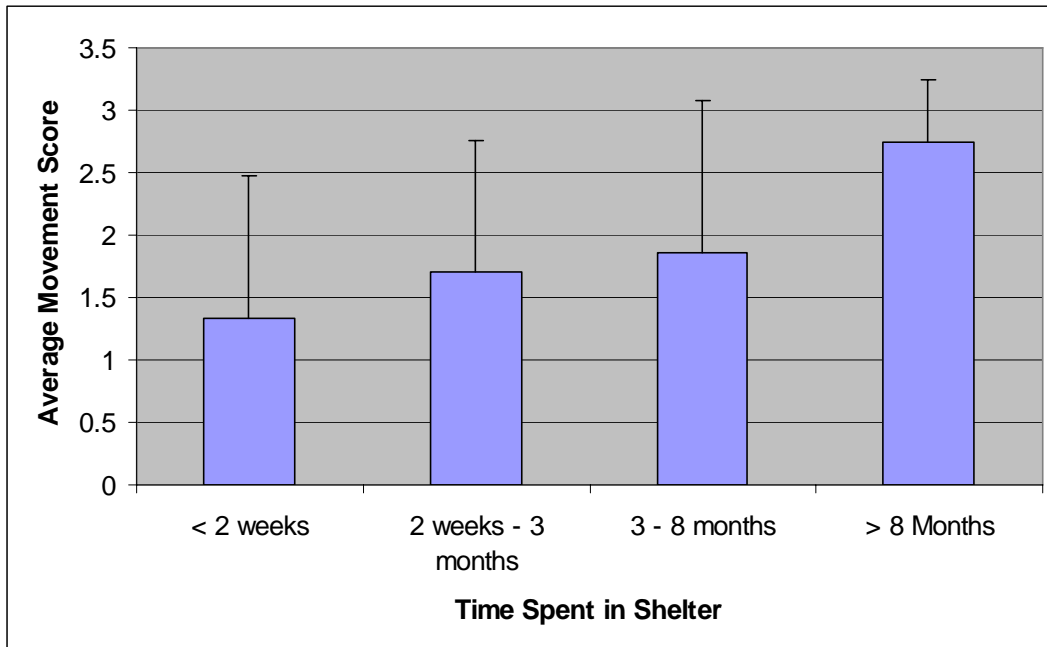

Figure 4 *– Average movement score grouped on the amount of time the cat had been in the shelter at the time of the observation (n=24).*

Interactions with Conspecifics

The correlation between time spent in the shelter and total number of interactions was not significant (SLR, $P = 0.31$). Negative interactions and time spent in the shelter were also not significantly correlated (SLR, $P = 0.36$). Total interactions was positively correlated with the movement score (SLR, $P = 0.00$).
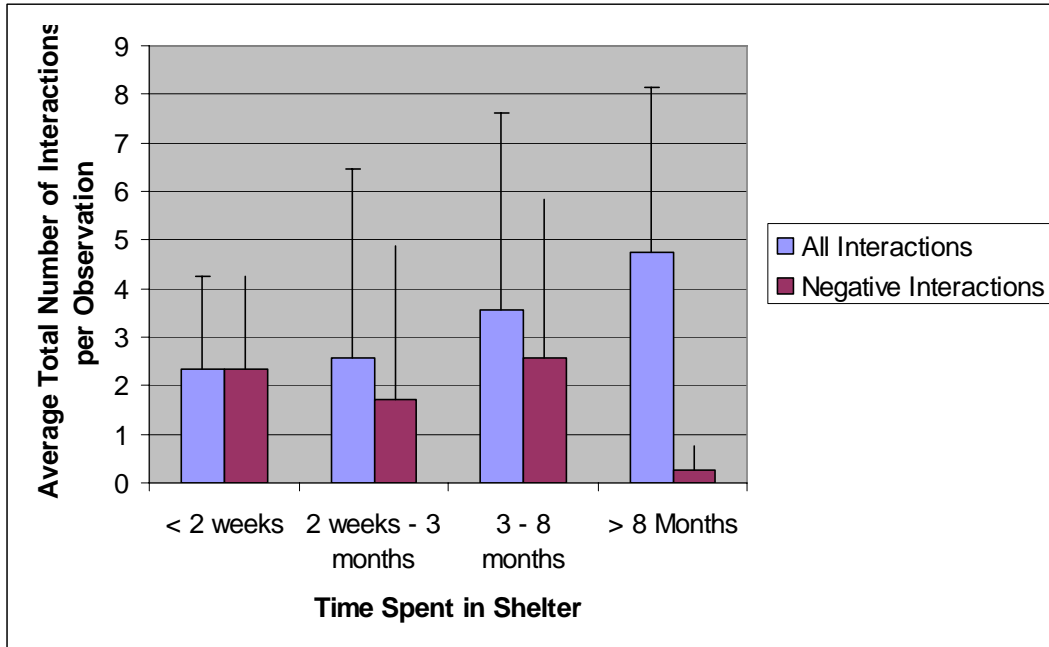

Figure 5 – *The average total number of interactions per observation period (3 hours) grouped on the amount of time the cat had been in the shelter at the time of the observation (n=24).*

There was a significant negative correlation between time spent in the shelter and the ratio of negative to total interactions (SLR, $P = 0.00$).

Table I – *Ratio of negative to total interactions grouped on amount of time the cat had been at the shelter (ANOVA, p = 0.00). B is significantly different from A (Tukey HSD All-Pairwise Comparisons Test).*

Time Spent in the Shelter	< 2 Weeks	2 Weeks – 3 Months	3 – 8 Months	> 8 Months
Negative: Total Interactions	1.00 A	0.67 A	0.72 A	0.05 B

Sex

There were no detected effects of sex on any of the behavior measurements made

(Wilcoxon Rank Sum, $P > 0.10$).

Population Density of the Rooms

No significant linear regressions found between density of cats in the room and any of the

behavior measurements taken ($P > 0.10$).

Time Budgets

Table II *– Average time budgets of cats (n=24) grouped based on amount of time spent in group housing at time of observation period.*

Time Spent in the Shelter	< 2 Weeks	2 Weeks – 3 Months	3 – 8 Months	> 8 Months
Grooming	3%	4%	6%	13%
Sleeping	73%	72%	58%	45%
Eating	2%	1%	4%	2%
Active on the Floor	21%	9%	15%	14%

Temperament Tests

Time Spent in Shelter

There was no significant difference in temperament test scores over the four month

period of testing (ANOVA, $P = 0.50$). There was also no significant difference between

temperament test scores when compared to time spent in shelter and month of the test
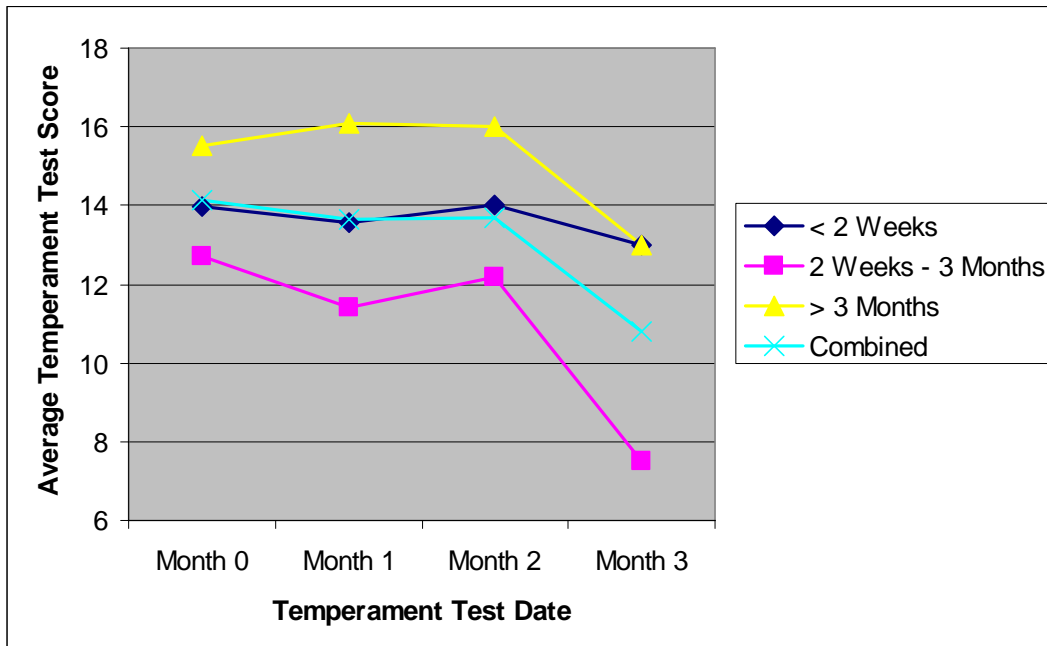
(ANOVA, $P = 0.59$).

Figure 6 *– Average temperament test score grouped based on length of time cat had been in shelter at the initial Month 0 test. Each line displays the average test score of the group of cats on the specific test date. At Month 0, the combined n=29, and subsequently decreased in the following tests as cats left the shelter and were unavailable for retest.*

Socialization Level

The score the cat received on the temperament test did not vary significantly between test months when the cats were grouped based on their level of socialization at the initial, Month 0 test (ANOVA, $P = 0.49$).
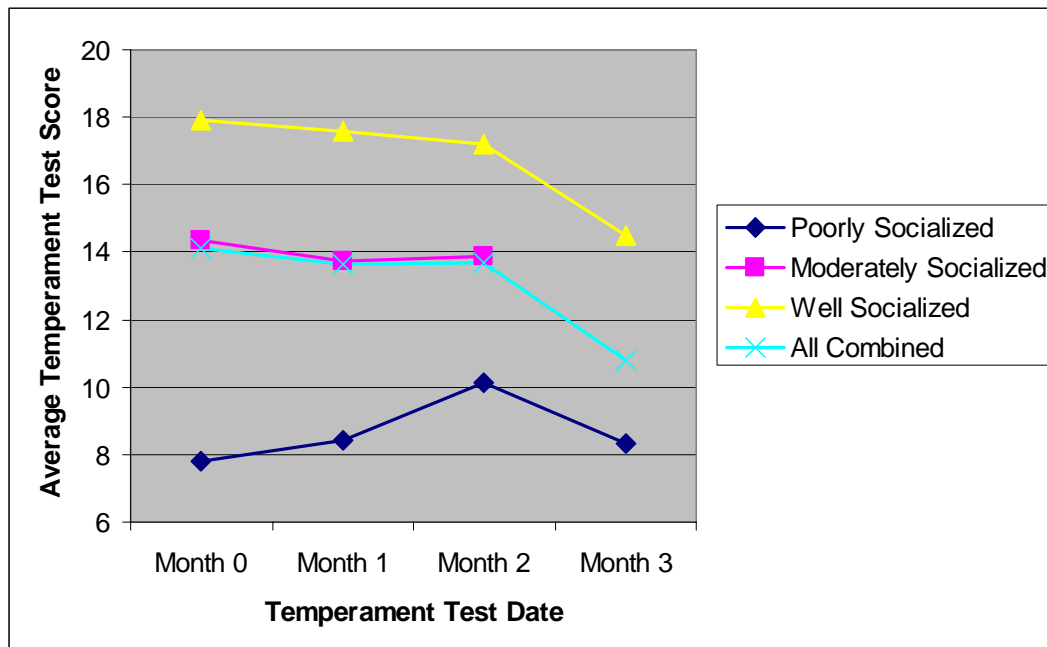

Figure 7 – Average temperament test score at each monthly test date grouped by the cat's level of socialization to humans. At Month 0, All Combined group n=29, which subsequently decreased in the following month tests. There is no data point for the moderately socialized group at Month 3 because all cats in this group were adopted prior to the Month 3 final temperament recheck.

5. DISCUSSION

Behavior Observations

Grooming

Cats were observed grooming more often the longer they were kept in group-housing, as illustrated in Figure 2. In previous studies, cats have been found to groom on average for

4% of their overall time budget (Eckstein & Hart, 2000). Cats that had been in the shelter for less than 2 weeks slightly inhibited their grooming behavior, showing signs of stress. The 2 week – 3 month group displayed the average time reported for grooming behavior. This showed that as the cats become acclimated to group housing, their time budgets for maintenance behaviors such as grooming return to normal. It has been found that the process of adjustment to a cattery takes more than two weeks (Kessler & Turner, 1997), and this is supported by the increase of maintenance behaviors between the < 2 week and 2 week to 3 month group. However, the time budgets for the 3 – 8 month and the > 8 month groups increased above the average time reported in other studies. Cats often groom directly after being woken up (Eckstein & Hart, 2000) or after interacting with a human (C Monk, personal observation). Since these two events were common during the part of the day in which the cats were observed, it follows that during this time there would be a higher than average display of grooming. Another possible source of these elevated grooming levels could be fleas. However, the shelter reported no significant problem with flea control on the adoption floor. The elevated levels of grooming are probably not high enough to indicate a stereotypy, and the lack of physical evidence of over-grooming on any if the observed cats corroborates this. If 13% is considered the average time spent grooming for an adjusted cat during the high-activity time of day in which the observations were made, then cats in the <2 week to 3 – 8 month groups clearly had inhibited maintenance behavior.

Sleeping

It has been found that the average cat spends 65% of its time sleeping (Hart, 1978), making rest the cat's most frequently performed behavior. Other studies have reported time budgets of 50% of overall time spent sleeping (Eckstein & Hart, 2000). The initial increase in Figure 3 of average minutes per hour spent sleeping between the cats housed in the shelter for less than two weeks and those housed from 2 weeks to 3 months was possibly due to alert inactive stage termed "alert rest" exhibited by highly stressed cats. Carlstead *et al,* (1993) found that stressed cats spent more time alert and attempting to hide, and Kry & Casey (2007) found that relaxed cats performed more true resting behavior and less vigilance marked by alert rest. Alert rest is characterized by recumbent posture with eyes predominantly open. It did not fit the sleeping criteria of recumbent with eyes closed and was observed in two highly stressed cats. After the most stressful time period, the first two weeks, alert rest was never observed. From then on, the average minutes per hour spent sleeping decreased the longer the cat had been in the shelter. The time budget for sleeping returned to a normal range for cats housed in the shelter for longer than eight months. Elevated time budgets for sleep prior to 8 months show the use of sleeping as a coping mechanism for the stressful entry to the new group-housing environment.

Another factor related to time spent sleeping was the total number of cats in the room during the observation period. More cats in the room combined with a longer time in the shelter also led to less sleep. The rooms that had a higher number of cats were closer to the entrance to the shelter, and adopters were most likely to visit these rooms. This led to

a higher activity level in the rooms with more cats, and therefore cats in these rooms had fewer opportunities for prolonged sleep.

Movement Score

The longer the time the cat had spent in group housing, the higher its activity level, shown by increase in movement score over time. Like the increased amount of sleep toward the beginning of tenure in group housing, inhibited movement also reflects the period of adjustment to the shelter. Cats that were stressed in group housing inhibited play and exploratory behavior, and thereby inhibited movement.

Movement score could be affected by cats' variable reaction to stress found in some studies. Non-socialized or highly stressed cats have been shown to have two distinct personalities when put in group housing. Kessler & Turner (1999b) found that when housed in groups, some cats became totally inactive while the rest reacted in a more active way and disturbed other group members much more. This actively stressed group may have falsely raised the movement score of cats housed in the shelter for less than two weeks, making them appear less stressed. However, an extremely actively stressed personality was not noted in any behavior observations and therefore is unlikely to greatly affect the data.

Movement score also increased with more cats in the room. Like the effect on sleep, this is a reflection of the higher activity levels in the larger rooms. With a larger volume of

human traffic and the resulting cat-human interactions, cats were more likely to get up and move at least once during the observation period.

Eating

The higher the number of cats in the room, the more often the cat was observed eating. This may be due to social facilitation, where cats eating or present encourages other cats to eat, and shows a positive aspect to group housing. Since the shelter environment is stressful, weight loss and anorexia are serious problems in shelter cat health**.** A higher number of cats in the room, or simply a more active room, may be beneficial by encouraging the cat to eat.

Another factor in time spent eating was the number of negative interactions in which the cat was engaged. Surprisingly, the more negative interactions a cat engaged in, the more often it was observed eating. Due to the set up of the room, cats often had to pass by each other to reach the food dish or litter box. Multiple situations were observed in which an extremely defensive cat severely impeded movements to these communal areas by hissing and swatting whenever the moving cat approached within a certain radius. Extreme defensiveness is characterized in cats by a low body position, flattened ears (Feldman, 1994) and hissing (Brown *et al,* 1978)**.** This defensive behavior was not a resource guarding mechanism, but self protection for extremely fearful cats. The welfare of cats would be improved if the food and litter trays were kept distant from all sleeping and hiding areas. Avoidance is a key mechanism in conflict resolution for cats (Crowell-Davis *et al,* 2004; van den Bos, 1998) where a stable hierarchy cannot be established.

When the room set up prohibits avoidance, inhibition in eating and other behaviors may result. Because of the fact that to obtain food cats often had to cross paths with other cats, negative interactions and eating became correlated.

Interactions with Conspecifics

Table I shows that cats living in the shelter for over 8 months had a significantly decreased ratio of negative to total interactions. These cats interacted more, but were less aggressive or defensive, and therefore better able to negotiate their changing roommates. This signifies a decrease in stress and an adjustment to group housing in cats housed for over 8 months, since negative interactions both contribute to stress and stress at conspecifics is manifested in aggressive or defensive behavior.

The amount of total interactions increased with an increased movement score. The more active a cat is, the more likely it will interact with another cat. The strong link between movement and interactions helps to further explain the inhibition of movement during the adjustment period. During this time the cats avoided stressful interactions by reducing movement around the enclosure. As the cats became adjusted to their environment, movement increased and so did interactions.

Sex

There was no detected relationship between sex and any of the behavior measurements made. All cats observed in the study were neutered or spayed. The data on sex fits with

previous studies that also found little effect of sex on behavior of cats that had been

altered (Kessler & Turner, 1997).

Population Density of the Rooms

The density of cats in the shelter rooms did not have any detected effects on the behaviors

measured in this study. These results were initially surprising in comparison to Kessler

and Turner's (1999) findings. Here they determined that all cats were "weakly tense"

when the density of the group reached above 0.6 animal/m^2, and the density at Tompkins

County ranged from 1.2 animal/m^2 to 2.2 animal/m^2. However, Kessler and Turner (1999)

used the Cat Stress Test, a systematic analysis of the cat's posture, to determine stress

levels, while this study used time budgets.

Time Spent in the Group-housing

Previous studies have shown stress declines after the first month in communal housing

(Smith et al, 1990), and other studies have found stress declines after the first two weeks

in boarding catteries (Kessler & Turner, 1997). This study found that adjustment to group

housing continues well into 8 months, summarized by the changing time budgets in Table

II. While time budgets for grooming returned to normal after the initial 2 weeks, time

budgets for sleeping did not return to normal until over 8 months in group housing.

Movement scores continued to increase into the over 8 month group. Furthermore, it was

not until over 8 months that there was a significant reduction in the ratio of negative to

total number of interactions.

In conclusion, initial entry to group housing at an animal shelter was found to be stressful resulting in a marked inhibition of maintenance and exploratory behavior. Avoidance of interactions through inhibited activity was a key coping mechanism at this time. Fearful cats showed elevated levels of negative interactions. As the cat stayed in the group housing environment, its behavior returned to more normal levels of grooming and activity, and negative interactions decreased. In a stable colony, aggressive behaviors are rarely seen (Podberscek *et al,* 1991). However, the colony was not stable, and it is unlikely that any dominance hierarchies formed. The cats at Tompkins County SPCA never had consistent roommates and often switched rooms within the shelter. Thus, the change in behavior shows a habituation to the shelter environment as opposed to the formation of stable dominance hierarchies within the groups.

One problem with this study was the fact that the shelter itself was a variable and acted as a selecting factor on the cats. This means that the effects seen on behavior were not due to time spent in group housing alone. Cats that were poorly adapted to the shelter probably became ill and had to be removed from the adoption floor. Cats that had been in the shelter for a prolonged period had a socialization and temperament that allowed them to live relatively healthily there. This is a confounding factor on the effects of time spent in the shelter on behavior.

Temperament Tests

Despite the differences in Figure 6, time spent in the shelter did not have a significant effect on the cats' temperament test scores. Furthermore, their scores did not change

significantly over the four month testing period. Therefore the hypothesis was not supported; there was no effect of time spent in the shelter on the temperament of the cat, contrary to popular belief.

There was no significant change in test score over the four months in any of the socialization measures. This means that poorly socialized cats did not significantly improve, and well socialized cats did not significantly worsen. In both Figure 6 and Figure 7, there was a noticeable decrease in average score in the last month of testing, but this was not significant. It was probably due to the better socialized cats being adopted, leaving only the more poorly socialized for a retest.

In conclusion, up to a four-month stay in group housing did not affect the temperament of a cat in relation to its behavior towards humans at the Tompkins County SPCA. Previous data that has found the biggest predictor of friendliness in kittens was paternity (Turner & Bateson, 2000). While this study does not refute this evidence, there were not enough factors considered to soundly indicate a strong genetic component in feline temperament towards humans. This study also does not refute the theory of a critical period for a cat's socialization to humans and conspecifics. This theory posits that a cat's socialization level is achieved in the first two to eight weeks of its life (Jongman, 2007) and remains relatively unchanged thereafter.

Welfare Applications

This study reveals ways to improve the welfare of cats in group-housing at a shelter. Since the level of negative interactions are highest during the first 2 weeks when cats are most stressed, it is recommended that they are kept in smaller groups with more hiding spaces during this time. This study highlights the importance of avoidance as a key coping mechanism during the adjustment to group housing. Because of this, it is vital to position the food, water, and litter trays away from the beds of other cats to minimize negative interactions. Furthermore, the increased spacing of resting places will also facilitate avoidance of other cats. Finally, the shelter can assure potential adopters that a stay up to four months in shelter group housing will not significantly change the cat's personality.

Further Research

The observation portion of this study could be improved by monitoring the same cat's behavior over the course of 8 months instead of taking a snap shot of their time budgets at a random point during their stay. This would remove the shelter-selection variable seen in this study. It would also be interesting to have a complete background of cats under observation, to determine which form of socialization prior to the shelter allowed for optimum adaptation to group housing. The study might also be improved if the visitor variable was removed. Because the study was done at a working shelter, it was impossible to remove the effects of human interaction during the observation period. Future studies could be improved by removing this variable during the observation period. Finally, it would be interesting to note the furniture in the room, since that contributes to the total space per cat, and any hiding spaces. Vertical space plays an

important role in reducing density in the room, and noting which furniture is best at providing vertical space could help shelters improve the set-up of their group-housing rooms.

A separate study that would further the field is research on the effects of stable groups versus transient groups. Some shelters create a stable group that is only changed by removal of cats through adoption. On the other hand, Tompkins County SPCA, like many others, keeps all the groups constantly in flux. Cats are purposely moved to reduce conflict, but may also be randomly shifted through adoption, addition, cleaning, or when adopters open room doors. If a stable group positively affects feline welfare, maintaining a contained colony in each room might become more important.

It would also be interesting to extend the temperament testing portion of this study. Correlating temperament test to behavior in group housing would investigate if socialization to humans has an effect on adaptation to group housing. Increasing the sample size for temperament tests and extending the period for testing might also detect a more subtle effect of a stay in an animal shelter on the cat's temperament.

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Group-housing Rooms Observed at Tompkins County SPCA
Blueprint courtesy of Colter Nemeck, Tompkins County SPCA
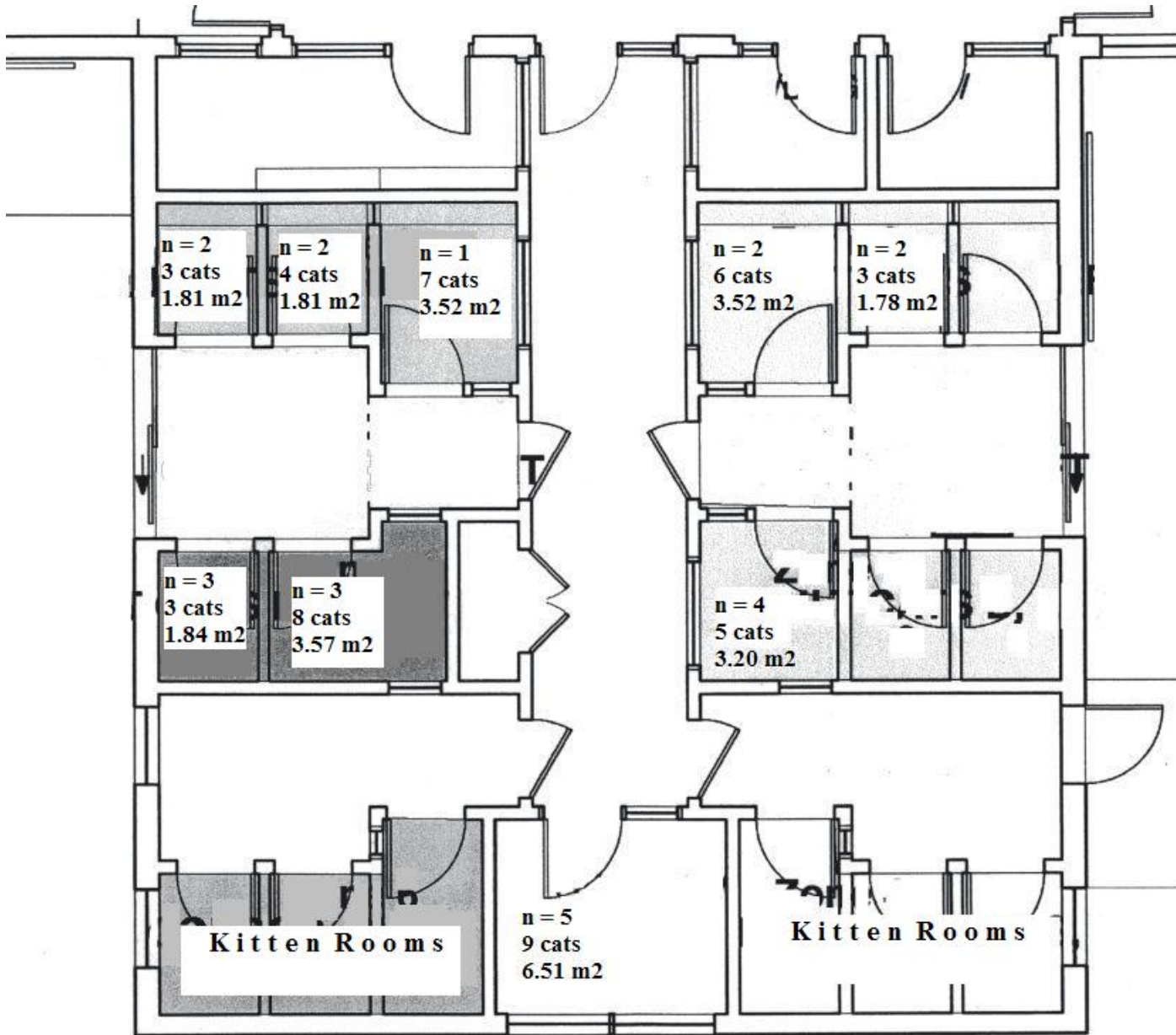
Behavior Ethogram Abbreviations
Developed in the lab of Dr. Katherine Houpt, Cornell University College of Veterinary Medicine

Posture
LC – Lie curled
LB – Lie back
LL – Lie lateral
LS – Lie sternal
LHS – Lie half-sternal
SIT – Sit
WA – Walk
RU - Run
CR – Crouch
RR – rear back, front feet on wall/window
ST - stand

Locations
BD – bed
FL – floor
LX – litter box
UB – under box
BT – box top
ST – stool
TS – top shelf of tree
MS – mid to lower shelf of tree
CH – chair
? – cannot see cat
X – cat not in room

Activity
RE – rest *lying down with eyes closed*
GR – groom
WA – watch (stare fixedly at a certain point for over 30 seconds)
IP – interaction with a person
IC – interact with another cat
EA - eat
RO – roll
CR – object rub
TR – tail rub
BR – body rub
EL – eliminate (squat)
SP – spray (standing)
PO – play with object
PX – play with other
ST – stretch
DR – drink
SC – scratch/ sharpen claws
ST – stalk (slink with belly close to ground toward a target)
MW – meow
HI – hiss
WA – wail
JU – jump
CL - climb

Interaction
SN – sniff other cat
TN – touch nose
MT – mount
LT – lay together
ST – stare (mutual gaze)
AP – approach
AV - avoid
SW – swipe (with front paw)
RT - retreat
PL –play
TT – tail twitch
TL – tail lash
PI – piloerect
CR – crouch (defensive)
TU – tail up (in greeting another cat)
AR - Allorubbing (cat-cat rubbing)
AG - Allogrooming (cat-cat grooming)
SRO – social roll in presence of other cat
FL – follow other cat
PC – pounce onto other cat
BI – bite
CH - chase

Feline Behavioral Assessment
Developed by Kelley Bollen, Tompkins County SPCA

While cat is in cage
Reaction to strangers
Stand quietly in front of the cage and record behavior of cat.

5____ comes to front of cage – soliciting, rubbing against cage front, reaching out
4____ comes to the front with some verbal encouragement
3____ does not come to front but acts calm and friendly
2____ does not come to front and ignores you completely
1____ hisses or growls at you
0 ____ swats at you

Reaction to touch
Open the door and try to touch the cat

5____ solicits petting and attention
4____ seems indifferent
3____ moves away from you to avoid being touched
2____ growls or hisses at you
1____ swats at you
0____ charges at you

If cat appears friendly – try to pick it up. Does it resist? Yes _____   No _____
Impossible - 0
Some struggling - 1
Easily picked up and carried – 2

Take cat into a quiet room
Social attraction
Sit quietly in a chair or on the floor and record cat's behavior.

3____ solicits attention from you – rubbing on you, or jumping in your lap
2____ more interested in environment
1____ fearful – hiding
0____ aggressive behavior (hissing or threatening you in any way)

Try to interact with the cat in a friendly manner.

3____ interested in interacting with you
2____ ignores your attempts to interact
1____ continues to hide
0____ aggressive behavior (hissing, swatting, etc.)

Handle the cat and record if the cat tolerates the handling

-hold cat under front legs, rear dangling yes____0.5 resisted __0.25 no ____0
-hug the cat   yes ___0.5_resisted___0.25 no ____0
-pat the cat on head   yes ___0.5_resisted___0.25 no ____0
-tug slightly on tail   yes ___0.5_resisted___0.25 no ____0