EFFECT OF FAMILIARITY AND RELATEDNESS ON PROXIMITY AND ALLOGROOMING IN THE DOMESTIC CAT (*FELIS CATUS*)

by

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(Under the Direction of Sharon L. Crowell-Davis)

ABSTRACT

Past research has shown that domestic cats form social groups and that non-random, close proximity between two cats may be indicative of a social bond. Social grooming or allogrooming has been observed in kangaroos, bovids, deer, antelopes, equids, canids, felids, rats, and primates. The contexts in which this allogrooming occurs indicates that its function may serve to help regulate social relationships rather than the care of body surface function alone.

Twenty-eight cats living as a stable colony were studied. The colony was privately owned and located in a suburban setting. The cats had access to approximately 0.1 ha of a secured fenced area outside and approximately 180 m^2 inside. There were 15 cats that had at least one relative in the colony, comprising five groups of related cats. Each cat was observed for a total of 3½ hours over the course of the study. All occurrences of allogrooming behavior were recorded during the sampling sessions. At the onset of each 15-minute focal sample and at 2-minute intervals thereafter, the identity and location of all the animals within 1m of the focal animal was recorded.

Both familiarity and relatedness had a significant effect on which cat a given cat associates with more and who its grooming partners are (GLM, $P < 0.001$). For relatives and non-relatives that were equally familiar to a given cat, relatives were more likely to be within 1m and to be groomed (paired t-test, $P = 0.003$ and 0.026, respectively).

INDEX WORDS: Domestic cat, Familiarity, Relatedness, Proximity

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DEDICATION

This is dedicated to my mom and dad who taught me that there are no such things as limits…

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This research could not have been done without the cooperation of Meri and Tony Blackburn and their colony of 28 cats. Their dedication to the well being and welfare of their cats is evident and an obvious priority. It was a privilege to conduct research at a place where there is such high regard for the quality of life.

A special thank-you also goes out to Rebecca Knowles, my right hand and more than able "recorder of events".

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CHAPTER 1

INTRODUCTION

Past research has shown that free-living domestic cats form social groups.[1-9] These groups typically consist of females, usually related, and their offspring. It has also been suggested that these groups are based on female kinship.[3] Some of the benefits that a cat might gain through group formation and subsequent sociality may include improved care of the offspring through shared maternal care[4], improved defense of food resources[10], and concentrations of potential mates.[11]

Non-random, close proximity between two cats may be indicative of social ties between two cats. In the research conducted by Wolfe[9], it was shown that in two colonies of 29 and 20 cats, respectively, there were adult cat dyads that were within 1m of one another more often than would be expected by chance alone. These dyads were referred to as preferred associates. Proximity of preferred associates was not dependent on location. Therefore, the cats were not simply aggregating at preferred resources at the same time. Effect of relationship could not be determined because in the first group the relationships of the 29 cats were unknown, and there was no way to ascertain if relatedness was the basis for preferential social behavior, such as proximity. In the second group of 20 cats, all but 2 were related.

Social grooming has been documented in a number of species. Dunbar[12] found that frequencies of social grooming recorded from 44 species of free-living primates

correlated with group size but not body size. This was interpreted as evidence for the social function of allogrooming as opposed to a purely hygienic function. In Japanese macaques (*Macaca fuscata*), social grooming occurs most often between kin, in particular mothers and offspring. In observations of Japanese macaques, it was also found that the duration and frequency of grooming often exceeded that necessary for hygiene alone (i.e. removal of ectoparasites).[13] As a result of this research, one of the conclusions has been that the social function of allogrooming is to establish and maintain affiliative relationships.

In beef cattle (*Bos taurus*), Sato, et al.[14] suggested that social licking might have a cleaning effect, a tension-reducing effect, and a bonding effect. When several social factors were investigated, including the difference in dominance status, the dominant/subordinate relationship, kinship and familiarity, and the sex of the calves, only familiarity had a significant effect on licking; exchanges of social licking increased with length of cohabitation. In a later study conducted by Sato, et al.[15], in a herd of 20 Holstein dairy cows (*Bos taurus*), closeness in birth (familiarity) and kinship both had significant effects on time spent in allogrooming; dominance relationships did not have a significant effect. It was once again suggested that allogrooming in cows is an important behavior pattern with functional significance for the formation and maintenance of social bonds, and the stabilization of social relationships.

In a discussion of the ethology and neurobiology of grooming behavior, Spruijt, et al.[16] cite that social grooming (or allogrooming) has been observed in kangaroos, bovids, deer, antelopes, equids, canids, felids, rats, and primates. The authors reiterate that the contexts in which the grooming occurs indicate that in many of these species social

grooming has a function in the regulation of social relationships rather than the care of body surface function alone.

Social grooming in cats is defined by Bradshaw & Cameron-Beaumont[17] as one cat licking another cat and has been reported to occur as part of mating behavior and in mother-young interactions, in which it has a utilitarian function of maintaining the kittens' cleanliness. However, in research conducted by both Sung[18] and Wolfe[9], allogrooming was observed to occur between intact adult cats that were not mother-offspring pairs. All gender combinations were observed to allogroom, i.e. males groomed males and females, and females groomed females and males. In the lion allogrooming occurs as part of mating and in mother-young interactions, and additionally, in non-specific social situations, as when two lions are resting together. [17] The function of allogrooming in this latter context has not been elucidated. Normally, cats kept in captivity also engage in social grooming in this context.

Bradshaw[19] points out that cats spend a great deal of time grooming, and there is no evidence to suggest that a solitary cat is any less clean than a cat that is groomed by others. The function of allogrooming, therefore, is likely to be primarily a social one, except in the case of young kittens that are groomed by their mother before they become competent in grooming themselves.

The influence of kinship on social interaction, such as proximity and social grooming, has been noted in many animal species. Spiny mice (*Acomys cahirinus*)[20], Belding's ground squirrels (*Spermophilus beldingi*)[21], Cascades frog (*Rana cascadae*) tadpoles[22], Richardson's ground squirrels (*Spermophilus richardsonii*)[23], white-footed deer mice (*Peromyscus leucopus*)[24], and Cascades froglets (*Rana cascadae*)[25] are among

the many species in which kin recognition and differential behavior toward kin and non-kin have been demonstrated. This tendency to interact preferentially with kin has also been identified in many primate species, including vervet monkeys (*Cercopithecus aethiops*)[26], Japanese macaques (*Macaca fuscata*)[27], rhesus macaques (*Macaca mulatta*)[28-32], pigtailed macaques (*Macaca nemestrina*)[33-35], and Celebes Black apes (*Macaca nigra*).[36]

The four hypotheses of this study were that 1) cats would spend significantly more time in proximity to kin than non-kin, 2) cats that have spent more time together, i.e., who are more familiar with one another, would spend more time together, 3) cats that have relatives would engage in allogrooming behavior with relatives more than with non-relatives, and 4) cats that are more familiar with each other would be more likely to allogroom each other than cats that are less familiar with each other.

CHAPTER 2

MATERIALS AND METHODS

Animals and Research Site

A group of 28 domestic cats served as subjects in this study. The colony consisted of 16 males and 12 females. Table 1 shows the group's composition. All of the cats were neutered before the study began, with the exception of Henry, who entered the colony on August 31, 2001 when he was approximately 12 weeks old. He was subsequently neutered on October 2, 2001 at approximately 16 weeks of age.

Of the 28 cats, 15 had one or more relatives in the colony, representing five genealogies. The composition of the five groups of related cats is presented in Table 2. It should be noted that when the term "related" is used, paternity is unknown for these cats, so only matrilineal relationships can be considered.

The group was located at a site consisting of a private dwelling and surrounding area (~ 0.1 ha) in Athens, Georgia. The cats had free access to certain indoor areas and to an escape-proof, fenced yard through a cat door. There was one bowl located inside on a table with an attached 3.6 kg container that provided a continuous supply of food. Food was replenished as needed by the owners. Several large water bowls were located both inside and outside. There were four litter boxes located in one of the indoor areas. The cats used these boxes to eliminate, as well as various locations outside in the yard. A layout of the research site is included as Figure 1.

Study Protocol

Focal-animal sampling and instantaneous sampling methods[37] were used for the collection of data in this study. A total of 14 focal samples, with 8 instantaneous scans per sample each at 2-minute intervals, were conducted on each cat in the colony over the course of the observation period. All of the on-site sampling was documented on videotape using a Sony HandyCam Video Hi8 camera. A Timex Ironman Triathlon watch was used for timing of the focal-animal and instantaneous samples.

The observers spent 8 hours at the site, prior to the beginning of data collection, to habituate the cats to their presence, to learn to identify the cats, and to observe the cats' general behavior. After the 8-hour habituation period all of the cats typically ignored the observers, or briefly investigated them upon site entry, then returned to normal activity.

For data collection purposes, each week was divided into two morning sessions (07:30 – 11:30) and two afternoon sessions (14:00 – 18:00). A focal sample was taken on each cat for 15 minutes during a morning session and 15 minutes during an evening session, for a total of one-half hour per cat per week. If any of the cats were not found during a particular session, the focal sample was done at a later date, during either a morning or afternoon session depending on when it had originally been absent.

For all of the sessions, the observers documented all occurrences of specific social behaviors, including allogrooming bouts. Data was collected from September 17, 2001 through October 25, 2001. A total of 14 morning sessions and 14 afternoon sessions were conducted over this period. Half of the cats (14) were observed during each session As there were sessions where not all of the cats scheduled to be observed were available, an additional ten sessions were conducted to obtain the necessary number of focal samples

for each cat, either morning or afternoon, as needed. These were conducted from November 5, 2001 through December 18, 2001. Allogrooming behavior was collected for an additional six months using *ad libitum* sampling.

Within each session, cats were randomly sampled, as described below. Each cat was observed for a total of 3 ½ hours over the course of the study. Subjects were usually observed from a distance of 2-3m, but most could be approached more closely when necessary, as they were habituated to the presence of humans. None of the cats were handled or spoken to by the observers. Some cats had been feral and were less tame than the others. For them, observation was done at a greater distance and the zoom feature of the video camera was used to aid the researcher in recording the cat's activity. All occurrences of allogrooming behavior by the focal cat and by cats in the vicinity of the focal cat were recorded *ad libitum* during the sampling sessions. Additionally, at the onset of each focal sample and at every 2 minutes during the sample (instantaneous scan), the identity and location of all animals within 1m of the focal animal were recorded.

Prior to each week of sampling, each cat's name was placed on a slip of paper and "drawn from a hat", without replacement, to determine the order in which each cat would be the focal cat for each morning and afternoon session. Two 15-minute samples per cat per week were attempted, one in the morning and one in the afternoon. When a cat was due to be the focal animal, the observers looked for the cat in all of the areas of the research site. If the cat was not found during the search, which could happen due to dense vegetation areas and the area under the bed inside the house where they could hide, the next cat on the list became the focal animal and it was searched for in the same manner. If the original cat was seen later in the session it became the next focal animal.

A cat that was not related to the focal cat, but had been in the colony for the same amount of time as a relative was referred to as a "relative equivalent". Table 1 shows the age at which each cat entered the colony. For those cats with relatives, the period of time spent with the colony after the initial time together is what is considered to be "equivalent" for purposes discussed here. For example, Norma was with her mother, Rosie and siblings, Curly and Norman for 6 weeks prior to being introduced to the colony. It is at the point of introduction to the colony that the term "relative equivalent" applies. So, for this same example, all of the other cats who were on-site at the time Norma was introduced are considered to be her "relative equivalents". The composition of the relatives and relative equivalents is presented in Table 3.

Data Analysis

Statistical comparisons were performed by use of the statistical software program SPSS® 10.1 for Windows®. Significance was designated as values of $P < 0.05$. The hypotheses that cats would be more likely to allogroom and be within 1m of related cats and cats with which they were more familiar was tested with a General Linear Model (GLM). For each cat that had relatives in the colony, the number of times either a relative or relative equivalent was within 1m was divided by the number of cats in each category, to obtain a frequency of proximity for each category. Likewise, for each cat that had relatives in the colony, the number of times either a relative or relative equivalent was groomed was divided by the number of cats in each category, to obtain a frequency of allogrooming for each category. Allogrooming and frequency of being within 1m of relatives vs. relative equivalents were compared using a paired t-test.

CHAPTER 3

RESULTS

The number of times a cat was within 1m of a given cat and was allogroomed by a given cat was significantly affected by whether or not that cat was a relative and how familiar the cats were with each other, i.e. how long they had lived together (GLM, $P < 0.001$). There was significant interaction between relationship and familiarity (GLM, $P = 0.047$). For each cat that had relatives in the colony, the number of times either a relative or relative equivalent was within 1m was divided by the number of cats in each category, to obtain a frequency of proximity for each category. Relatives and cats that the focal cat was more familiar with were more likely to be within 1m than non-relatives and cats with whom the focal cat was less familiar. The shortest period of time that cats with relatives were present in the colony was 7 months; the longest period of time was 76 months. For cats that had relatives in the colony and were together for 7 months, the mean number of times that a relative was within 1m was 5.5 ± 1.5 (Mean ± SE). The mean number of times that a non-relative that a cat had known for 7 months was within 1m was 3.6 ± 0.62. At the other extreme, for cats that had relatives and were together for 76 months, the mean number of times that a relative was within 1m was 12.6 ± 2.13. The mean number of times that a non-relative that a cat had known for 76 months was within 1m was 6.4 ± 0.82.

To determine which effect was stronger, relatedness or familiarity, for the cats in the colony that had relatives, the number of times a relative was within 1m was divided by the number of relatives. Non-relatives that the cat had been exposed to the same number of months as they had been exposed to their relatives, the relative equivalents, were then identified. The number of times one of these cats had been within 1m was then divided by the number of cats that fit this criterion. On a per cat basis, a relative was more likely to be within 1m than a relative equivalent (paired t-test, $P = 0.003$). On average, a relative was within 1m 8.44 ± 1.37 times while a relative equivalent was within 1m 4.17 ± 0.64 times (Figure 2).

Likewise, for the cats in the colony that had relatives, the number of times a relative was groomed was divided by the number of relatives. The number of times that a relative equivalent was groomed was divided by the number of cats in that category. Relatives were groomed significantly more than relative equivalents (paired t-test, $P = 0.026$) for a mean of 2.19 ± 0.73 compared to 0.35 ± 0.13. Three of the 15 cats with relatives did not allogroom at all. The average number of grooming bouts per cat for the 6 cats that did not groom relatives more than familiars was 0.5 versus 5.47 for the 6 cats that groomed relatives more than familiars (Figure 3). All of the 6 cats that groomed relatives more than non-relatives were from groups in which the mother was present. Of those cats with relatives whose mother was not present on-site (Chip, Dill, Daphne, and Scooby), two of the cats did not allogroom at all (Daphne and Dill), and two groomed only non-relatives at a low rate (Chip: Paco once and Bob once; Scooby: Alfalfa once and Henry twice).

CHAPTER 4

DISCUSSION

For those cats with relatives in the colony, a relative was proportionately more likely to be within 1m than was a "relative equivalent". For the allogrooming behavior, again, cats with relatives were more likely to groom a relative than a non-relative. And for those cats with relatives that did allogroom (3 of the 15 did not), the average number of grooming bouts with a relative was 11 times more than with a relative equivalent. It was of interest to note that all of the 6 cats that groomed relatives more than non-relatives had their mothers present in the colony. This fact is notable given the observation that female kinship is the basis of social group formation in free-living cats.[3]

Post hoc, looking at grooming as a function of proximity, results indicated that there was no difference in the rate of grooming for time in proximity for relatives vs. non-relatives. This fact does not give any information about cause and effect. A cat may simply groom whoever it is close to. However, a cat may be close to another individual because they specifically approached in order to groom.

Social grooming (allogrooming) has been documented in many species. The results of extensive research indicate that allogrooming serves a social function, i.e., to establish and maintain affiliative relationships, rather than a purely hygienic function. To our knowledge, the study reported here represents the first time that the effect of relatedness and familiarity on affiliative behaviors such as proximity and allogrooming

has been studied in the domestic cat. Barry and Crowell-Davis[38] looked at the effect of familiarity on aggression in cats and found an inverse relationship between the length of time the cats had co-habited and the aggression rate. The longer the cats had lived together the less likely it was that there would be aggression between them. The influence of kinship on social interaction has also been noted in many species, with demonstrable differential and preferential behavior towards kin.

Hamilton's kin selection theory[39] allows for the prediction that, to the extent that social behaviors entail costs and benefits to the reproductive success of the individuals involved, these behaviors should be expected to be influenced by relatedness. If an animal can increase the fitness of relatives by grooming them, thereby increasing its own inclusive fitness, one would expect to see preferential grooming of relatives more than non-relatives, provided, of course, that the cost to the groomer's own fitness does not exceed the benefits obtained by the groomee.

The fact that the results of this study demonstrate that there is kin preference in the affiliative behaviors of proximity and allogrooming in the domestic cat adheres to Hamilton's theory regardless of the fact that all of the cats in this particular colony were neutered. This would suggest that the underlying mechanisms that promote differential behavior toward kin still exist, whether or not the animals are neutered. This neutered population is unaware of its evolutionary "dead end".

Possible evolutionary benefits of proximity include mutual defense and agonistic aiding, i.e. creating coalitions for the purpose of fighting. The body care aspect of allogrooming can certainly be considered to be its evolutionary benefit. However, the proximate cause for these affiliative behaviors may be some "emotional" response to a

particular individual, a relative or a familiar companion, even though the evolutionary cause may no longer exist. This would help explain why the cats in this particular colony preferentially remained near and allogroomed their relatives and cats with which they were more familiar more than non-relatives and cats with which they were less familiar.

It may be of relevance to note that in each case of cats with relatives, a period of time was spent with one or more relatives prior to their introduction to the colony. For example, Mama and her offspring, Alfalfa, Buckwheat, Darla and Spanky, were together for 4 weeks. Rosie and her offspring, Curly, Norma and Norman, were together for 6 weeks. Itty Bitty and her son, Paco, were together for 8 weeks. Siblings Chip and Dill were together for 6 weeks (hand-raised from 5 days old). Siblings Daphne and Scooby were together for 7 weeks. This time spent with relatives took place during the sensitive period for cats, which occurs from 2-7 weeks.[40] Close contact with one or more relatives during this period may also cause a bond to form that endures and that is preferentially favored, as the results of this study indicate. While relationships formed later also have an effect on social behaviors, it is speculated that it is the initial familial bond that is stronger. In this study there were no non-relatives kept together during the sensitive period. It may be the case that non-relatives raised together during the 2-7 week sensitive period would likewise show this strong social bonding exhibited by the related cats in this study. Determining if this were the case would require further study.

In conclusion, the results of this study indicate that both familiarity and relatedness have a significant effect on which cat, a given cat, associates with and will groom more. This is relevant in advising owners who are adopting new and unrelated cats and/or regarding unrelated cats that they already own, that aggression is expected to

decrease over time[38], and that affiliative behavior should increase over time. Owners concerned about issues of intercat aggression and social bonding should be made aware of this.

Reasons for relinquishment of cats to animal shelters include aggression between household cats and other behavioral problems[41]. There is a significant association between the presence of other pets in the household and relinquishment for both dogs and cats. Specifically, the addition of at least one cat to the household in the year preceding one study was significantly associated with relinquishment of a cat to an animal shelter.[41] In another study, Scarlett et al.[42] found that among animals from households with other animals at home, 32.9% were relinquished to animal shelters because of too many animals in the household. It was concluded that "educating and counseling people with regard to issues surrounding pet acquisition, ownership and behavioral modification must be proactively undertaken by all facets of the pet-associated community".

The results of this study have implications when deciding to adopt one or more kittens and/or when adding a new cat to a household where other cats are present. Adopting a related litter, a set of siblings, a mother and siblings, or even unrelated kittens of the same age, may result in higher rates of affiliative behavior and stronger bonding than periodically adopting single, unrelated adult cats. These data may be invoked to help animal shelters and Humane Societies make a case for adopting two or more siblings with their mother included, citing the resultant relationship these cats are likely to exhibit as adults. These data may also have implications in adopting multiple kittens or adult cats with the expectation that over time they will become familiar with each other and develop affiliative relationships.

Results of this study indicated that relatedness was a more powerful effect than familiarity. Thus, keeping kittens together during the sensitive period should have a beneficial effect on social bonding. Nevertheless, the results also indicated that the longer non-related cats were together the more they groomed each other and spent time together. Given that many people adopt cats that are unrelated, this is an important finding that fits with Barry and Crowell-Davis' finding of decreased aggression the longer cats have been together.[38] Thus, in general, when people adopt unrelated cats they can expect aggressive behavior to decrease and affiliative behavior to increase over time.

Table 1 – The composition of the cat research colony as of 9/01

Table 1

Name of Cat	Sex	Approx. Age	Time On-Site	Arrival Date/ Age
Jordan	Male	11 yrs	124 mos	May-91 at 6wks
Raja	Female	7.5 yrs	84 mos	Sep-94 at 4 mos
Lexi	Female	7.5 yrs	82 mos	Nov-94 at 8 wks
Kazi	Female	7.5 yrs	79 mos	Feb-95 at 4 mos
Moose	Male	8 yrs	76 mos	May-95 at 1-2 yrs
Mama	Female	8 yrs	76 mos	May-95 at 1-2 yrs
Alfalfa	Male	7 yrs	76 mos	May-95 at 4 wks
Buckwheat	Male	7 yrs	76 mos	May-95 at 4 wks
Darla	Female	7 yrs	76 mos	May-95 at 4 wks
Spanky	Male	7 yrs	76 mos	May-95 at 4 wks
Freeway	Female	7 yrs	69 mos	Dec-95 at 12 wks
Zeus	Male	6 yrs	59 mos	Oct-96 at 12 wks
Danny	Male	6 yrs	56 mos	Jan-97 at 6 wks
Cisco	Male	5 yrs	43 mos	Feb-98 at 1 yr
Medi	Female	3 yrs	38 mos	Jul-98 at 5 wks
Rosie	Female	3 yrs	26 mos	Jul-99 at 1-2 yrs
Curly	Male	2 yrs	26 mos	Jul-99 at 6 wks
Norma	Female	2 yrs	26 mos	Jul-99 at 6 wks
Norman	Male	2 yrs	26 mos	Jul-99 at 6 wks
Smudge	Male	2 yrs	26 mos	Jul-99 at 5 wks
Bob	Male	2 yrs	25 mos	Aug-99 at 4 mos
Itty Bitty	Female	2 yrs	19 mos	Feb-00 at 1 yr
Paco	Male	1 yr	19 mos	Feb-00 at 8 wks
Chip	Male	1 yr	15 mos	Jun-00 at 5 days
Dill	Female	1 yr	15 mos	Jun-00 at 5 days
Daphne	Female	1 yr	12 mos	Sep-00 at 7 wks
Scooby	Male	1 yr	12 mos	Feb-01 at 6 mos
Henry	Male	4 mos	1 mos	Aug-01 at 12 wks

Table 2 – The composition of the five groups of related cats in the research colony

Table 2

Mother	**Offspring**
Mama	
	Alfalfa
	Buckwheat
	Darla
	Spanky
Rosie	
	Curly
	Norma
	Norman
Itty Bitty	
	Paco
unknown	
	Chip
	Dill
unknown	
	Daphne
	Scooby

Table 3 – The composition of the related cats and the relative equivalents: those cats not related to the focal cat but on-site for the same amount of time as a relative.

Table 3

Name and # of Cat		Relative	Time On-Site	Relative Equivalent
Jordan	#1	none	124 mos	none
Raja	#2	none	84 mos	none
Lexi	#3	none	82 mos	none
Kazi	#4	none	79 mos	none
Moose	#5	none	76 mos	none
Mama	#6	#5, 7-10	76 mos	#1-5
Alfalfa	#7	#6, 8-10	76 mos	#1-5
Buckwheat	#8	#6,7,9,10	76 mos	#1-5
Darla	#9	#6-8,10	76 mos	#1-5
Spanky	#10	#6-9	76 mos	#1-5
Freeway	#11	none	69 mos	none
Zeus	#12	none	59 mos	none
Danny	#13	none	56 mos	none
Cisco	#14	none	43 mos	none
Medi	#15	none	38 mos	none
Rosie	#16	#17-19	26 mos	#1-15, 20
Curly	#17	#16, 18, 19	26 mos	#1-15, 20
Norma	#18	#16, 17, 19	26 mos	#1-15, 20
Norman	#19	#16-18	26 mos	#1-15, 20
Smudge	#20	none	26 mos	none
Bob	#21	none	25 mos	none
Itty Bitty	#22	#23	19 mos	#1-21
Paco	#23	#22	19 mos	#1-21
Chip	#24	#25	15 mos	#1-23
Dill	#25	#24	15 mos	#1-23
Daphne	#26	#27	12 mos	#1-25
Scooby	#27	#26	12 mos	#1-25
Henry	#28	none	1 mos	none

Figure 1

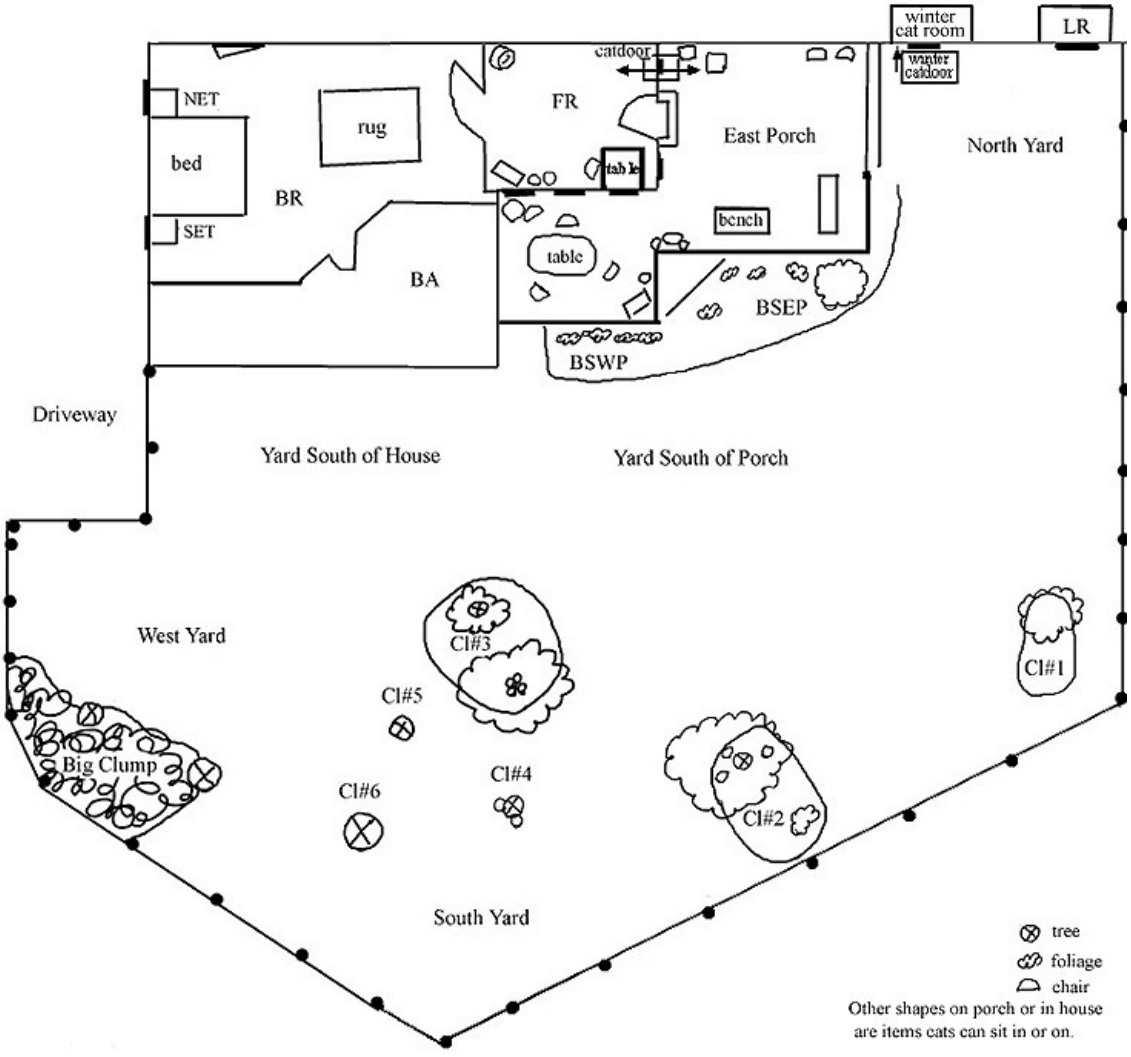

Figure 1 – Layout of Study Site

Figure 2

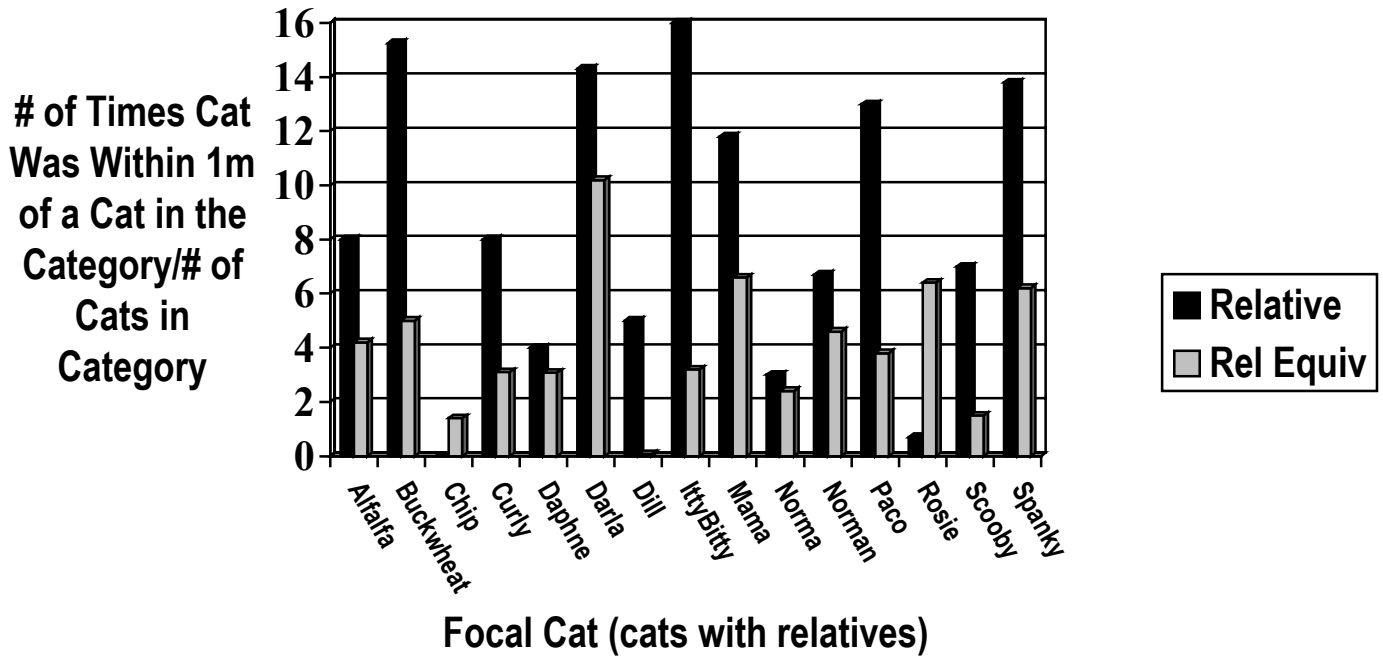

Figure 2 – Comparison of relatedness vs. familiarity and its effect on proximity. For each cat that had relatives in the colony, the number of times either a relative or relative equivalent (non-relative present on-site as long as a relative) was within 1m was divided by the number of cats in each category to obtain a frequency of proximity for each category. On a per cat basis, a relative was more likely to be within 1m than a relative equivalent (paired t-test, $P = 0.003$). On average, a relative was within 1m 8.44 ± 1.37 times while a relative equivalent was within 1m 4.17 ± 0.64 times.

Figure 3

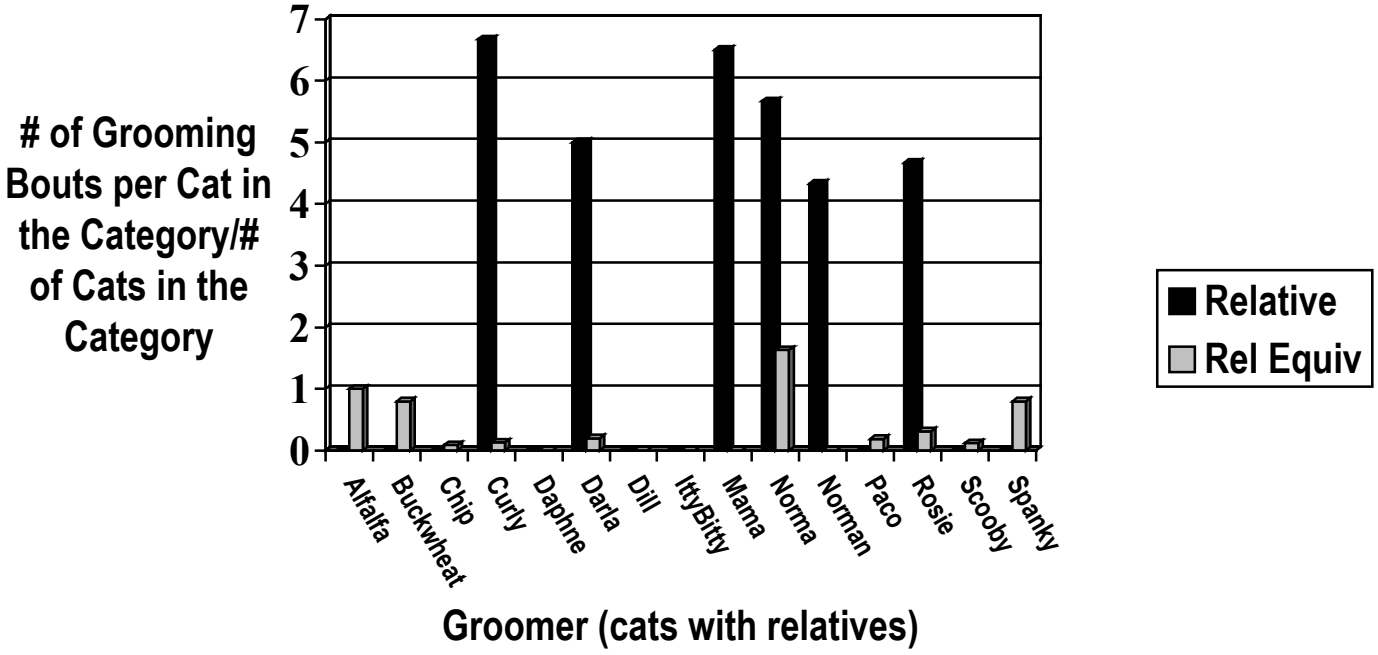

Figure 3 – – Comparison of relatedness vs. familiarity and its effect on allogrooming behavior. For each cat that had relatives in the colony, the number of times either a relative or relative equivalent (non-relative present on-site as long as a relative) was groomed was divided by the number of cats in each category to obtain a frequency of allogrooming for each category. On a per cat basis, relatives were groomed significantly more than relative equivalents (paired t-test, $P = 0.026$) for a mean of 2.19 ± 0.73 compared to 0.35 ± 0.13. On average, those cats that had relatives and groomed, groomed a relative 6.3 times more than they groomed relative equivalents.

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