

# Influence of familiarity and relatedness on proximity and allogrooming in domestic cats (*Felis catus*)

Terry Marie Curtis, DVM, MS; Rebecca J. Knowles, MS; Sharon L. Crowell-Davis, DVM, PhD

**Objective**—To evaluate associations between relatedness and familiarity with the affiliative behaviors of maintaining proximity and allogrooming in cats.

**Animals**—28 privately owned cats in 1 colony.

**Procedure**—15 of the cats had 1 or more relatives present representing 5 genealogies. Each cat was observed in 15-minute intervals for 3.5 hours during the study. All occurrences of allogrooming behavior were recorded. At the onset of each 15-minute observation period and at 2-minute intervals thereafter, the identity and location of all cats within 1 m of the observed cat were recorded.

**Results**—Relatedness and familiarity was significantly associated with the number of times a cat was within 1 m of another cat and how often a cat was groomed. For relatives and nonrelatives that were equally familiar to a given cat, relatives were significantly more likely to be within 1 m and to be groomed.

**Conclusions and Clinical Relevance**—Familiarity and relatedness are significantly associated with allogrooming and proximity of another cat. This may be important when considering adoption of 1 or more kittens and when adding a new cat to a household in which other cats are present. Adopting small family groups may result in higher rates of affiliative behavior, stronger bonding, and lower incidence of conflict than periodically adopting single unrelated adult cats. (*Am J Vet Res* 2003;64:1151–1154)

Results of previous research indicate that free-living domestic cats form social groups.<sup>1-7</sup> These groups typically consist of females that are usually related and their offspring. It has also been suggested that female kinship is the basis of this group formation.<sup>2</sup>

Some of the benefits that a cat might gain through group formation and subsequent sociality may include improved care of offspring through shared maternal care,<sup>3</sup> improved defense of food resources,<sup>7</sup> and concentration of potential mates.<sup>8</sup>

Nonrandom close proximity between 2 cats may be indicative of strong social ties between the cats. In research conducted by Wolfe<sup>a</sup> in 2 colonies of 29 and 20 cats, respectively, adult cat dyads (pairs) were within 1 m of each other 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. Because the relationships among the 29 cats were unknown, it was not possible to ascertain whether relatedness was the basis for preferential social behavior, such as proximity. In the study of 20 cats, all but 2 were related.

Social grooming (allogrooming) has been reported in many species. Dunbar<sup>9</sup> 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 and against the purely hygienic function. In Japanese macaques, social grooming occurs most often between kin-related individuals—mothers and offspring in particular.<sup>10</sup> Duration and frequency of grooming often exceeded that necessary for hygiene alone (ie, removal of ectoparasites). As a result of such research, 1 conclusion was that the social function of allogrooming is to establish and maintain affiliative relationships.

In beef cattle (*Bos taurus*), social licking might have cleaning, tension-reducing, and bonding effects.<sup>11</sup> When several social factors were investigated including the difference of dominance status, the dominant-subordinate relationship, kinship and familiarity, and the sex of the calves, only familiarity was significantly associated with licking; exchanges of social licking increased with length of cohabitation. In a herd of 20 Holstein dairy cows, closeness in birth (familiarity) and kinship were both significantly associated with time spent in allogrooming; dominance relationships did not have a significant effect.<sup>12</sup> It was suggested that allogrooming in cows is an important behavior pattern with functional importance 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<sup>13</sup> indicated that social grooming or allogrooming has been observed in kangaroos, bovines, deer, antelope, 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 and Cameron-Beaumont<sup>14</sup> as 1 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 Sung<sup>b</sup> and Wolfe,<sup>a</sup> allogrooming was observed to occur between sexually intact adult cats that were not moth-

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From the Department of Anatomy and Radiology, College of Veterinary Medicine, University of Georgia, Athens, GA 30602, (Knowles, Crowell-Davis) and the Department of Small Animal Clinical Sciences, College of Veterinary Medicine, University of Florida, Gainesville, FL 32610 (Curtis).

Address correspondence to Dr. Curtis.

er-offspring pairs. All sex combinations were observed to allogroom; that is, males groomed males and females, and females groomed females and males. In lions, allogrooming occurs as part of mating and in mother-young interactions and additionally when 2 lions are resting together. The function of allogrooming in this latter context has not been elucidated. Typically, cats kept in captivity also engage in social grooming in this context.

Bradshaw<sup>15</sup> reported 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 purpose of the study reported here was to evaluate associations between relatedness and familiarity and the affiliative behaviors of maintaining proximity and allogrooming in cats. The 4 hypotheses of the study were that cats with relatives would spend more time with relatives than nonrelatives, cats that have spent more time together (ie, that are more familiar with each other) would spend more time together, cats that have relatives would engage in allogrooming behavior with relatives more than with nonrelatives, and 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.

## Materials and Methods

**Cats and research site**—A group of 28 domestic cats served as subjects in this study. The colony consisted of 16 males and 12 females. All of the cats were neutered before the study began, with the exception of 1 cat that entered the colony when it was approximately 12 weeks old and was subsequently neutered at approximately 16 weeks of age.

Of the 28 cats, 15 had 1 or more relatives in the colony representing 5 genealogies. Among these, 1 cat had 4 offspring, 1 cat had 3 offspring, 1 cat had 1 offspring, and there were 2 pairs of 2 siblings. It should be noted that when the term related is used, only matrilineal relationships are indicated, because paternity was unknown for these cats.

The group was located at a private dwelling and surrounding area (approx 0.1 hectare) in Athens, Georgia. The cats had free access to certain indoor areas and an escape-proof fenced yard through a cat door. A bowl located inside the dwelling on a table with an attached 3.6-kg container provided a continuous supply of food. This bowl was replenished by the owners as needed. Several large water bowls were located inside and outside the dwelling. Four litter boxes were located in 1 of the indoor areas. For urination and defecation, the cats used these boxes as well as various locations in the yard.

**Study protocol**—Focal-animal sampling (observing 1 individual for a specified amount of time) and instantaneous sampling (dividing the observation session into short sampling intervals) were used for the collection of data in this study. Fourteen 15-minute focal samples with 8 instantaneous scans/sample at 2-minute intervals were conducted on each cat in the colony during the observation period. All of the on-site sampling was documented on videotape with a video camera.<sup>6</sup> A wristwatch<sup>4</sup> was used for timing the focal (observed) cat and instantaneous samples. All observations were performed as described by Altmann.<sup>16</sup>

Observers spent 8 hours at the site prior to the begin-

ning of data collection to habituate the cats to their presence, learn to identify the cats, and observe the cats' general behavior. After the 8-hour habituation period, all cats typically ignored the observers or briefly investigated them upon entry to the site and then returned to normal activity. For data collection purposes, each week was divided into 2 morning sessions (7:30 to 11:30 AM) and 2 afternoon sessions (2:00 to 6:00 PM). Each cat was observed for 15 minutes during 1 morning session and 15 minutes during 1 afternoon session for a total of 30 min/wk.

Overall, each cat was observed for 3.5 hours during the study. In each session, cats were randomly chosen for observation. Prior to each study week, 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. When a cat was due to be the focal cat, 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 because of dense vegetation or because cats hid under the bed inside the house, the next cat on the list became the focal cat, and it was searched for in the same manner. If the original cat was seen later in the session, it became the next focal cat. If a cat was not found during a particular session, the observation was performed at a later date, during either a morning or afternoon session, depending on which session had been missed. Cats were usually observed from a distance of 2 to 3 m, but most could be approached more closely when necessary, because 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 those cats, observation was performed from a greater distance, and the zoom feature of the video camera was used to aid the researcher in recording the cat's activity.

For all of the sessions, the observers documented all occurrences of specific social behaviors including bouts of allogrooming. Data were collected from September 17, 2001 through October 25, 2001. Fourteen morning sessions and 14 afternoon sessions were conducted during this period. Half the cats ( $n = 14$ ) were observed during each session. Because there were sessions in which not all the cats scheduled to be observed were available, an additional 10 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 recorded for an additional 6 months by use of ad libitum sampling, meaning that no systematic constraints were placed on what was recorded and when.

All occurrences of allogrooming behavior by the focal cat were recorded during the sampling sessions. Additionally, at the onset of each observation of the focal cat and at every 2 minutes during the observation, the identity and location of all cats within 1 m of the focal cat were recorded.

A cat that was not related to the focal cat but that had been in the colony for the same amount of time as a relative of the focal cat was referred to as a relative equivalent. For those cats with relatives, the period of time spent with the colony after the initial time together with any relative was the factor considered to be equivalent for our purposes. It was at the point of introduction to the colony that the term relative equivalent was applicable.

**Statistical analyses**—Statistical analyses were performed by use of a software program.<sup>6</sup> Differences were considered significant at  $P < 0.05$ . The hypotheses that cats would be more likely to allogroom and be within 1 m of related cats and cats with which they were more familiar was tested with a general linear model. Familiarity was quantitated by the length of time that a focal cat and other cats had been

together in the colony. For each cat that had relatives in the colony, the number of times either a relative or relative equivalent was within 1 m of the cat was divided by the number of cats in each category, relative or relative equivalent, 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. Frequency of allogrooming and frequency of being within 1 m by relatives versus relative equivalents were compared by use of a paired *t* test.

## Results

The number of times a cat was within 1 m of a focal cat and allogroomed by a given cat was significantly ( $P < 0.001$ ) associated with the cat being a relative and familiarity between the cats (ie, how long they had lived together). There was a significant ( $P = 0.047$ ) association between relationship and familiarity. The shortest period that cats with relatives were present in the colony was 7 months; the longest period was 76 months. For cats that had relatives in the colony and were together for 7 months, the number of times that a relative was within 1 m was  $5.5 \pm 2.12$  (mean  $\pm$  SD). The mean number of times that a nonrelative cat that a focal cat had known for 7 months was within 1 m was  $3.6 \pm 4.36$ . At the other extreme of cats that had relatives and were together for 76 months, the mean number of times that a relative was within 1 m of a focal cat was  $12.6 \pm 9.53$ . The mean number of times that a nonrelative cat that a focal cat had known for 76 months was within 1 m was  $6.4 \pm 6.28$ .

For focal cats, a relative was more likely to be within 1 m than a relative equivalent ( $P = 0.003$ ). A relative was within 1 m of a focal cat  $8.44 \pm 5.32$  times, whereas a relative equivalent was within 1 m  $4.17 \pm 2.46$  times.

Likewise, relatives were groomed significantly ( $P = 0.026$ ;  $2.19 \pm 2.84$  times) more than relative equivalents ( $0.35 \pm 0.49$  times). Three of the 15 cats with relatives did not allogroom at all. The mean number of allogrooming events per cat for the 6 cats that did not groom relatives more than relative equivalents was 0.5, compared with 5.47 times for the 6 cats that groomed relatives more than relative equivalents. All of the 6 cats that groomed relatives more than nonrelatives were from groups in which the mother was present.

## Discussion

Allogrooming has been documented in many species. Our results indicate that allogrooming serves a social function to establish and maintain affiliative relationships rather than a purely hygienic function. Barry and Crowell-Davis<sup>17</sup> evaluated the association between familiarity and aggression in cats and found an inverse relationship between the length of time the cats had cohabited and the rate of aggression. The longer the cats had lived together, the less likely was 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<sup>18</sup> 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 nonrelatives provided that the cost to the groomer's own fitness does not exceed the benefits obtained by the individual being groomed.

The fact that our results indicate there is kin preference in the affiliative behaviors of proximity and allogrooming in domestic cats adheres to Hamilton's theory, regardless of the fact that all of the cats in this particular colony were neutered. This suggests that the underlying mechanisms that promote differential behavior toward kin still exist whether or not the cats are neutered. This neutered population did not behave differently than would be expected if the cats had not been neutered.

Possible evolutionary benefits of proximity include mutual defense and agonistic aiding (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 putatively emotional response to a particular cat, a relative or a familiar companion, although the evolutionary cause may no longer exist. This helps explain why cats in this particular colony preferentially remained near and allogroomed their relatives and cats with which they were more familiar more than nonrelatives and cats with which they were less familiar.

For cats with relatives that did groom, the mean number of grooming bouts with a relative was 6.3 times more than the mean number with a relative equivalent. It was of interest that all 6 cats that groomed relatives more than nonrelatives had their mothers in the colony. This fact is notable given the observation that female kinship is the basis of social group formation in free-living cats.<sup>2</sup>

For each cat with relatives, a period was spent with 1 or more relatives prior to their introduction to the colony. This time spent with relatives took place during the sensitive period for socialization in cats, which occurs from 2 to 7 weeks of age.<sup>19</sup> Close contact with 1 or more relatives during this period may also cause a bond to form that endures and is preferentially favored, as the results of this study indicated. Although relationships formed later also have an effect on social behaviors, the initial familial bond is stronger. In this study, there were no nonrelatives kept together during the sensitive period. It may be that nonrelatives raised together during the 2- to 7-week sensitive period would likewise have this strong social bonding as well.

Our results are relevant in advising owners of unrelated cats and those who are adopting new, unrelated cats, in that aggression is expected to decrease over time<sup>17</sup> and affiliative behavior should increase over time. Owners concerned about issues of intercat aggression and social bonding should be made aware of this.

Adopting a related litter, a set of siblings, a moth-

er 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. Our data may be used to help animal shelters, and humane societies suggest adopting 2 or more siblings and their mother. 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.

Although relatedness was a more powerful effect, the longer nonrelated 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 Barry and Crowell-Davis' finding of decreased aggression among cats that had been together longer.<sup>17</sup> Thus, in general, when people adopt unrelated cats, they can expect aggressive behavior to decrease and affiliative behavior to increase over time.

<sup>a</sup>Wolfe RC. The social organization of the free ranging domestic cat (*Felis catus*). PhD dissertation, University of Georgia, Athens, Ga, 2001.

<sup>b</sup>Sung W. Effect of gender on initiation of proximity in free ranging domestic cats (*Felis catus*). MS thesis, University of Georgia, Athens, Ga, 1998.

<sup>c</sup>Sony HandyCam Video Hi8, Sony Corp, New York, NY.

<sup>d</sup>Timex Ironman Triathlon, Timex, Little Rock, Ariz.

<sup>e</sup>SPSS 10.1 for Windows, SPSS Inc, Chicago, Ill.

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