Responses of pet cats to being held by an unfamiliar person, from weaning to three years of age

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Abstract

We have determined the extent to which individual responses of domestic cats on being handled by an unfamiliar person are stable between 2 and 33 months of age. Twenty-nine household cats from nine litters were tested at 2, 4, 12, 24 and 33 months of age, by being held for 1 minute by a standard, unfamiliar person. Between 4 and 33 months of age, individual differences in the number of attempts made by the cat to escape, and in whether or not it showed signs of distress, were stable, with the partial exception of the test at 12 months. There was no consistency between tests in whether or not a particular cat purred. At 2 months of age, the number of escape attempts was highest in cats which had been handled the least in the second month of life, but this trend was reversed in the number of escape attempts made at 4 months. The lack of distress exhibited by all cats in the test at 2 months indicated that all had received at least adequate socialization to people, and that none were therefore comparable with the unsocialized cats used in several previous studies. We conclude that under normal domestic conditions, the behavior of a cat when handled by an unfamiliar person reflects a stable character trait, and that extensive handling during the socialization period may be subsequently associated with a reduction in inhibited behavior when interacting with an unfamiliar person.

Keywords: *domestic cat, socialization, animal welfare, behavioral ontogeny, animal personality*

The behavior of young domestic cats and dogs towards people is strongly influenced by the extent and quality of exposure to humans that they receive during their sensitive phases for socialization (reviewed in McCune 1995). In the cat, socialization is less effective if delayed until after the kitten is 7 weeks old, and the sensitive

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period appears to be between the second and seventh weeks (Karsh and Turner 1988). There is also some evidence to suggest that the amount and quality of exposure to people during this period influences the subsequent "friendliness" of the individual cat, although this attribute may itself be multidimensional, incorporating elements of the individual relationship with the cat's owner as well as the cat's reaction to less familiar people. Karsh (1984) found that kittens handled for 40 minutes per day subsequently approached a person quicker and could be held for longer, than kittens handled for 15 minutes per day. Kittens handled by several people tend to be less wary of an unfamiliar person than those always handled by the same person (Collard 1967). There are also genetic effects on friendliness, which have been demonstrated via paternal effects (Turner et al. 1986; Reisner et al. 1994; McCune 1995). Maternal effects, which are also apparent (Turner et al. 1986), could also be caused by direct influences of the queen's behavior on that of her offspring (Rheingold and Eckerman 1971). Genetic and experiential influences may interact; for example, the genetic tendency towards "boldness," responsiveness to unfamiliar objects including people (McCune 1995), may lead to a kitten seeking out more social contact with people and hence receiving more socialization.

The majority of these studies have used laboratory-reared cats, and none has followed the development of behavior towards people beyond one year of age. It is therefore uncertain whether reaction to unfamiliar people is a consistent trait that persists into adulthood, and also to what extent each of the factors mentioned contributes to adult behavior. We have therefore set out to answer two questions; (*a*) do the responses of pet cats towards unfamiliar people change with age between the end of the sensitive period for socialization and three years of age, *i.e.* into adulthood? (*b*) do variations within the socialization received by kittens born in a typical range of domestic environments subsequently affect this aspect of friendliness?

Methods

Animals

The subjects were non-pedigree cats from nine litters born in households in southern Hampshire (UK) over a nine-month period, recruited through word of mouth and publicity in local press and radio. Each litter had a different mother and almost certainly a different father (see Lowe and Bradshaw 2001). All were domestic household pets throughout the study; homing of the kittens was left entirely to the owners of the mothers. Litter sizes ranged from two to five; the total number of kittens born was 36, but

seven died or could not be traced after homing, and so none of the data recorded for these kittens was used in the analysis. The remaining 29 (16 males and 13 females) were followed from birth up to the age of 33 months. All were neutered between 4 and 12 months of age, with the exception of one male, which was castrated soon after the 12-month test. Three cats remained in their original household, with their mothers; the remainder were homed between eight and thirteen weeks of age. Ten were homed in sibling pairs, two were homed with unrelated cats of the same age, seven went to households with other cat(s), and the remainder went to households without cats. They were tested once at each of 2, 4, 12, 24 (n=22, 8 litters) and 33 (n=19) months of age. The holding test at 2 months (7–8 weeks old) was conducted in the home of their mother and all the littermates were present. The remaining tests were carried out after the cats had been homed; no cat that was tested had moved from one household to another after the initial homing.

Procedure

The holding test was adapted from that devised by Karsh (1984). One unfamiliar, female person (SEL) conducted all the tests during the fourth of four visits which she made to each household at each of the specified ages except at 33 months; she did not handle the cats or otherwise have any contact with them during any of the first three visits (at which feeding tests, not reported here, were conducted). At 33 months the test was conducted at a single visit. In each test the owner placed the cat in her lap facing away from her, and for the next 60 seconds she talked to the cat and stroked its head and neck. If the cat tried to jump off her lap this was noted as an escape attempt and the cat was gently retrieved, and replaced for the remaining time. If the cat could not be retrieved, it was assigned one more escape attempt than the maximum recorded in one full minute by any cat of the same age. Whether or not the cat purred at any time during the test was also recorded, since this vocalisation is thought to be an invitation to maintain physical contact (Bradshaw 1992) and is anecdotally believed to reflect friendliness. An estimate of distress was obtained by noting vocalisations (anger wail, growl), whether the cat's body was tense, whether its claws were protruding, and any defensive behavior patterns (e.g. scratching). The cat was classified as having been distressed during a test if it performed one or more of these behavior patterns.

The amount of handling each litter received between 1 and 2 months of age, and a ranking of the kittens in each litter with respect to the proportion of handling each had received, were obtained from a questionnaire given to the owners of the mother cats. (When we were piloting the ques-

tionnaire, owners found it easier to give estimates for these two parameters than to specify the precise amount of handling each kitten had received).

Statistical analysis

All the statistical analyses were performed using SPSS v.10 (SPSS, Inc.). To compare tests at different ages, Spearman rank correlations were carried out on the number of escape attempts, and Fisher's exact test was used for the states distress/no distress and purring/not purring. The relationship between the amount of handling received by each cat during the second month and the numbers of escape attempts at each age was analysed using Linear Regression, with the rank of the number of escape attempts as the dependent variable, and the rank of the amount of handling given to the litter and the within-litter rank of handling received as independent variables. Littermate similarities in escape attempts were examined by one-way ANOVA on ranks. Since the ten kittens homed in pairs could not be assumed to be independent samples, all significant results were checked by repeating the analysis twice, omitting one of each pair, selected at random, in the first analysis, and the other in the second. No meaningful changes in significance were found, other than those expected from the reduction in sample size.

Results

Distress

At 2 months of age, no cats showed any signs of distress, indicating that all kittens had received at least adequate levels of socialization during the first 8 weeks of life. At 4 months there were three, at 12 months 13, at 24 months four and at 33 months there were six distressed cats. Three of the cats distressed at 24 months, and five distressed at 33 months, had been distressed at 12 months (both significant associations, p=0.01); three out of the four distressed at 24 months were also distressed at 33 months. Eight of the cats were distressed in at least two of the tests; these came from six of the eight litters represented in all the tests, suggesting that environment up to eight weeks and genetics were not major influences.

Purring

No kittens purred when tested at 2 months; thereafter the percentages purring were 67% (4 months), 35% (12 months), 45% (24 months), and 42% (33 months). There were no significant associations between ages, i.e. cats that had purred at one test were no more or less likely to purr at the next test than cats which had not purred. The reduced overall extent

of purring at 12 months is consistent with the peak level of distress at the same age.

Escape attempts

The number of escape attempts performed by the cats ranged from zero to a maximum measured value of 17: medians were one at 24 months, two at 2 and 33 months, and three at 4 and 12 months. Distressed cats always made slightly more escape attempts but this was only significant at 33 months of age (Mann-Whitney Z=2.19, p<0.05). The degree of overlap between the distressed and non-distressed cats suggests that some escaped repeatedly for reasons other than fear of the test person.

The frequency of escape attempts was significantly correlated (Table 1) between 4 and 24 months, 24 and 33 months, and also 4 and 33 months (Figure 1). Correlations between the test at 12 months and those at 4, 24 and 33 months were all positive, but not significant at p<0.05 (Table 1). Since more cats were distressed at the 12 months test than at any other, we considered the possibility that escape with and without showing distress might be qualitatively different. Separate sets of correlations for escape at 12 months were carried out for the cats that had and had not been distressed during the 12-month test, but none were significant.

Table 1. Spearman rank correlation coefficients between numbers of escape attempts recorded at each age.

Age	4 months	12 months	24 months	33 months
12 months	0.012			
24 months	0.630**	0.296		
33 months	0.660**	0.437	0.558*	
2 months	-0.208	-0.246	-0.544	-0.113

**Significant at p<0.01, *significant at p<0.05 (2-tailed).

All four correlations with the 2-month data for escape attempts were negative, the largest coefficient being between the 2 and 24-month tests. Since each litter was tested on the same day and in the same place at 2 months old, their data may not be independent; hence, it is not possible to assign precise significance levels to these correlations. However, the consistently negative correlation coefficients suggest that the kittens that had been particularly active at 2 months of age became less active with age, and that conversely, those that hardly tried to escape prior to homing increased their attempts as they grew older (Figure 2).

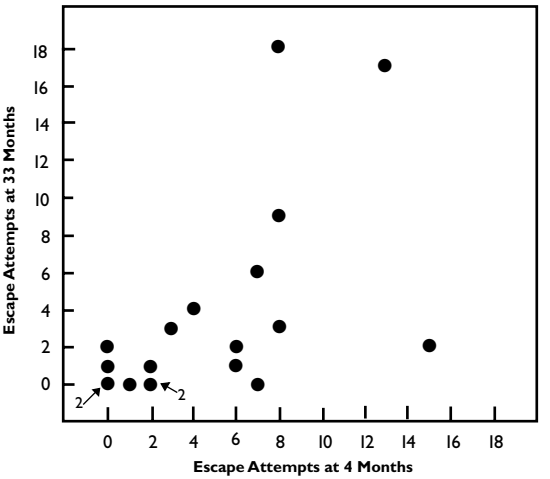

Figure 1. Frequencies of escape attempts made by individual cats during 60 seconds in the tests at 4 and 33 months of age. Numbers attached to points indicate the number of cats with that pair of values.

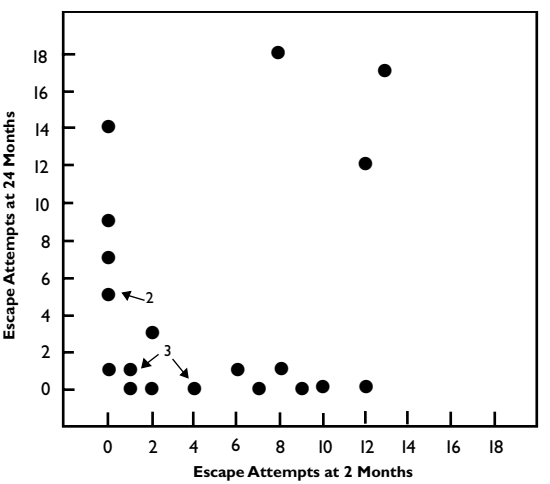

Figure 2. Frequencies of escape attempts made by individual cats during 60 seconds in the tests at 2 and 24 months of age. Numbers attached to points indicate the number of cats with that pair of values.

Amount of handling

The amount of handling per day received by the litters in their second month varied from twenty minutes to two and a half hours, with a median of one and a half hours.

We could find no systematic relationship between the amount of handling received and whether or not a cat purred or was distressed in any of the tests.

When tested at 2 months of age, there was a tendency for kittens from litters which had received the most handling to make fewer escape attempts than those which had received least handling, but the reported within-litter variation in the amount of handling received had little effect (model R square = 0.22, p=0.04; standardized Beta for between-litter variation in handling = -0.45, p= 0.02; standardized Beta for within-litter variation in handling = -0.13, p=0.46). This suggests that at that point the socialization of those kittens which had received least handling was still incomplete.

Conversely, the number of escape attempts made at 4 months was positively related to the amount of handling the cats had received as kittens (model R square = 0.23, p=0.04; standardized Beta for between-litter

variation in handling = +0.40, p=0.03; standardized Beta for within-litter variation in handling = +0.26, p=0.15); the cats from litters that had been handled the least now tended to make fewer escape attempts than those handled the most. The number of escape attempts at subsequent ages (12, 24, 33 months) appeared to be unaffected by the amount of early handling (model R square <0.15, p>0.3), and littermates did not show any similarities (One-way ANOVA, all p>0.10).

Behavioral styles

The number of escape attempts was compared with the four elements of "behavioral style," tendency to stay indoors, tendency to rub on objects and people, tendency to boldness, and investigative style (tactile vs. olfactory), identified from spontaneous post-meal behavior in the same cats by Lowe and Bradshaw (2001), at 4, 12 and 24 months, using Spearman Rank correlations. Correlation coefficients ranged between -0.25 and +0.15; it therefore appears that the reaction to being handled is a separate trait to those involved in interactive behavior initiated by the cat.

Discussion

The behavior of these cats while being held by an unfamiliar person was generally consistent between 4 and 33 months of age. This is reflected both in whether they became distressed, and also in the number of attempts that they made to escape. The most inconsistent results were obtained at 12 months, when the number of cats showing distress peaked, and the number of escape attempts was least well correlated with those at other ages. Since all but one of the cats had been neutered by this age, the onset of adult (e.g. sexual) behavior in some cats, but not others, is unlikely to explain the apparent degree of "noise" within the 12-month data; it is possible that at this age some cats were more generally reactive than others due to repeated territorial encounters with cats from nearby houses. With the partial exception of the 12-month test, individual variation in the reaction of cats to unfamiliar people from 4 months of age onwards appears to be stable, which indicates that this character trait is relatively robust. However, we could not investigate the effect of a change in owner after 4 months of age, so the contribution of the physical environment and ownership "style" (Turner 2000) to this stability cannot be assessed from our data.

Although we used the same "unfamiliar" person to perform the test on each occasion, none of the data suggests that the cats' responses were sys-

tematically influenced by their previous contact with her (for example, the number of escape attempts did not decline with age).

The consistency in the response to being held between 4 months and 33 months mirrors the stability in the Investigative and Boldness traits between 4 and 24 months in the same animals (Lowe and Bradshaw 2001). These three aspects of behavioral style therefore appear to form within the first 4 months of life, and do not change substantially thereafter, in cats which stay within the same household. Although it could be argued that they might be linked motivationally, in our data these traits were uncorrelated with one another, suggesting that they may reflect different aspects of "personality."

The differences between individuals at 4 months of age appear to be influenced by the amount of handling that each kitten had received during the socialization period (second month), in addition to presumed effects of genetics and maternal behavior, which we did not set out to measure. At 2 months of age, the kittens that had been handled the least made the most escape attempts, which is consistent with McCune's (1995) Stranger Approach Test, in which cats that had received the least handling were least likely to make spontaneous contact with an unfamiliar person, and would therefore be expected to make the most attempts to escape if held. However, by 4 months of age the trend in our data had reversed, i.e. the kittens that had received the most handling now made the most escape attempts.

This apparent disparity can be explained by the substantial differences between the ranges of handling in the two studies. McCune contrasted unsocialized kittens, which received the minimum contact with people consistent with feeding and cleaning, with kittens which were handled for 5 hours each week between 2 and 12 weeks of age. All of our sample were handled, approximately one-third for slightly less time than used by McCune, and two-thirds for the same time or more. Also, the amounts of socialization received by the kittens in our study were probably higher than these figures would suggest, since our domestic environment would have provided more opportunities for other types of contact with people than the cattery environment employed by McCune. None of our kittens was distressed when handled for the first time by the unfamiliar person, at 2 months of age, and therefore it is reasonable to assume that all had received at least minimal socialization to people, although the presence of the mother at this test may have contributed a calming effect on the kittens (Chesler 1969).

In our sample, the kittens which had received least handling in their second month of life appear not to have completed their socialization by 2 months of age, but presumably did so during their third month, when most of them were moved to new homes. By 4 months of age the residual effect

of restricted early handling appears to be behavioral inhibition (sensu Carlstead, Brown and Strawn 1993) when handled by an unfamiliar person, whereas those which had been handled the most were now active (and playful) even with a person who was unfamiliar.

Subsequently, no effects of early handling could be detected, nor could any other similarities between littermates, but there was a significant consistency in the cats' behavior when handled. It therefore seems likely that the way in which a cat reacts to being handled by an unfamiliar person is largely determined by events within the first 4 months of life.

We hypothesize that extensive handling throughout this period may induce a tendency for a cat to be more active and/or playful in unfamiliar situations, whereas individuals which have received less early socialization tend to adopt a strategy of remaining still. Similar experience-related behavioral polymorphisms have been detected in other species (see Wilson et al. 1994 for review), including silver foxes (Pedersen and Jeppesen 1990) and rats (Ader and Grota 1969).

This trait does not seem to affect the likelihood that a cat will purr in the same situation, since this measure was inconsistent between ages. Purring may therefore be affected by transient changes in motivation or "mood" of the cat. The complete absence of purring in the test at 2 months was unexpected, since kittens are capable of purring at a few days of age (Moelk 1944), and also because in a similar test of rescued 2-month-old kittens held by a familiar person, 20 out of 44 purred (Lowe and Bradshaw, unpublished). This may suggest that by 2 months of age kittens have formed a social bond with the specific people who have handled them, but merely show an absence of the fear reaction (cf. the domestic dog; Zimen 1987) to people they do not recognize.

Conclusions

The extent of handling during the socialization period (2–7 weeks) appears to influence the reaction of a kitten to an unfamiliar person a few weeks after homing, suggesting that those kittens which have received most socialization are initially the best equipped to cope with the stress of new experience. However, the influence of handling at 2–7 weeks was virtually undetectable in the tests conducted thereafter, and this, combined with the stability of the response to the holding test between 4 months and three years, suggests that a kitten's experiences in the third and fourth months of life may also be important in determining its subsequent behavior towards people. As one hypothesis, handling in the socialization period between 2

and 7 weeks may inhibit the development of fearful behavior towards people in general, and then further experience, between 8 and 16 weeks, may influence the way that the cat subsequently reacts to different categories of people, e.g. familiar vs. unfamiliar. Since many owners describe their cats as fearful of unfamiliar people (Bradshaw, Casey and Macdonald 2000), and this fearfulness is presumably experienced as a negative emotional state by the cat, more detailed understanding of these processes is likely to lead to improvements in cat welfare.

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