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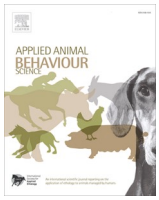
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Introducing new cats to multi-cat households: Results of a representative survey of Danish cat owners

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ABSTRACT

Based on a quantitative questionnaire survey aimed at Danish cat owners representing the background population regarding a number of demographic parameters, we examined: 1) The use of different introduction techniques for new cats in multi-cat households; 2) the correlation between recommended practices for introducing new cats to resident cats in homes and the cats' reactions to each other within the first month after introduction. Of 1507 cat-owning respondents, 308 had introduced new cat(s) to resident cat(s) among the cats living in their house at the time of the survey, and the study focused on these. Firstly, descriptive statistics served to map the prevalence of (i) 16 different introduction techniques and (ii) the new and resident cats' reactions. Secondly, the study applied exploratory binary phi correlation tests (i) between new and resident cats' reactions to each other and (ii) between applied introduction practices and reactions. Moreover, we also took the age of the cats into account, by disaggregating our analyses on age classes of the new and resident cats. We identified two main ways new cats are introduced: putting the cats together from the beginning (56 % of respondents); and following recommended introduction techniques, including separation, use of barriers and scent exchange, exploration of each other's areas, and using calming scents / pheromones / supplements / food. In general, the statistically significant associations between introduction practices and cats' subsequent reactions were not strong. However, the findings suggest that when both the new and resident cats are juvenile and/or young adults (< 4 years) applying separation, allowing the cats to explore the others' areas, use of barriers, swapping scent and using calming scent pheromones are associated with agonistic reactions in the first month after introduction. On the other hand, if both the new and resident cats are mature (5 + years), use of barriers, engaging the cats in play in the same room and introducing additional resources are associated with affiliative relations. The reason for these results, especially in young cats, requires further investigation. Possible explanations for recommended introduction practices appearing counterproductive include that owners anticipate problems or apply the techniques after the cats have already displayed agonistic reactions to each other.

1. Introduction

Sharing a home with conspecifics is not always easy for domestic cats (*Felis silvestris catus*). Descended from the solitary African wildcat (*Felis silvestris lybica*), they have acquired some social tolerance during the domestication process (Bradshaw, 2018, 2016), probably as a result of individuals more tolerant of conspecifics being favoured by selection (Finka, 2022). Behaviours suggestive of positive relations (e.g. allo-rubbing, allo-grooming, resting together, playing) are often observed among cohabiting companion cats (Barry and Crowell-Davis, 1999; Elzerman et al., 2020; Finka and Foreman-Worsley, 2022). However, behaviours indicative of conflict (e.g. house soiling, marking, aggression, staring, blocking, avoidance) are also commonly observed (Barcelos et al., 2018; Bradshaw, 2016; Elzerman et al., 2020; Finka and Foreman-Worsley, 2022; Heidenberger, 1997; Pryor et al., 2001; Ramos, 2019; Rodan et al., 2024). Given that conflicts among cohabiting cats

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are linked to a range of welfare concerns (Amat et al., 2016; Ramos, 2019; Rodan et al., 2024), it is important to understand how conflicts can be avoided or mitigated.

The factors that influence the relationship between cohabiting cats are clearly multifactorial and dynamic (Finka, 2022; Finka and Foreman-Worsley, 2022). For example, Khoddami et al. (2023) in a survey of 6529 owners of two cohabiting cats found that the sex, absolute and relative age, relatedness between the cats, degree of outdoor access and temperament all influence the social relationship that exists between the cats. Nonetheless a key factor of concern is the method by which new cats are introduced to resident cats in the home (Elzerman et al., 2020; Finka, 2022; Levine et al., 2005; Rodan et al., 2024). Various introduction techniques (including separation, scent swapping, meeting through a barrier, positive controlled encounters, use of pheromone products, etc.) is frequently recommended by cat professionals (Bradshaw and Ellis, 2016; De Souza Dantas, 2020; Ramos, 2019; Rodan et al., 2024), based on the belief that these introduction practices will increase the probability of long-term affiliative relations. Moreover, most sources recommend gradual introduction regardless of the cats' ages. Some sources claim that resident cats may more readily tolerate kittens than adult cats, and that preventive measures against agonistic encounters may therefore not be necessary (Ramos, 2019). Others claim that adult cats may react aggressively to unknown kittens, especially if they replace previous companions (Beaver, 2003). In the absence of supporting data, these claims remain theoretical and open to challenge.

To date, little research has focused on how cat owners introduce new cats to resident cats in practice. The association between the method of introduction and the subsequent quality of the relationship between cohabiting cats is also understudied (Bradshaw, 2018; Elzerman et al., 2020; Finka, 2022; Levine et al., 2005). Levine et al. (2005) found a significant positive correlation between short-term (the first weeks following introduction) and long-term fighting (defined at 'scratching and/or biting') between new and resident cats. Likewise, they found a significant positive correlation between long-term fighting, and the owners describing the first meeting as being 'unfriendly/aggressive'. Their results were controlled for method of introduction (differentiated between (i) immediate, (ii) separation and then putting the cats directly together, (iii) separation combined with gradual introduction), age and sex of cats, number of cats in home, outdoor access and home size, but not for further factors such as other pets in the home or children. No significant correlation was found between the cats' ages, sex or number of cats in the home, and the prevalence of short- or long-term fighting. Likewise, there was no significant relationship between long-term fighting and method of introduction. The authors argued that the latter finding may result from a lack of question detail in relation to the introduction techniques applied. Moreover, the study did not include questions relating to other, and more subtle, agonistic displays. The authors note that they may therefore underestimate the degree of social tension between new and resident cats (Rodan et al., 2024). It may be speculated how including more types of agonistic displays would have affected their results. Elzerman et al. (2020) demonstrated a significantly higher rate of long-term affiliative behaviours between new and resident cats when the owners claimed the initial introduction 'went well', compared to when the introduction did 'not go well', but did not examine correlations with the introduction method, nor with the cats' ages. On the other hand, they only found weak correlation between agonistic/affiliative displays and cat sex, ages, declaw status, number of cats in the home, access outdoor and temperament.

These studies suggest that subsequent affiliative relations between new and resident cats depend on how early encounters are experienced by the cats. However, the impact of specific elements of the introduction process on initial affiliative relations remains unknown. A gap therefore exists in the current literature on the association between recommended introduction practices and subsequent relations between new and resident cats in the domestic home. Given the varied advice regarding introducing new cats and kittens, the relevance of the cats' ages for the success of introductions is also unknown. This paper seeks to fill this gap in two steps: First we describe how cat owners in multi-cat households introduce new cats. Secondly, we use exploratory correlation analysis to examine the overt associations between introduction methods and subsequent reactions of new and resident cats to each other the first month after introduction. Furthermore, we also take the age of the cats into account, by disaggregating our analyses on age classes of the new and resident cats. The findings are based on responses to a questionnaire answered by a sample of 308 Danish cat-owners who have introduced new cats to resident cats. The sample represents the background population regarding a number of demographic parameters.

Our main hypothesis, based on the above arguments, is that using aspects of gradual introduction techniques correlates with greater positive initial reactions for new and resident cats towards each other and that this effect may be stronger the older the new and resident cats are, and that it may be less strong if the new cat is a kitten or a very young cat.

Our focus on relations between new and resident cats during the first month post-introduction may not predict long-term relationships, which are a function of many factors, apart from introduction approaches (Finka and Foreman-Worsley, 2022, Khoddami et al., 2023). However, given the findings by Levine et al. (2005) and Elzerman et al. (2020), that the degree of success of the initial meeting is correlated with long-term affiliative or agonistic relations, we consider our focus on the correlation between initial reactions and introduction methods as a valuable contribution to understanding factors that influence inter-cat relations in the home.

2. Materials and methods

2.1. Survey design

Data was derived from a larger quantitative questionnaire survey performed in connection with a project investigating various aspects of the welfare of cohabiting companion cats.[1] Supplementary Material A presents an English translation of the part of the questionnaire (originally in Danish) used for the results presented in this paper, while Supplementary Material B provides the data. The cats and households looked at in the current study were selected based on an item which asked the respondents about the number of cats in the household at the time of the study. If the answer to this question was two or more cats, the respondents were asked if they had acquired the cats at different times. If so, we asked whether the most recently acquired cat(s) had been acquired from a source outside the home (e.g., from a breeder, shelter, friend, stray or other). Respondents who answered 'yes' to this question are the focus of the analysis presented in this paper.

These respondents were asked a number of questions relating to the introduction of the most recently arriving cat(s). Firstly, how many cats were brought home and how many cats were resident in the home when the new cat(s) arrived. Secondly, the ages of the new and resident cats at the time the new cat(s) arrived; in the case of more than one new cat, the respondents were asked the age of the youngest and oldest new cat, and likewise for the resident cat(s). When more than one new cat was introduced, the average age of the youngest and oldest new cat was used as an indicator of the new cats' ages in this study. Likewise, when more than one cat was resident in the home at the time of introduction, the average age of the youngest and oldest resident cat was used as an indicator of the resident cats' ages.

Furthermore, the respondents were asked whether they applied one or more of 16 introduction techniques, details of which can be seen in

[1] 'How to best introduce and ensure welfare of cohabiting companion cats', the Danish Centre for Companion Animal Welfare, https://dyreetik.ku.dk/center-for-forskning-i-familiedyrs-velfaerd/forskningsprojekter/how-best-to-introduce-and-ensure-welfare-for-cohabiting-companion-cats/

Supplementary material A. If they applied one or more of these, they were asked for how long each technique was applied (options (i) 'Less than one day', (ii) '1–3 days', (ii) '4–7 days', (iv) '8–14 days', (v) '15–30 days', (vi) 'More than 30 days'). The only exceptions to the questions about duration of the intervention were in relation to (i) if the respondents had put the new and resident cats in the same room from the beginning, and (ii) if the respondents had introduced new resources (litter boxes, food and water bowls, beds, dens etc.) when the new cats arrived.

Following this, the respondents were asked whether they had observed the new cat(s) display any of 10 reactions (ranging from affiliative, over indifference, to agonistic) at some point during the first month after introduction; and likewise, if the resident cat(s) had displayed any of the 10 reactions towards the new cat(s) in the first month after introduction. In both cases more than one reaction could be selected. A detailed outline of the 10 reactions is given in Supplementary material A.

Finally, the respondents provided more detailed background information (current age, breed, sex, outdoor access) relating to two of the cats in the household, regardless of the number of cats in the household. For the most recently introduced new cat(s) who were still present in the household at the time of the survey, the cat whose name came first in the alphabet was selected. Similarly, respondents were asked to select the cat whose name came first in the alphabet among the still-resident cat(s) who were present in the home when the new cat(s) was introduced.

The questionnaire was piloted mainly for flow and comprehensibility by asking five cat owners to answer the questionnaire during an interview with one of the authors of this paper. The interview format was chosen to ensure that all questions and options were well understood. The pilot study led to optimisation of the questionnaire with respect to ease of understanding.

Data collection was carried out by a Danish survey company (Norstat) in October 2024. Norstat manages citizen panels in many European countries. The members of these panels have agreed to receive invitations to participate in research in exchange for Norstat points that can be exchanged to gifts. As for the Danish panel, there are 86893 (as of 1st of November 2024) members that all reside in Denmark. Panel members are recruited through a mixture of telephone interviews (random digit dialing), and online sources (typically internet pages). Norstat conducted a random draw of panel members with a view to achieve a sample of Danish citizens, representing the background population regarding a number of demographic parameters, including their age (age range: 18–79 years). Further, during data collection, Norstat monitored the number of respondents that had completed the questionnaire across different age groups, geographical location (NUTS2 regional level), and gender. If particular groups were under-represented (compared with the Danish census), extra invitations were issued within this group (still using the random draw principle within the group).

Invitations to participate were issued to N = 25365 panel members via an e-mail containing a link to the online questionnaire in exchange for Norstat points. A total of N = 7408 panel members (henceforth referred to as respondents) completed the survey giving a response rate of 29 %. Respondents not owning cats were screened out for the present study, leading to a net sample of 1507 respondents having one or more cats in their household. While power analysis was performed for the sample of all multi-cat households, an *a priori* power calculation was not conducted for the results reported in this manuscript.

It should be noted that the recruitment method used in pre-recruited internet panels – such as the one employed by Norstat – does not follow the classical probability-based sampling approach, where each unit in the target population has an equal chance of being selected. Consequently, population estimates derived from internet panels tend to deviate from those obtained through standard probability sampling methods. When probability-based recruitment is used for panel formation, the average absolute error rate is approximately 2.6 %. In non-probability recruitment this error rate is 5.8 % (Mercer and Lau, 2023).

In other words, while the sample represents the background population well for age, gender and geography, the nature of the sampling scheme (pre-recruited internet panel) makes it likely that our estimations of proportions, e.g. share of cat owners in Denmark and the owners' estimations of cat reactions, is slightly error prone. A study of Danish pet owners based on a high-quality probability sample found that 15.4 % of Danes owned a cat (Lund et al., 2024). The share in this study sample is 20.3 % (1507 of 7408). This suggests that the sample is slightly skewed. The former study surveyed participants in the age range 18–89 year, while the age range in our sample is 18–79 years. Since pet ownership decreases with age, this accounts for some of the difference, but certainly not all of it.

Data were pseudo-anonymised by Norstat before transfer to the University of Copenhagen. Respondents gave consent for their answers to be used for research and dissemination. The consent form can be seen in Supplementary Material C. The study was approved by the Research Ethichs Committee at the University of Copenhagen (CASE Number: 504-0535/24–5000).

2.2. Statistical analysis

Descriptive analyses were used to map the distribution of introduction techniques and the distribution of reactions of the new and resident cats to each other during the first month following introduction. Phi correlations coefficients were applied to investigate (i) correlation between initial reactions of the new and resident cats, (ii) correlation between use of different introduction techniques and (iii) correlation between introduction techniques and initial reactions of the new and resident cats. Correlation analysis was applied, rather than regression analysis including control variables (e.g., background information for the cats). Firstly, because the aim of our analysis was exploratory, testing possible relationships, and the strength of these, among the cats' initial reactions to each other, and between these and introduction approaches. Secondly, we did not have detailed background data for all new and resident cats present in the households at the time of the introduction (see above), and therefore it would only have been possible to further investigate cat-related risk factors for successful vs. unsuccessful introductions for a sub-sample. However, the available background information was used to map summary sex and breed distribution data for the subset of cats for which this information was collected.

Significance of phi correlation coefficients is measured through the corresponding χ^2 probability. Two thresholds for significance are highlighted and discussed: the unadjusted 5 % level and the Bonferroni adjusted 5 % level. The latter threshold is included as a high number of correlations are tested simultaneously, which increases the probability of type I errors. Thus, correlation coefficients with probabilities below the adjusted level are deemed significant in the present context. However, given that our study is an exploratory analysis of possible correlations between the various variables, the risk of type II statistical errors is also of concern (excluding factors that may be important), so we also discuss the possible implications of correlation coefficients with probabilities between the two thresholds (see also Armstrong 2014 for a further discussion of when to use Bonferroni adjusted alpha levels). Furthermore, phi coefficients larger than $|0.6|$ are, in the present context, considered strong correlations, while coefficients between $|0.3|$ and $|0.6|$ are considered weak to moderate. These are conservative limits, as some authors claim that phi coefficients larger than $|0.25|$ are very strong (Akoglu, 2018). However, others claim that phi correlation coefficients are negligible to moderate when $< |0.4|$ and strong to very strong when $> |0.6|$ (Lee, 2016). We follow the latter recommendation but scale the lower limit for weak to moderate correlation down, given the former recommendation.

3. Results

3.1. The population

1507 respondents had cats in their household. Of these, 977 (65 %) had one cat in their household, while 530 (35 %) had two or more cats. Of the latter, 308 respondents (58 %) had acquired their most recent cat (s) from outside the home, e.g., from a shelter, breeder, as a stray or other. These 308 respondents are the focus of this study. Of these, 232 respondents (75 %) owned two cats at the time of the study, 50 respondents (15 %) owned three cats, and 26 respondents (8 %) owned four or more cats. 222 respondents (72 %) had acquired one new cat, while 86 (28 %) had acquired two or more new cats. 197 respondents (64 %) had one cat in the home when the new cat(s) arrived, while 111 (36 %) had two or more cats.

The average age of the new cats when arriving in the home was 1.7 years (with a standard deviation SD of +/-2.5 years), while the average age of the resident cats in the home at the time of introduction was 4.0 years (+/- 3.3 years). Table 1 presents the distribution of average ages of the new and resident cats at the time of introduction. The table shows that most new cats were younger than 6 months old, while most resident cats were older than one year. The majority of respondents introduced new cats younger than 6 months old to resident cats aged between 1 and 4 years. Given the relatively few new and especially resident cats in the age group '6–11 months', this age group was aggregated with the group '< 6 months' for the analyses. Further, since there were few respondents introducing new cats > 1 year to resident cats < 1 year (2.3 %), these groups were excluded from analysis; likewise for respondents who introduced new cats > 5 years to resident cats aged 1–4 years (1.6 %).

As outlined above, background questions were asked for 2 cats in the household, one randomly selected new cat, and one randomly selected resident cat (the rule for randomisation is outlined in the Materials and Methods section). Thus, background information was obtained for 616 cats. The sex and neutering distribution for these cats was 237 (38 %) neutered females, 253 (41 %) neutered males, 57 (9 %) intact females and 63 (10 %) intact males. The sex of 6 cats (1 %) was unknown. 305 (50 %) of the cats were domestic shorthair, 158 (26 %) mixed breed, 110 (18 %) purebred, while the breed of 43 (7 %) of the cats was unknown. 93 cats (15 %) were indoor cats with no outdoor access, 171 (28 %) had access to outdoor enclosures or was taken out on a lead and harness, while 334 (54 %) had regular access to roam freely outdoors. 15 cats (2 %) had 'other forms of outdoor access'.

3.2. Short-term reactions from the new and resident cats

3.2.1. Distribution of short-term reactions

Table 2 displays the percentage of respondents having observed the reactions for the new and resident cats together with the percentage of respondents who had observed 'other reactions', 'were not sure' or had 'not observed' any of the listed reactions. The table also reports p-values from χ^2 tests examining whether there was a difference in the percentage of new versus resident cats observed to display a given reaction.

The most frequent reaction from both resident and new cats was curiosity (56 % of resident cats and 60 % of new cats), followed by hissing for resident cats (40 %) and wanting to play from new cats (47 %). Hissing and wanting to play are also the only reactions for which there was a significant difference (at the 5 % level) between the proportions of new and resident cats that displayed these reactions. Being relaxed and friendly was also relatively common for both resident and new cats (34 % of resident cats and 37 % of new cats). Other affiliative and agonistic reactions were less common among both the new and resident cats, with values between 13 % and 37 %. Less than 4 % noted the last three categories (other reactions, nor sure, neither of above), and these categories are therefore excluded from further analyses.

Table 2
Percentage of reported reactions from resident and new cat(s) the first month after introduction. Significant differences at the 5 % level are highlighted in bold.

Reaction first month after introduction	Reactions observed for resident cat	Reactions observed for new cat	χ^2 test
1. Curious	174 (56 %)	184 (60 %)	0.595
2. Relaxed and friendly	106 (34 %)	115 (37 %)	0.542
3. Washed new / resident cat(s)	67 (22 %)	60 (19 %)	0.530
4. Cuddled / slept with new / resident cat(s)	65 (21 %)	58 (19 %)	0.524
5. Indifferent	55 (18 %)	45 (15 %)	0.315
6. Wanted to play	**91 (30 %)**	**144 (47 %)**	**0.001**
7. Fear / Avoidance	56 (18 %)	50 (16 %)	0.555
8. Hissed	**122 (40 %)**	**58 (19 %)**	**0.000**
9. Chased but did not attack	57 (19 %)	52 (17 %)	0.625
10. Attacked	50 (16 %)	39 (13 %)	0.242
11. Other reactions	11 (4 %)	6 (2 %)	0.216
12. Not Sure	9 (3 %)	5 (2 %)	0.270
13. Neither of above reactions	6 (2 %)	8 (3 %)	0.550

3.2.2. Correlation between short-term reactions

Table 3 displays phi (ϕ) correlation coefficients between reactions the first month after introduction for the resident cats (Panel A), for the new cats (Panel B), and for the resident vs. new cats (Panel C). '*' indicates significance at the unadjusted 5 % level, while '**' indicates significance at the Bonferroni adjusted 5 % level ($p < \frac{0.05}{10^2+2\bullet 55} = 0.0002$).

From Panels A and B in Table 3, most affiliative reactions (i.e., reactions 1.–4. and 6.) were significantly positively correlated with each other at the adjusted level for both the resident and new cats. However, none of these phi coefficients were larger than 0.6 and only few were between 0.3 and 0.6, indicating weak to moderate correlation:

i. The resident cats being relaxed and friendly vs. washing the new cats ($\phi = 0.38$) and wanting to play with the new cats ($\phi = 0.31$).
ii. The resident cats washing the new cats vs. the resident cats cuddling / sleeping with the new cats ($\phi = 0.38$), and the resident cats wanting to play with the new cats ($\phi = 0.3$).
iii. The new cats wanting to play with the resident cats vs. the new cats being curious ($\phi = 0.38$), and the new cats being relaxed and friendly ($\phi = 0.31$).
iv. The new cats washing the resident cats vs. the new cats cuddling / sleeping with the resident cats ($\phi = 0.37$).

Table 1
Distribution of average ages of new and resident cats at the time of introduction.

		Resident cats' age				
		< 6 months	6–11 months	1–4 years	5 + years	Total
New cat's age	< 6 months	30 (9.7 %)	13 (4.2 %)	64 (20.8 %)	54 (17.5 %)	161 (52.3 %)
	6–11 months	3 (1.0 %)	14 (4.6 %)	15 (4.9 %)	16 (5.2 %)	48 (15.6 %)
	1–4 years	4 (1.3 %)	3 (1.0 %)	39 (12.7 %)	22 (7.1 %)	68 (22.1 %)
	5 + years	0 (0.0 %)	0 (0.0 %)	5 (1.6 %)	26 (8.4 %)	31 (10.1 %)
	Total	37 (12.0 %)	30 (9.7 %)	123 (39.9 %)	118 (38.3 %)	308 (100 %)

Table 3
Phi (ϕ) correlation coefficients between the reactions displayed by the resident and new cats in the home the first month after the new cat(s) arrived. '*' indicate significance at the 5 % level, while '**' indicate significance at the Bonferroni adjusted 5 % level ($\frac{0.05}{10^2 + 2 \bullet 55} = 0.0002$).

A

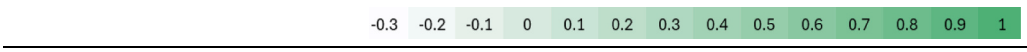
Resident cat reaction no.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1.	1**									
2.	0.28**	1**								
3.	0.24**	0.38**	1**							
4.	0.23**	0.19*	0.38**	1**						
5.	0.1	0.22**	0.1	0.2*	1**					
6.	0.25**	0.31**	0.3**	0.28**	0.01	1**				
7.	-0.06	-0.08	-0.04	-0.06	0.02	-0.1	1**			
8.	0.01	-0.17*	0.02	-0.04	0.02	0	0.2*	1**		
9.	0.03	-0.05	-0.03	-0.06	0.02	0.06	0.04	0.2*	1**	
10.	-0.06	-0.1	-0.02	-0.03	-0.04	-0.01	0.04	0.26**	0.18*	1**

B

New cat reaction no.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1.	1**									
2.	0.28**	1**								
3.	0.1	0.26**	1**							
4.	0.21*	0.23**	0.37**	1**						
5.	-0.02	0.1	-0.02	0.06	1**					
6.	0.38**	0.31**	0.21**	0.26**	0.04	1**				
7.	-0.09	-0.21**	-0.06	-0.08	0.04	-0.11*	1.00			
8.	-0.08	-0.2*	-0.07	-0.1	-0.03	-0.17*	0.26**	1**		
9.	0.05	-0.08	0	0.03	-0.01	0.01	0.06	0.16*	1**	
10.	-0.07	-0.11*	0.06	-0.03	0.09	-0.02	0.1	0.17*	0.19*	1**

C

New cat reaction no.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1.	0.33**	0.22**	0.22**	0.2*	0.14*	0.24**	-0.01	0.18*	-0.07	0.02
2.	0.23**	0.33**	0.18*	0.13*	0.2*	0.24**	0.07	0.02	0.01	-0.16*
3.	0.15*	0.21**	0.38**	0.33**	0.16*	0.27**	0.02	-0.1	0.02	-0.02
4.	0.26**	0.37**	0.39**	0.54**	0.21*	0.4**	-0.1	-0.08	0.01	-0.08
5.	0.07	0.11	0	0.1	0.26**	0.05	0.19*	0.04	-0.01	0.02
6.	0.22**	0.13*	0.25**	0.23**	0.17*	0.26**	0.1	0.24**	0.04	0.1
7.	0.07	0	0.05	-0.06	-0.02	-0.01	0.16*	0.15*	0.08	0.21**
8.	0.05	-0.09	-0.01	-0.09	0.04	0	0.1	0.24**	0.07	0.17*
9.	0.05	-0.02	-0.01	-0.06	-0.01	0.13*	-0.01	0.13*	0.3**	0.2*
10.	-0.04	-0.05	0.06	0.09	0.03	-0.05	0.12*	0.17*	0.27**	0.36**



Notes: '1'=Curious, '2'=Relaxed and friendly, '3'=Washed resident / new cat, '4'=Cuddled / slept with resident / new cat, '5'=Indifferent, '6'=Wanted to play, '7'=Fear / avoidance, '8'=Hissed,'9'=Chased but did not attack, '10'=Attacked.

Likewise, there were indications of positive correlations between agonistic reactions (7.–10.) for the resident and new cats, respectively. However, few of these phi coefficients were significant at the adjusted level, and none of the coefficients were larger than 0.3. Thus, generally agonistic reactions were more likely to be observed individually rather than in escalating clusters.

From Panel C, Table 3, it is apparent that there were significant positive correlations at the adjusted level between several of the affiliative reactions (1.–4. and 6.) displayed by the new and resident cats. None of these phi coefficients were larger than 0.6, while some were between 0.3 and 0.6, indicating weak to moderate correlation:

i. The resident cats being curious vs. the new cats being curious ($\phi = 0.33$).

ii. The resident cats being relaxed friendly vs. the new cats being relaxed friendly ($\phi = 0.33$), and the new cats cuddling / sleeping with the resident cats ($\phi = 0.37$).
iii. The resident cats washing the new cats vs. the new cats washing the resident cats ($\phi = 0.38$) and the new cats cuddling / sleeping with the resident cats ($\phi = 0.39$).
iv. The resident cats cuddling / sleeping with the new cats vs. the new cats washing the resident cats ($\phi = 0.38$), and the new cats cuddling / sleeping with the resident cats ($\phi = 0.54$).
v. The resident cats initiating play with the new cats vs. the new cats cuddling / sleeping with the resident cats ($\phi = 0.4$).

All phi coefficients between affiliative reactions that were significant at the unadjusted level but not at the adjusted level and were below 0.3 will not be discussed further.

Table 3 further shows only few significant correlations at the adjusted level between agonistic reactions (7.–10.) displayed by the new and resident cats. None of these phi coefficients were above 0.6, but a few between 0.3 and 0.6:

i. The resident cat chasing the new cat without attacking vs. the new cat chasing the resident cat without attacking ($\phi = 0.3$).
ii. The resident cat attacking the new cat vs. the new cat attacking the resident cat ($\phi = 0.36$).

Finally, there were no significant correlations at the adjusted level between affiliative and agonistic reactions for the new and resident cats, and only few at the unadjusted level, with none larger than $|0.3|$.

In summary, there were no reliable correlations between affiliative and agonistic reactions displayed by the new or resident cats, while there were some weak correlations between displays of affiliative reactions and between displays of agonistic reactions within each group (and between groups).

Based on this, two aggregated indicators of the reactions within the first month were constructed for the new and resident cats; (i) Affiliative reactions, comprising curious, relaxed/ friendly, washed the other cat, rested/slept with the other cat, and initiated play, and (ii) Agonistic reactions, comprising fear/avoidance, hissed, chased and attacked. Cats were sorted into corresponding groups depending on whether the owner had observed the cats displaying at least one reaction for each indicator (one cat can belong to two groups at the same time). A third type of reaction, (iii) Indifferent, was also retained. This was based on the single-item question 5. of Table 2.

3.2.3. *Influence of cats' ages on correlations between short-term reactions*

Table 4 presents number of respondents reporting reactions in the aggregate affiliative and agonistic groups for the new and resident cats, and phi correlation coefficients between the new and resident cats' reactions, both disaggregated into age-groups of the new and resident cats. Age group combinations with 5 or less respondents (cf. Table 1) have been left out in the correlation analyses. As Panel C in Table 3 only indicated weak to no correlation between the new or resident cats being indifferent and the other reaction indicators, 'indifference' was left out in this analysis. However, percentages of new and resident cats displaying indifference, disaggregated on age-groups, are presented in the notes below the table.

2. Indifference was for new cats observed by 22 (11 %) of cats < 1 year, for 16 (24 %) of cats 1–4 years and for 7 (23 %) of cats 5 + years, while it was for resident cats observed for 6 (9 %) of cats < 1 year, for 18 (15 %) of cats 1–4 years and for 31 (26 %) of cats 5 + years.

Table 4 firstly shows that the prevalence of affiliative reactions was higher than for agonistic reactions for both the new and resident cats in all age groups. However, for resident cats that were 5 + years, almost the same fraction displays affiliative (69 % of resident cats that were 5 + years) and agonistic (65 % of resident cats that were 5 + years) reactions. It is further seen that the fraction of cats that displayed affiliative reactions decreased for resident cats with increasing age. On the other hand, the fraction of new cats that displayed affiliative reactions was the same for new cats < 1 year and 1–4 years but then decreased for new cats that were 5 + years. Contrary to this, the fraction of cats that displayed agonistic reactions increased with increasing age for both new and resident cats.

Table 4 further shows the same tendencies as Panel C of Table 3, i.e., some degree of correlation between the resident and new cats displaying affiliative reactions, and between the new and the resident cats displaying agonistic reactions. Three correlation coefficients were significant at the adjusted level, and had a weak to moderate correlation strength:

i. Between new and resident cats, both < 1 year, displaying affiliative reactions ($\phi = 0.51$).
ii. Between new and resident cats, both < 1 year, displaying agonistic reactions ($\phi = 0.42$).
iii. Between new cats < 1 year, and resident cats 5 + years, displaying affiliative reactions ($\phi = 0.5$).

Similar tendencies were seen in most other age combinations, but only at the unadjusted 5 % significance level. However, the correlation coefficients were generally higher than in Panel C of Table 3, and most had a weak to moderate correlation.

3.3. *Introduction practices*

3.3.1. *Distribution of introduction techniques*

Table 5 presents the distribution of responses for each introduction technique disaggregated into age groups for the new and resident cats, together with the average duration in days the technique was applied. Age group combinations with 5 or less respondents (qv. Table 1) have been left out.

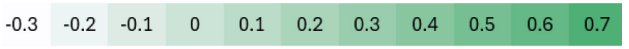
Table 5 shows that the most frequently applied technique was feeding the cats nice things (e.g., treats, or favourite food) in the same room, which was applied by 86 % of all respondents. Other frequently used techniques included acquiring new resources (litter trays, food and water bowls, beds, dens etc.) when the new cats arrived (applied by 77 % of respondents), engaging the cats in play in the same room (applied by 76 % of respondents) and allowing the cats to be together in the same room from the beginning (applied by 56 % of respondents). The technique used least frequently was giving calming supplements and food (applied by 20 % of respondents), followed by collecting the cats' scent using cotton swabs or similar and placing this in the other cats' area (applied by 27 % of respondents). With regards to separating the cats, a core element of many recommended introduction practices, almost 60 % separated the cats for short periods, or separated the new cats in a room the resident cats did not have access to, while 42 % separated the new cats in an enclosure in a room the resident cats had access to. Fifty-two percent allowed the cats to meet through a barrier, while approximately 4 in 10 owners engaged the cats in feeding (44 %) or playing (39 %) on each side of a barrier. Approximately 6 in 10 allowed the cats to access each other's areas. Specifically, 56 % allowed the resident cat(s), and 59 % allowed the new cat, to do this. Finally, 35 % used calming scents or pheromones.

Most introduction techniques were applied by a larger fraction of respondents who introduced new cats < 1 year to resident cats < 1 year, compared to other age combinations, the exception being introducing new resources (litterboxes, food and water bowls, beds, dens etc.) when the new cat arrived, as this was most prevalent when both the new and resident cats were 5 + years old. Likewise, the fractions of respondents who separated the new cats in a different room was almost identical when the new and resident cats were < 1 year, when the new cats were < 1 year and the resident cats 1–4 years, and when both new and resident cats were 5 + years.

It is notable that when the new cats were < 1 year, the fraction of

Table 4
Phi (ϕ)correlation coefficients between the reactions displayed by the resident and new cat(s) in the home the first month after the new cat(s) arrived, disaggregated on the basis of new and resident cats' average age groups. Moreover, number of respondents reporting affiliative and agonistic behaviours, and percentage of these within the age group. Affil = showing affiliative reactions, Agon = showing agonistic reactions. '*' indicates significance at the unadjusted 5 % level, while '**' indicates significance at the Bonferroni adjusted 5 % level($p < \frac{0.05}{24} = 0.002$).

				Resident cats					
				< 1 year (67 resp)		1-4 years (123 resp)		5+ years (118 resp)	
				Affil	Agon	Affil	Agon	Affil	Agon
			No. Resp.	53 (79%)	34 (51%)	92 (75%)	64 (52%)	81 (69%)	77 (65%)
New cats	< 1 year (209 resp)	Affil	171 (82%)	0.51**	-0.02	0.24*	0.01	0.5**	-0.14
		Agon	80 (38%)	0.08	0.42**	0.09	0.31*	-0.09	0.29*
	1-4 years (68 resp)	Affil	56 (82%)			0.1	-0.23	0.52*	0.09
		Agon	33 (49%)			0.11	0.28	0.26	0.64*
	5+ years (31 resp)	Affil	21 (68%)					0.35	-0.17
		Agon	18 (58%)					0.05	0.48*



Notes: **1.** The number of respondents in the age combination groups are: 60 respondents in (New cats <1 year)∗(Resident cats <1 year), 79 respondents in (New cats <1year) ∗(Resident cats < 1–4 years), 70 respondents in (New cats <1 year) ∗(Resident cats 5 + years), 39 resondents in (New cats 1–4 years) ∗(Resident cats 1–4 years), 22 respondents in (New cats 1–4 years) ∗(Resident cats 5 + years), 26 respondents in (New cats 5 + years) ∗(Resident cats 5 +years).

Table 5
Number of respondents who applied the introduction techniques, disaggregated into age groups for the new and resident cats. Parentheses show the percentage of respondents in each combined age group that applied the technique. The final column is the average number of days the technique was applied.

New cats' age		< 1 year			1-4 years		5+ years	Total	Av. Days
Resident cats' age		< 1 year	1-4 years	5+ years	1-4 years	5+ years	5+ years		
Introduction technique	Number of respondents	60	79	70	39	22	26	308	
0. Did you put the cats together in the same room from the beginning?		42 (70%)	40 (51%)	34 (49%)	23 (59%)	11 (50%)	14 (54%)	173 (56%)	NA
1. Did you separate the cats for shorter periods but not all the time?		42 (70%)	46 (58%)	35 (50%)	21 (54%)	14 (64%)	16 (62%)	181 (59%)	8.2
2. Did you separate the new cat(s) in an enclosure in a room the resident cat(s) had access to?		36 (60%)	28 (35%)	19 (27%)	19 (49%)	9 (41%)	12 (46%)	130 (42%)	6.9
3. Did you separate the new cat(s) in a room the resident cat(s) did not have access to?		39 (65%)	49 (62%)	34 (49%)	19 (49%)	13 (59%)	16 (62%)	178 (58%)	7.6
4. Did you allow the cats to meet through a barrier (e.g. a netframe)?		39 (65%)	42 (53%)	30 (43%)	17 (44%)	13 (59%)	10 (38%)	160 (52%)	5.9
5. Did you allow the residents cat(s) access to the new cat(s) area while they were somewhere else?		45 (75%)	42 (53%)	31 (44%)	23 (59%)	10 (45%)	16 (62%)	174 (56%)	7.7
6. Did you allow the new cat(s) access to the resident cat(s) area while they were somewhere else?		43 (72%)	43 (54%)	36 (51%)	22 (56%)	14 (64%)	16 (62%)	182 (59%)	7.7
7. Did you feed the cats nice things on each side of a barrier, while they could see each other?		39 (65%)	34 (43%)	20 (29%)	14 (36%)	11 (50%)	10 (38%)	134 (44%)	7.2
8. Did you engage the cats in play on each side of a barrier, while they could see each other?		37 (62%)	28 (35%)	15 (21%)	13 (33%)	10 (45%)	10 (38%)	120 (39%)	7.2
9. Did you feed the cats nice things while in the same room?		57 (95%)	66 (84%)	57 (81%)	34 (87%)	18 (82%)	23 (88%)	264 (86%)	17.3
10. Did you engage the cats in individual or mutual play while in the same room?		55 (92%)	66 (84%)	45 (64%)	26 (67%)	17 (77%)	17 (65%)	235 (76%)	16.1
11. Did you swap things that carried the cats' scents between the new and resident cats?		40 (67%)	35 (44%)	29 (41%)	17 (44%)	12 (55%)	11 (42%)	152 (49%)	9.5
12. Did you collect the cats' scents (e.g., by rubbing a cotton bud against their cheeks) and place these in the other cats' areas or around the home?		28 (47%)	16 (20%)	9 (13%)	9 (23%)	5 (23%)	8 (31%)	82 (27%)	7.3
13. Did you use calming scent or pheromone products (e.g., Feliway, Pet Remedy or other)?		30 (50%)	28 (35%)	15 (21%)	14 (36%)	9 (41%)	7 (27%)	109 (35%)	12.8
14. Did you use calming supplements or food (e.g., Zylkene, Aptus Relax, Calm food or other)?		28 (47%)	9 (11%)	4 (6%)	5 (13%)	5 (23%)	6 (23%)	63 (20%)	7.0
15. Did you buy extra beds, dens, littertrays, food and water bowls, toys or other things?		48 (80%)	60 (76%)	50 (71%)	28 (72%)	18 (82%)	22 (85%)	236 (77%)	NA
			0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

respondents who used the introduction techniques generally decreased with increasing age of the resident cats. The same general tendency was not observed when the new cats are 1–4 years.

Table 5 further shows that most recommended introduction techniques were applied for on average a week. Separation of the cats was on average done for between 7 and 8 days, approximately corresponding with the average number of days the cats were allowed to explore each other's areas (~8 days). Likewise, the average time used for collecting the cats' scent (using cotton swabs or other) and placing in the other cats' areas was ~7 days, while on average ~10 days was used to swap things carrying the cats' scent between them. Meeting through a barrier was applied for an average of ~6 days, approximately corresponding with the average number of days that was used for engaging the cats in feeding or playing on each side of a barrier (~7 days). Feeding the cats nice things and engaging them in play in the same room were on average applied for the longest time, with an average duration of 16–17 days. Calming scents / pheromones were applied for an average of ~13 days, while calming supplements / food were applied on average 7 days.

3.3.2. *Correlation between use of introduction techniques*

Table 6 displays correlation coefficients for all pairs of the 16 introduction techniques presented in Table 5. Two levels of significance are presented; Asterisks (*) indicate significance at the unadjusted 5 % level, while double asterisks (**) indicate significance given Bonferroni adjustment ($p = \frac{0.05}{16^2} = 0.0002$).

Table 6 shows that most correlation coefficients were significant at the adjusted level. Strong correlation (coefficients >0.6) at this level of significance was observed between:

i. Separating the cats for shorter periods and separating the new cat in a room the resident cats did not have access to ($\phi = 0.75$).
ii. Allowing the cats to meet through a barrier and feeding the cats nice things / engaging them in play on each side of a barrier ($\phi > 0.64$).
iii. Feeding the cats nice things and engaging them in play on each side of a barrier ($\phi = 0.72$).
iv. Allowing the new cats to explore the resident cats' area and allowing the resident cats to explore the new cats' area ($\phi = 0.67$).
v. Exchanging scent using swabs (e.g., by rubbing the cats' cheeks with cotton buds) and using calming supplements / food ($\phi = 0.68$).
vi. Using calming scents / pheromones and using calming supplements / food ($\phi = 0.6$).

The remaining phi coefficients significant at the adjusted level were all between |0.58| and |0.23|, with a few below |0.3|. This indicates a weak to moderate correlation for most pairwise combinations that were significant at the adjusted alpha level. Most of these phi coefficients were positive. The exceptions were correlations between allowing the cats to be together in the same room from the beginning that was weakly negatively correlated at the adjusted level with separating the cats for shorter periods ($\phi = -0.39$), with separating the new cats in a room separate from the resident cats ($\phi = -0.42$), and with allowing the cats to meet through a barrier ($\phi = -0.37$). On the other hand, correlation coefficients that were significant at the unadjusted 5 %, but not at the adjusted level, were all below |0.21|, indicating very weak to no correlation.

3.3.3. *Correlation between reactions and introduction techniques, disaggregated on cats' ages*

Here, we focus on the association between introduction techniques and reactions across different age combinations of the resident cats and new cats.

In general, when we do not consider these age combinations, and

Table 6
Phi (ϕ) correlation coefficients among whether introduction techniques were used or not (and where 'used' aggregated according to whether from the beginning, later, several times and combinations of these). '*' indicate significance at the unadjusted 5 % level, while '**' indicate significance at the Bonferroni adjusted level ($p = \frac{0.05}{16^2} = 0.0002$).

	Introduction technique no.															
	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
0.	1**															
1.	-0.39**	1**														
2.	-0.2*	0.58**	1**													
3.	-0.42**	0.75**	0.45**	1**												
4.	-0.37**	0.5**	0.53**	0.53**	1**											
5.	-0.08	0.38**	0.34**	0.39**	0.34**	1**										
6.	-0.16*	0.5**	0.32**	0.47**	0.42**	0.67**	1**									
7.	-0.19*	0.5**	0.51**	0.51**	0.66**	0.44**	0.42**	1**								
8.	-0.17*	0.49**	0.53**	0.49**	0.64**	0.39**	0.39**	0.72**	1**							
9.	0.16*	0	-0.06	0.05	0.07	0.11	0.08	0.19*	0.15*	1**						
10.	0.15*	0.06	0.11	0.14*	0.14*	0.3**	0.19*	0.29**	0.29**	0.43**	1**					
11.	-0.15*	0.4**	0.37**	0.42**	0.43**	0.42**	0.48**	0.51**	0.44**	0.16*	0.31**	1**				
12.	0.04	0.36**	0.48**	0.34**	0.42**	0.37**	0.41**	0.49**	0.51**	0.14*	0.25**	0.57**	1**			
13.	-0.02	0.3**	0.43**	0.4**	0.43**	0.32**	0.31**	0.49**	0.44**	0.15*	0.28**	0.42**	0.52**	1**		
14.	0.16*	0.36**	0.4**	0.35**	0.37**	0.35**	0.41**	0.45**	0.52**	0.14*	0.26**	0.48**	0.68**	0.6**	1**	
15.	-0.04	0.25**	0.21*	0.29**	0.28**	0.18*	0.24**	0.28**	0.28**	0.26**	0.31**	0.28**	0.19*	0.23**	0.26**	1**

-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

Notes: '0'=Cats put in same room from beginning, '1'=Separation for shorter periods, '2'=Separation using cage / enclosure, '3'=Separation of new cat in separate room, '4'=Cats meeting through barrier, '5'= New cats explore resident cats' area, '6'=Resident cats explore new cats' area, '7'=Feeding on each side of barrier, '8'=Play on each side of barrier, '9'=Feeding in same room, '10'=Play in same room, '11'=Swap things carrying cats' scent, '12'=Exchange scent using swabs, '13'=Calming scents / pheromones, '14'=Calming supplements / food, '15'=Additional resources.

study the associational patterns for the entire sample, the correlation coefficients between introduction practices and initial reactions of the new and resident cats were, at the most, weak (below 0.26). For more details, see Table S1 in Supplementary Material D. Nevertheless, three correlation coefficients were significant at the adjusted level: i) Positive correlation between separating the new cats in a separate room and the new cats displaying agonistic reactions ($\phi = 0.23$), ii) Positive correlation between separating the new cats in a separate room and the resident cats displaying agonistic reactions ($\phi = 0.26$), and iii) positive correlation between separating the cats for shorter periods and the resident cats displaying agonistic reactions ($\phi = 0.22$).

Likewise, the correlation coefficients between introduction practices and initial reactions were weak, when the analysis is disaggregated on the new and resident cats' age groups. None of these correlations were significant at the adjusted level, while a number were significant at the 5 % level, some of which had correlation levels above |0.3| (for more details, see Table S2 in Supplementary Material D). These are outlined below, as they are indicators of possible tendencies that may form the basis for further investigation. As such Table 7 summarizes correlation coefficients > |0.3| that are significant at the unadjusted 5 % level but only include age combinations and reaction indicators for which such correlation coefficients are found.

Table 7 shows that when the new and resident cats were both < 4 years, a positive correlation was found between applying a number of the introduction techniques and agonistic reactions displayed by both the new and resident cats. When new and resident cats were both < 1 year, a positive correlation was found between the resident cats displaying agonistic reactions and separating the cats for shorter periods ($\phi = 0.31$), allowing the cats to meet through a barrier ($\phi = 0.34$), feeding the cats nice things on each side of a barrier ($\phi = 0.34$), swapping things carrying the cats' scents between them ($\phi = 0.31$) and using calming scents / pheromones ($\phi = 0.37$). When the new cats were < 1 year and the resident cats were 1–4 years, there was negative correlation between the new cats displaying agonistic reactions and allowing the cats to be together from the beginning ($\phi = -0.33$). While there was positive correlation between the new cats displaying agonistic reactions and separating the cats for shorter periods ($\phi = 0.31$), separating the new cats in a room the resident cats did not have access to ($\phi = 0.31$) and allowing the resident cats to explore the new cats' areas ($\phi = 0.36$). Likewise, there was positive correlation between the resident cats displaying agonistic reactions and separating the new cats in a separate room ($\phi = 0.33$). Finally, when the new cats were < 1 year, while the resident cats were 5 + years, there was positive correlation between the new cats displaying agonistic reactions and separating the new cats in a separate room ($\phi = 0.34$). And there was positive correlation between the resident cats displaying agonistic reactions and separating the cats for shorter periods ($\phi = 0.3$).

When the new cats were 1 + years, there were relatively few significant correlations between any introduction techniques and agonistic reactions from both the new and resident cats. The only exceptions being when both the new and resident cats were 1–4 years, where there was a positive correlation between the new cats displaying agonistic reactions and engaging the cats in play in the same room ($\phi = 0.33$), and between the resident cats displaying agonistic reactions and separating the new cats in a room the resident cats did not have access to ($\phi = 0.33$).

Regarding affiliative reactions, there were few significant correlations between these and introduction techniques when the new cats were < 5 years. When the new cats were < 1 year and the resident cats 1–4 years, there was positive correlation between both the new and resident cats displaying affiliative reactions and feeding the cats nice things in the same room ($\phi = 0.39$ for the new cats and $\phi = 0.3$ for the resident cats). And when the new cats were 1–4 years, while the resident cats were 5 + years there were negative correlation between the resident cats displaying affiliative reactions and allowing the cats to meet through a barrier ($\phi = -0.51$) or engaging the cats in play on each side of a barrier ($\phi = -0.47$).

When both the new and resident cats were older than 5 years, there were several positive correlations between the cats displaying affiliative reactions and introduction techniques, all with correlation coefficients > 0.4. For the new cats there was a positive correlation between affiliative reactions and allowing the cats to meet through a barrier ($\phi = 0.48$), feeding the cats on each side of a barrier ($\phi = 0.48$), engaging the cats in play on each side of a barrier ($\phi = 0.48$), engaging the cats in play in the same room ($\phi = 0.47$), or introducing new resources (litter trays, food and water bowls, beds, dens etc.) when the new cats arrived ($\phi = 0.7$). For the resident cats there was positive correlation between

Table 7
Phi (ϕ) correlation coefficients between reaction indicators (agonistic='Agon.', affiliative='Affil' and indifference='Indiff') and introduction techniques, disaggregated into ages for new and resident ('Res.') cats. Only ϕ coefficients significant at the unadjusted 5 % level and > |0.3| are included.

New cats' age	< 1 year					1–4 years					5 + years				
Res. cats' age	< 1 year	1–4 years				5 + years			1–4 years		5 + years			5 + years	
No. Respondents	60	79				70			39		22			26	
Intro. Tech.	Res.	New		Res.		New	Res.		New	Res.	New	Res.		New	Res.
	Agon.	Affil.	Agon.	Affil.	Agon.	Agon.	Agon.	Indiff.	Agon.	Agon.	Indiff.	Affil.	Indiff.	Affil.	Affil.
0			−0.33								0.54				0.55
1	0.31		0.31				0.3				−0.72		−0.5		
2											−0.45		−0.57		
3			0.31		0.33	0.34				0.33	−0.65		−0.42		
4	0.34										−0.43	−0.51	−0.62	0.48	
5											−0.5		−0.43		
6			0.36												
7	0.34							−0.31			−0.54		−0.68	0.48	
8											−0.5	−0.47	−0.62	0.48	
9		0.39		0.3											
10									0.33				−0.56	0.47	
11	0.31														0.4
12															0.44
13	0.37										−0.45		−0.57		0.4
14															
15														0.7	0.41

Notes: '0'=Cats put in same room from beginning, '1'=Separation for shorter periods, '2'=Separation using cage / enclosure, '3'=Separation of new cat in separate room, '4'=Cats meeting through barrier, '5'= New cats explore resident cats' area, '6'=Resident cats explore new cats' area, '7'=Feeding on each side of barrier, '8'=Play on each side of barrier, '9'=Feeding in same room, '10'=Play in same room, '11'=Swap things carrying cats' scent, '12'=Exchange scent using swabs, '13'=Calming scents / pheromones, '14'=Calming supplements / food, '15'=Additional resources.

affiliative reactions and putting the cats together in the same room from the beginning ($\phi = 0.55$), swapping things carrying the cats scents between them ($\phi = 0.4$), exchanging scent between the cats using cheek swabs ($\phi = 0.44$), using calming scents / pheromones ($\phi = 0.4$), or introducing new resources when the new cats arrived ($\phi = 0.41$).

Finally, Table 7 shows that significant correlations were detected between the cats being indifferent to each other and a number of introduction techniques, especially when the new cats were 1–4 years while the resident cats were 5 + years. In this case all correlations are negative and below −0.42, except for putting the cats together in the same room from the beginning, which was positively correlated with the new cats being indifferent ($\phi = 0.54$). There was negative correlation between both the new and resident cats displaying indifference and all three types of separation, together with allowing the cats to meet through a barrier, allowing the new cats to explore the resident cats' area, feeding or engaging the cats in play on each side of a barrier and using calming scents / pheromones, all with correlations coefficients stronger than −0.42, and in many cases below −0.5. Furthermore, there was negative correlation between the resident cats displaying indifference and engaging the cats in play in the same room ($\phi = -0.56$). For the remaining age groups there were almost no significant correlation between indifference and introduction techniques. The exception was when the new cats were < 1 year and the resident cats 5 + years, where there was negative correlation between the resident cats displaying indifference and feeding the cats nice things on each side of a barrier ($\phi = -0.31$).

4. Discussion

4.1. Short term reactions

Our study found that affiliative displays were on average more frequent than agonistic displays from both new and resident cats during the first month after introduction. Most affiliative and agonistic reactions were equally likely to be displayed by new and resident cats, but resident cats were more likely to hiss, and new cats were more likely to solicit play.

This is partly in accordance with Levine et al. (2005), who found that resident cats were more likely to hiss compared with new cats at the first meeting, while new cats were more likely to try to play. However, Levine et al. (2005) also found that resident cats were more likely to scratch, flee/hide, ignore and stare. The difference may be due to Levine et al. (2005) focus on reactions at the first meeting, while we examined reactions in the first month after introduction. Thus, resident cats could be more likely to display agonistic reactions at the first meeting, given that a new cat enters their established territory, but may later start displaying affiliative reactions, perhaps in response to the new cats' reactions, including attempts at play solicitation. It is suggested that play may help developing bonds between domestic dogs (Bekoff, 1974; Sommerville et al., 2017). This has also been suggested for domestic cats, seeing that even free-ranging adult cats may play (Crowell-Davis, 2007). Vitale (2022) observed that among free-ranging cats social play may be displayed together with other affiliative reactions, and that kittens in line with our findings may be more likely to solicit play than adult cats.

We further observed reciprocity between affiliative displays from the new and resident cats, especially when new cats were < 5 years. Reciprocity of affiliative reactions are often observed in cat colonies. For example, friendly displays (tail-up) have been observed to be correlated with allo-rubbing (Cameron-Beaumont, 1997; Natoli et al., 2022). Moreover, Elzerman et al. (2020) observed positive correlations between affiliative cat-cat exchanges and between agonistic cat-cat exchanges among cohabiting cats. However, these results are for established cat groups, while our study found similar correlations in the first month after introducing new cats < 5 years. This may be explained partly by resident cats sometimes finding it easier to accept kittens compared to adult cats (Ramos, 2019).

Our study also indicated some reciprocity between agonistic displays, especially between hissing displayed by resident cats, and fear/avoidance, hissing, chasing and attacks displayed by new cats. Likewise, chasing and attacks by new and resident cats were correlated. This seemingly contradicts Lindell et al. (1997), who studied aggressive encounters between cohabiting companion cats, and found that the most frequent constellation is one aggressor and one victim. However, Lindell et al. (1997) studied established cohabiting cat dyads, while we focused on the first month after introduction. Thus, the cats in our study may still have been in the process of establishing their social relationships, leading to reciprocal agonistic displays.

We observed reciprocity in agonistic displays from the new and resident cats, especially when resident cats were 5 + years old and new cats were > 1 year old. This supports the claim from Ramos (2019), that when adult cats are introduced to adult cats, owners should expect agonistic encounters.

4.2. Introduction practices

We identified two main paths for introducing new cats to resident cats in the domestic home. One path was putting the cats together from the beginning. The other path was combining separation of the cats with allowing them to meet through a barrier, engaging them in feeding or play on each side of a barrier, allowing them to explore each other's areas, exchanging scent, and using calming scents / pheromones / supplements / food, in line with recommended introduction practices (Bradshaw and Ellis, 2016; De Souza Dantas, 2020; Ramos, 2019; Rodan et al., 2024). Fifty-six percent of respondents put the cats together from the beginning, while 41 % separated the new cats in a separate room. This is roughly in line with findings from Levine et al. (2005), and together our studies indicate that approximately 50 % of cat owners will allow new and resident cats to be together from the beginning, in spite of recommendations against this.

Furthermore, we find that with few exceptions (see below), recommended introduction techniques were somewhat more likely to be used when both new and resident cats were < 1 year, compared with other age combinations. This is perhaps surprising, given that younger cats may be expected to be more accepting of each other than older cats (see e.g. Ramos, 2019).

The practice of separating the new cats into separate rooms was almost equally likely for many age combinations. This finding may reflect that separating new cats in different rooms is the core element of recommended introduction practices. Therefore, if owners intend to follow recommended practices, they will, as a minimum, separate the cats. We also found that owners were almost equally likely to introduce new litterboxes, food and water bowls, beds, etc., regardless of the cats' ages. This relatively simple practice is another element of the mentioned current recommendations.

Finally, we found that most introduction techniques were on average applied for approximately one week. Recommended introduction practices emphasise the importance of progressing slowly and at the cats' pace (Bradshaw and Ellis, 2016; De Souza Dantas, 2020; Ramos, 2019; Rodan et al., 2024). Our results raise the question of whether, when applied, introduction practices may sometimes be rushed, as some cats may need longer than a week to adapt to each other.

4.3. Correlations between reactions and introduction practises

Regarding correlations between introduction practices and reactions of new and resident cats, our study showed, that when not differentiating the results according to the cats' ages, positive correlations at the adjusted level were found i) between both the new and resident cats displaying agonistic reactions and the new cats being separated in a separate room, and ii) between the resident cats displaying agonistic reactions and the cats being separated for shorter periods. These results are surprising, given that gradual introduction, including initial

separation of the cats, is claimed to reduce aggressive encounters between new and resident cats (Bradshaw and Ellis, 2016; De Souza Dantas, 2020; Rodan et al., 2024). Despite being weak, these correlations point to interesting tendencies that should be investigated further. Our investigation of correlations disaggregated on the ages of the cat is a first step towards this. Here we found relationships significant at the unadjusted but not at the adjusted level. However, some interesting trends also emerged between these, as discussed below.

Firstly, when both new and resident cats were 5 + years, we saw a positive relationship between several introduction practices and both new and resident cats displaying affiliative reactions. This is based on only 26 observations and should thus be viewed with some caution. However, the result is in line with the above argument that recommended introduction practices promote good relations. On the other hand, when both new and resident cats were < 5 years, and especially when new cats were < 1 year, we saw the opposite. This contrast, given the cats' ages, is perhaps unexpected, given that recommended introduction practices are usually not differentiated according to the cats' ages (Bradshaw and Ellis, 2016; De Souza Dantas, 2020; Rodan et al., 2024). However, Ramos (2019) notes that adult cats may be tolerant towards introduced kittens. This suggests that it might be acceptable to allow cats to be together from the beginning, when the new cats are young. In feral cat colonies kittens are often communally reared (Bradshaw et al., 2012; Crowell-Davis et al., 2004), suggesting that female cats may accept unrelated kittens more readily, and that unrelated kittens accept sharing nests. Thus, considering current literature and our results, there seems to be less reason to recommend gradual introduction when both new and resident cats are young.

These results should, however, be interpreted with caution, given that we do not have information on why our respondents chose to use various introduction approaches. Gradual introduction may be applied if owners suspect that the resident cat may react aggressively to new cats, e.g. if the resident cat (young or old) has already had conflicts with other cats in- or outside the home. Alternatively, owners of young cats may use gradual introduction to protect the cats against agonistic encounters.

Finally, we also found negative correlations between several introduction techniques and both the new and resident cats displaying indifference when the new cats were 1–4 years and the resident cats 5 + years. This does not indicate whether cats then displayed affiliative or agonistic reactions. The only indication of this is coming indirectly from a negative correlation between the new cats displaying affiliative reactions and two of the introduction techniques, indicating that use of these introduction techniques may be related to a reduced probability of positive relations in these age groups. However, it must also be noticed that there are only 22 observations with this age combination, and thus again this result must be viewed with caution.

4.4. Limitations and future work

Several limitations of our study should be considered. Firstly, we did not ask when the new cat(s) arrived in the home. Thus, there may be recall bias (see e.g. Fenner et al., 2020) in the respondents' answers relating to introduction practices and initial reactions. E.g., the owners may, if the new cat arrived a while ago, only remember more extreme reactions, thus potentially skewing the reported reactions towards agonistic displays. Moreover, the reported agonistic reactions may have been misread social play by both new and resident cats. Gajdoš-Kmecová et al. (2023) observe that inter-cat play can have an 'intermediate' form involving wrestling, chasing and vocalisation, which may be confused with true agonistic displays. Likewise, they observe that kittens are more prone to wrestling than adult cats. Thus, there might be some bias in the respondents reporting of agonistic displays, especially for younger cats. Furthermore, the owners may not accurately remember all aspects of the introduction practice they applied or the duration of the practices. This bias may affect our observed correlation between usage of the various aspects of recommended introduction practices.

Likewise, we did not ask for the order in which the different introduction techniques were applied. Our correlation analysis only showed that recommended practices are often applied together, but not in which order. Thus, we do not know whether some aspects were applied in the recommended order or rather remedially if the cats displayed agonistic reactions. Knowing this would give further understanding of owners' perception of how best to introduce cats to each other, and how they react if things do not go according to plan. However, our exploratory work provides a foundation for identifying which practices could form the basis of a more in-depth study that would allow this type of analysis.

Secondly, and related to the above, we did not ask about the degree of intensity or frequency of the initial reactions. Thus, we do not know for example whether a cat hissed once or many times during the first month, or the intensity of the hissing. However, such data is subject to even greater risk of owner reporting bias, and is best explored using video (e.g., Gajdoš-Kmecová et al., 2023). Nonetheless, it is worth noting that we did see some correlations between affiliative reactions, and to a lesser degree between agonistic reactions. This suggests that one-off displays of especially affiliative reactions were rare, and understanding the relationship between these is worthy of future field-based study.

In accordance with the above, when investigating the correlation between introduction practices and reactions we classified the cats as having displayed affiliative reactions if they had displayed at least one of the 5 affiliative reactions, and likewise with agonistic reactions. Thus, a cat could be classified as having displayed both affiliative and agonistic reactions. An alternative approach would be to classify the cats according to their predominant reaction type, i.e., as being either affiliative or agonistic. However, we think that our approach makes best use of the available data accepting that cats may shift between agonistic and affiliative reactions during their first month together, especially as they build a relationship (Gajdoš-Kmecová et al., 2023). Our approach also allows us to identify introduction techniques which are correlated with both affiliative and agonistic reactions, which is important given our exploratory approach.

In continuation of this, we on the other hand did not ask about the temporal progression from one set of reactions to another during the first month. Knowing this and correlating with similar temporal instigation of different aspects of the introduction practices applied, would further have added to understanding the link between introduction practices and initial reactions of new and resident cats to each other.

Moreover, we only asked the ages of the youngest and oldest new / resident cats when more than one new cat was introduced to the home, or when more than one resident cat was present in the home at the time of introduction. We used the averages of these two limits in the case with two+ new cats or two+ resident cats. This may bias our age differentiated results and conclusions. However, we found that only 28 % of the respondents had acquired two+ new cats, while 36 % had two+ resident cats in the home at the time of introduction. Thus, the majority of the ages used for both new and resident cats are absolute (and not averages), which reduces the impact of this potential bias.

Finally, we acknowledge that we did not include other control variables, apart from the average ages of the cats. This is so firstly because the aim of this study was exploratory. Given the few studies of the implications of using recommended introduction practices, and the mixed messages from these (Elzerman et al., 2020; Levine et al., 2005), we wished to investigate possible relationships, and the strength of these, between introduction practices and cat relations. This we did without assuming any cause-effect relations at this point, as would be the case when using regression analysis. Secondly, as also outlined in 'Materials and Methods', we only had detailed cat-related background information for a subsample of the new and resident cats, which prevented follow-up regression analyses for the full sample. Likewise, we did not include the number of cats in the households at the time of introduction. Although it is worth noting that Levine et al. (2005) found no correlation between number of cats and short- and long-term fighting and Elzerman et al.

(2020) only found a weak positive correlation between number of cats and increased prevalence of agonistic displays. Indeed, Finka and Foreman-Worsley (2022) have shown that the number of cats in the home may affect cat welfare both positively and negatively. Thus, by including the number of cats in the home we could have added to this discussion. However, it must also be recognized that there is a danger of over-analysing the data. Our aim was to examine the most overt associations and as outlined in the Introduction, the relationship between cohabiting cats depends on a complex interplay of dynamic and static factors. Our results aim to provide further insight of factors for consideration and test current "perceived wisdom". In light of our results more focused research in future may seek to specifically investigate the interplay between the most common introduction methods and other factors which are believed to influence the relations between new and resident cats in the home.

Summarizing many of the above limitations of our work, it appears that we could have added many additional items to our questionnaire in order to extend the depth and detail of the data. However, collecting more detailed, and thus complex, information comes at the price of reducing the accuracy and thus trustworthiness of the responses. Given the exploratory nature of our analysis, we propose that such further detail can be added in future studies of the possible associations revealed in our study.

5. Conclusion

We have investigated the reactions of new and resident cats during the first month after introduction. Summarizing our results, we find no clear pattern between recommended introduction practices and new and resident cats' reactions to each other during the first month after introduction. That said, our findings suggest that recommended introduction practices may be beneficial when introducing mature cats (5 + years) to each other, but also that recommended practices may be less relevant when introducing young cats (<5 year) to each other.

In this study we only look at relations between cohabiting cats overall, during the first month and not beyond. However, given that Levine et al. (2005) show positive correlation between short- and longer-term fighting our study contributes to understanding what aspects of recommended introduction practices may prevent these initial agonistic reactions that can have harmful long-term consequences. In particular, our results indicate that using recommended gradual introduction techniques may not always be decisive for the development of long-term affiliative relations between cohabiting cats, especially when the new and resident cats are both young at the time of introduction. As Finka and Foreman-Worsley (2022) and Khoddami et al. (2023) emphasize many factors may influence whether long-term relations between cohabiting cats are affiliative or agonistic, possibly including the number of cats in the household, housing (indoor cats vs. outdoor access), space per cat in the household, amount of resources per cat in the household, owner demographics, ages of cats in the household, and the personality traits of the cats.

Our results to some degree contradict the common general recommendation of gradual introductions, notably that these will always increase the probability of affiliative relations. However, given the cross-sectional nature or our data, it is difficult to distinguish between cause and effect in our study. I.e., it is hard to know whether gradual introductions lead to agonistic reactions in younger cats, or whether the owners react to agonistic displays from the cats and therefore start applying aspects of gradual introduction. Moreover, there may be some uncertainty concerning whether the reported agonistic reactions in some cases may be rough play (Gajdoš-Kmecová et al., 2023). It is therefore clear that more research is needed, as emphasized previously by Finka and Foreman-Worsley (2022), to understand factors that increase the probability for affiliative relations between non-related companion cats in homes. In particular, there is a need for longitudinal studies that track what is done and when and the consequent cat reactions.

CRediT authorship contribution statement

Irena Czycholl: Conceptualization, Formal analysis, Methodology, Writing – review & editing. **Thomas Bøker Lund:** Conceptualization, Formal analysis, Methodology, Writing – review & editing. **Peter Sandøe:** Conceptualization, Funding acquisition, Methodology, Writing – original draft, Writing – review & editing, Project administration. **Ayoe Hoff:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft, Writing – review & editing. **James Serpell:** Conceptualization, Methodology, Writing – review & editing. **Daniel Mills:** Conceptualization, Methodology, Writing – review & editing.

Declaration of Competing Interest

Ayoe Hoff is an Examined Cat Behaviour Consultant and operates a Cat Behaviour Clinic alongside her work at the University of Copenhagen. The remaining authors have no conflicts of interest to report.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.applanim.2025.106855.

References

Akoglu, H., 2018. User's guide to correlation coefficients. Turk. J. Emerg. Med. 18, 91–93. https://doi.org/10.1016/j.tjem.2018.08.001.

Amat, M., Camps, T., Manteca, X., 2016. Stress in owned cats: behavioural changes and welfare implications. J. Feline Med. Surg. 18, 577–586. https://doi.org/10.1177/1098612X15590867.

Armstrong, R.A., 2014. When to use the B Onferroni correction. Ophthalmic Physiol. Opt. 34, 502–508. https://doi.org/10.1111/opo.12131.

Barcelos, A.M., McPeake, K., Affenzeller, N., Mills, D.S., 2018. Common risk factors for urinary house Soiling (Periuria) in cats and its differentiation: the sensitivity and specificity of common diagnostic signs. Front. Vet. Sci. 5, 108. https://doi.org/10.3389/fvets.2018.00108.

Barry, K.J., Crowell-Davis, S.L., 1999. Gender differences in the social behavior of the neutered indoor-only domestic cat. Appl. Anim. Behav. Sci. 64, 193–211. https://doi.org/10.1016/S0168-1591(99)00030-1.

Beaver, B.V., 2003. Feline Behavior. A Guide for Veterinarians. Elsevier. https://doi.org/10.1016/B0-7216-9498-5/X5001-1.

Bekoff, M., 1974. Social play and play-soliciting by infant canids. Am. Zool. 14, 323–340. https://doi.org/10.1093/icb/14.1.323.

Bradshaw, J.W.S., 2016. Sociality in cats: a comparative review. J. Vet. Behav. 11, 113–124. https://doi.org/10.1016/j.jveb.2015.09.004.

Bradshaw, J., 2018. Normal feline behaviour: … and why problem behaviours develop. J. Feline Med. Surg. 20, 411–421. https://doi.org/10.1177/1098612X18771203.

Bradshaw, J.W.S., Casey, R.A., Brown, S.L., 2012. Social behaviour. In: Bradshaw, J.W.S., Casey, R.A., Brown, S.L. (Eds.), The Behaviour of the Domestic Cat. CABI, UK, pp. 142–160. https://doi.org/10.1079/9781845939922.0142.

Bradshaw, J., Ellis, S., 2016. The trainable cat: how to make life happier for you and your cat. Penguin Books, London.

Cameron-Beaumont, C.L., 1997. Visual and tactile communication in the Domestic cat (Felis silvestris catus) and undomesticated small felids (Doctoral Thesis). University of Southampton, United Kingdom.

Crowell-Davis, S.L., 2007. Cat behaviour: social organization, communication and development. In: Rochlitz, I. (Ed.), The Welfare Of Cats. Animal Welfare. Springer, Dordrecht.

Crowell-Davis, S.L., Curtis, T.M., Knowles, R.J., 2004. Social organization in the cat: A modern understanding. J. Feline Med. Surg. 6, 19–28. https://doi.org/10.1016/j.jfms.2003.09.013.

De Souza Dantas, L.M., 2020. Living with multiple cats – creating harmony in the multicat household. Decoding Your Cat: The Ultimate Experts Explain Common Cat Behaviors and Reveal How to Prevent or Change Unwanted Ones. American College of Veterinary Behaviourists, Houghton Mifflin Harcourt, Boston.

Elzerman, A.L., DePorter, T.L., Beck, A., Collin, J.-F., 2020. Conflict and affiliative behavior frequency between cats in multi-cat households: a survey-based study. J. Feline Med. Surg. 22, 705–717. https://doi.org/10.1177/1098612X19877988.

Fenner, K., Hyde, M., Crean, A., McGreevy, P., 2020. Identifying sources of potential bias when using online survey data to explore horse training, management, and behaviour: a systematic literature review. Vet. Sci. 7, 140. https://doi.org/10.3390/vetsci7030140.

Finka, L.R., 2022. Conspecific and human sociality in the domestic cat: consideration of proximate mechanisms, human selection and implications for cat welfare. Animals 12, 298. https://doi.org/10.3390/ani12030298.

Finka, L.R., Foreman-Worsley, R., 2022. Are multi-cat homes more stressful? A critical review of the evidence associated with cat group size and wellbeing. J. Feline Med. Surg. 24, 65–76. https://doi.org/10.1177/1098612X211013741.

Gajdoš-Kmecová, N., Peťková, B., Kottferová, J., Halls, V., Haddon, C., De Assis, L.S., Mills, D.S., 2023. An ethological analysis of close-contact inter-cat interactions determining if cats are playing, fighting, or something in between. Sci. Rep. 13, 92. https://doi.org/10.1038/s41598-022-26121-1.

Heidenberger, E., 1997. Housing conditions and behavioural problems of indoor cats as assessed by their owners. Appl. Anim. Behav. Sci. 52, 345–364. https://doi.org/10.1016/S0168-1591(96)01134-3.

Khoddami, S., Kiser, M.C., Moody, C.M., 2023. Why can't we be friends? Exploring factors associated with cat owners' perceptions of the cat-cat relationship in two-cat households. Front. Vet. Sci. 10, 1128757. https://doi.org/10.3389/fvets.2023.1128757.

Lee, D.K., 2016. Alternatives to P value: confidence interval and effect size. Korean J. Anesth. 69, 555. https://doi.org/10.4097/kjae.2016.69.6.555.

Levine, E., Perry, P., Scarlett, J., Houpt, K.A., 2005. Intercat aggression in households following the introduction of a new cat. Appl. Anim. Behav. Sci. 90, 325–336. https://doi.org/10.1016/j.applanim.2004.07.006.

Lindell, E.M., Erb, H.N., Houpt, K.A., 1997. Intercat aggression: a retrospective study examining types of aggression, sexes of fighting pairs, and effectiveness of treatment. Appl. Anim. Behav. Sci. 55, 153–162. https://doi.org/10.1016/S0168-1591(97)00032-4.

Lund, T.B., Forkman, B., Meyer, I., Sandøe, P., 2024. How is human socioeconomic position linked with dog ownership practices? A study from Denmark. Anthrozoös 37, 1171–1193. https://doi.org/10.1080/08927936.2024.2384211.

Mercer, A., Lau, A., 2023. Comparing two types of online survey samples.

Natoli, E., Litchfield, C., Pontier, D., 2022. Coexistence between humans and 'Misunderstood' domestic cats in the anthropocene: exploring behavioural plasticity as a gatekeeper of evolution. Animals 12, 1717. https://doi.org/10.3390/ani12131717.

Pryor, P.A., Hart, B.L., Bain, M.J., Cliff, K.D., 2001. Causes of urine marking in cats and effects of environmental management on frequency of marking. J. Am. Vet. Med. Assoc. 219, 1709–1713. https://doi.org/10.2460/javma.2001.219.1709.

Ramos, D., 2019. Common feline problem behaviors: aggression in multi-cat households. J. Feline Med. Surg. 21, 221–233. https://doi.org/10.1177/1098612X19831204.

Rodan, I., Ramos, D., Carney, H., DePorter, T., Horwitz, D.F., Mills, D., Vitale, K., 2024. 2024 AAFP intercat tension guidelines: recognition, prevention and management. J. Feline Med. Surg. 26, 1098612X241263465. https://doi.org/10.1177/1098612X241263465.

Sommerville, R., O'Connor, E.A., Asher, L., 2017. Why do dogs play? Function and welfare implications of play in the domestic dog. Appl. Anim. Behav. Sci. 197, 1–8. https://doi.org/10.1016/j.applanim.2017.09.007.

Vitale, K.R., 2022. The social lives of free-ranging cats. Animals 12, 126. https://doi.org/10.3390/ani12010126.