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Risk factors for behavior problems in cats presented to an Australian companion animal behavior clinic

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12
13 **Abstract**

14 Behavior problems in companion animals are common reasons for relinquishment or euthanasia. Insight into
15 the risk factors for problem behaviors will facilitate the construction of strategies for solutions. We
16 identified risk factors for behavior problems in domestic cats whose owners contacted a companion animal
17 behavior clinic in Brisbane, Australia. Owners of 1,556 cats reported on their cats' behavior problem, breed,
18 sex and age, and owner's postcodes and work-routine were also recorded. Risk factors were determined
19 from proportional morbidities for the behavior problem that each cat was reported as having. Breed effects
20 were also assessed by comparing the numbers of cats in each breed group with the breeds of registered cats
21 in a part of the catchment area. Behavior problems in domestic cats where the owners sought professional
22 advice were mostly (71% of all cats) related to house soiling, usually urination, and aggression, especially to
23 familiar people. Persian and similar breeds were at reduced risk of aggression to familiar cats but increased
24 risk of house soiling, compared to other breed groups. Overall, Persian, Siamese, Burmese and similar
25 breeds had more behavior problems than companion cat breeds. Older cats showed increasing tolerance of
26 familiar people but reduced tolerance of other cats. Males were more likely to present with excessive
27 vocalisation and house soiling with urine and less likely to present with aggression between familiar cats.

We conclude that cat breed, age and sex, and social advantage of the area in which the cat lives are risk factors for specific behavior problems.

Key words: *behavior problem; breed; cat; socio-economic status; veterinary clinic; work routine*

Introduction

Veterinary practices are increasingly consulted about behavior problems in cats (Heath, 2007). The term ‘abnormal’ is used to describe any behavior that is ‘away from the norm’, ‘statistically rare in their context’ or ‘different from a given normal population’ (Mason, 1991), where a normal population may consist of free living animals (Hediger, 1950) or animals living in conditions that allow a full range of behavior (Fraser and Broom, 1990). In addition, in clinical veterinary medicine and psychology, the term ‘abnormal behavior’ is linked to pathological illness or damage (Gershon and Rieder, 1992). The term ‘behavioral problem’ is commonly used by the general public for activities that are undesirable to the owner (O’Farrell, 1990; McBane, 1994). Thus ‘behavior problems’ may include normal behaviors and merely reflect the subjective perspective of the reporter rather than any deviant nature of the behavior itself (Dawkins, 1980). However, behavior problems may also indicate physical or mental suffering by the cat, and underlying causal factors can include an inappropriate environment (Cooper and Mason, 1998) and failure to adapt to the captive environment, where relevant (Dawkins, 1980; Mench and Mason, 1997).

In a study of 385 cats euthanized in English veterinary practices, only 1% (n=4) were because of an intractable behavior problem (Edney, 1998). Behavioral problems have been found to be the second most common reason (28%) for cat relinquishment to an animal shelter, in particular house soiling, incompatibility with other pets, aggressiveness, destructiveness, biting, disobedience, fearful behavior, activeness and excessive attention seeking (Salman et al., 2000). In another large study of 1361 relinquishments to 12 animal shelters spread over 6 states in the US in 1995-1996, cat relinquishment was caused by aggression towards people (5% of cases), aggression towards other animals (6%), and other behavior-problems (21%) (Scarlett et al., 1999). The Association of Pet Behavior Counsellors (2003, cited in Heath, 2007) found indoor marking to be the biggest behavior problem in cats (25%), followed by

55 aggression to people (23%), aggression to other cats (13%), difficult house training (12%), attention seeking
56 (11%) and self-mutilation (6%), calculated from a database of 66 cases submitted to a behavior clinic. Cats
57 submitted to behavior counsellors often have more than one behavior problem, with a mean of 1.7 problems
58 per cat (Scarlett et al. 1999). It is also increasingly recognised that behavior problems can be sequelae to
59 medical problems.

60 Susceptibility to behavior problems may differ between breeds, which is not always only a genetic
61 effect, but may be due to certain breeds being affected more by environmental factors, such as early weaning
62 which predisposes Birman but not Siamese cats to wool-sucking (Borns-Weil et al., 2015). In another study,
63 Siamese cats were over-represented for aggression and ingestive behavior problems, Persians over-
64 represented for elimination outside of the litter box, and domestic shorthairs under-represented for most
65 behavior problems, in particular aggression, ingestive behavior and house soiling (Bamberger and Houpt,
66 2006). However, other studies did not find breed to be a risk factor for developing behavior problems (e.g.
67 Ramos and Mills, 2009; Adamelli et al., 2005). Sex can also influence the risk of behavior problems, with
68 Bamberger and Houpt (2006) finding that male cats were over-represented (58%) for behavior problems.
69 Males were particularly overrepresented amongst spraying cats (with 75% of affected cats being male) and
70 less so amongst house soiling cats (where 56% of affected cats were male). Neutered cats are generally at
71 greater risk of having behavior problems than entire cats, but intact females are more likely to have
72 aggression problems than neutered females (Heidenberger, 1997; Salman et al., 2000). Other risk factors
73 include a lack of early social exposure people, which reduces friendly responses to both familiar and
74 unfamiliar people (McCune, 1995). The physical environment in the home may present risks related to
75 behavior problems, including failing to provide a scratching post to alleviate unwanted scratching behavior
76 (Mengoli et al., 2013). Stress in the home environment, defined as ‘the prolonged inability to remove a
77 source of potential danger, leading to activation of systems for coping with danger beyond their range of
78 maximum efficiency’ (Archer, 1979), often as a result of change, is another risk factor, facilitating
79 aggression towards humans (Ramos and Mills, 2009). Other factors may include the time cats are alone at
80 home, age at adoption, location and positioning of the house, number of cats together, and available space
81 per cat (Heidenberger, 1997). Aggression (towards owners) is more common in single cat households than

82 in multi-cat households (Amat et al., 2009), and cats from pet shops and cats without outdoor access have
83 the most behavior problems. Possible human factors include the number of household members (singles and
84 couples without children more often report anxiety in their cats), number of children (absence of children
85 has been related to more behavior problems), number of interactions between cat and owner, and owner's cat
86 experience (i.e., number of cats the owner had in the past) (both negatively associated with risk of behavior
87 problems) (Heidenberger, 1997).

88 Factors associated with behavior problems in cats have rarely been examined in large studies. We
89 used a large case series to identify the relevant factors. We hypothesized that specific breeds may exhibit
90 certain behavior problems, and also that there is a relationship between work-routine of the owner and some
91 behavior problems in cats. We assessed proportional morbidities in cats submitted to the clinic and
92 compared these by cat breed, sex, and age when reported, and owner's work-routine and estimated, assumed
93 socioeconomic status derived from postcodes. We also compared distributions of breeds for cats with
94 common behavior problems to the expected breed distribution based on council registrations for each breed
95 to determine whether commonness of problem was associated with relative popularity of relevant breed.

97 **Material and Methods**

98 A retrospective case series evaluation of 1,557 cats was conducted. Privately-owned cats with behavior
99 problems were identified from records of a Brisbane companion animal behavior clinic (Pethealth.com.au).
100 Each cat owner respondent was uniquely identified. Cat owners were 'clients', i.e., those that had face-to-
101 face consultations, 'customers', i.e., those that had purchased products but did not have a consultation, or
102 'prospective clients' i.e., those who made an inquiry but did not proceed to a consultation or to purchase a
103 product. The clinical consultation notes for the cat owners were provided by a professional veterinary
104 behavior consultant¹. Approximately 43% of the participants (N= 674) were referred to the clinic directly or
105 indirectly by their own veterinarian or the RSPCA. Descriptions of problem behaviors were collected using
106 an on-line questionnaire (available from Pethealth.com.au or in the Supplemental Material). This was

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usually the first point of contact with the clinic. The URL was also sent to prospective respondents by e-mail after they had spoken to the staff of the clinic and the questionnaire was promoted in social media. In about 60% of cases (N= approximately 934), questionnaire data were clarified with the owner by clinic staff during or after phone conversations with cat owners who called for advice or during a face-to-face consultation. Consultations were in one of four forms: a 30 minute telephone review (allowed in Australia), a 30 minute in-clinic assessment, a 2 hour in-clinic consultation and a 2 hour house call with treatment. In the remainder of cases the questionnaire was completed by the client. Multiple owner-level records from the same owner were identified based on respondent email addresses. Clinic staff also routinely checked for duplicate owner-level records and, when detected, concatenated records. Data were collected from 2001 to 2013. Respondents owning multiple animals with behavior problems were asked to provide details for the animal with the most problematic behavior first. Behavior problems could be either selected from a drop-down list or described by the respondent in a free-text field, allowing the inclusion of multiple behavior problems. Within each owner only the first cat listed was used for analysis. Where multiple behavior problems were reported, only the first listed problem was used, on the assumption this was the most problematic one. The unit of analysis was the first-listed cat for each owner. All cats whose owner's record was created from 2001 to 2013 were included except where there was incomplete description of the behavioral problem or a non-Australian postcode was recorded. Records with no postcode and invalid but fully numeric postcodes were retained as these were almost certainly from cats in Australia.

The questionnaire recorded the owners' residential postcode, work routine (i.e., time people were away from home for work), the cat's date of birth, breed, and sex, its neuter status at the time the owner's record was created, and the nature of the behavior problem(s). Australia is divided spatially into postcode areas. It was not possible to assess the socio-economic status of each cat's household but the owner's postcodes were used to identify the relative socioeconomic status of each owner's residential postcode using the Index of Relative Socio-Economic Advantage and Disadvantage (Pink, 2013). This index summarises information about the economic and social conditions of people and households within an area. The index is a relative measure and particular absolute differences have no readily identifiable meaning. But a low score indicates relatively greater disadvantage and a lack of advantage in the area, and a high score indicates a

134 relative lack of disadvantage and greater advantage in the area. Postcodes were identified using on-line
135 software (Freemaptools, 2015). Respondents' work routine was categorised based on responses selected by
136 respondents: mostly at home, 20-40 h per week at work; 40-60 h per week at work; or variable work routine
137 (shift work). Behavior problems were subsequently categorised by the authors into the following categories:
138 aggression (specified as predatory, between familiar cats, to dogs, to familiar people, to unfamiliar cats, to
139 unfamiliar people, of mixed type or unspecified); anxiousness/fearfulness; assimilation with a new baby;
140 assimilation into a new home or with new cats; attention seeking; clawing, vertical scratching; excessive
141 vocalising; grieving; house soiling (either with feces only, urine only, unspecified, or urine and feces);
142 hyperactive and boisterous; overgrooming/self-harming; pica/oral compulsions; roaming, escaping and
143 confinement; and unspecified behavior problem.

144 For breed identification, the online questionnaire enabled respondents to describe the animal's breed
145 in a free-text field. Breed types were specified and then categorised into groups defined by the Australian
146 Cat Federation Inc (ACF, 2014): group 1 - Persian, Ragdoll, Maine coon and similar breeds; group 2 -
147 Siamese, Balinese and similar breeds; group 3 - Australian mist, Bengal, Burmese and similar breeds; group
148 4 - companion pets. When a cat was listed as cross bred with the parent breeds described, the first breed
149 description was used, unless it was a crossbred crossed with a crossbred, in which case its breed was
150 recorded as such. If the owner only described their cat as crossbred, it was listed as crossbred. Respondents
151 indicated the cat's sex as a combination of male/female and neutered-desexed/entire.

152 The animal's approximate or actual date of birth was entered in a free-text field. This was used in
153 combination with the date that the owner's record was created to estimate the animal's age at the time of
154 reporting the problem behavior (problems were usually reported on the date that the owner's record was
155 created), to the nearest half year when older than one year. When younger than one year, age was calculated
156 to the nearest month. Four age classes for analyses were then used: < 1 year; 1 to < 2 years; 2 to < 9 years,
157 and 9 years and older.

158 Registration of domestic cats kept in the Council area was compulsory at the time of data collection.
159 Data sourced from cats registered with a large municipal council servicing part of the catchment area of our
160 study, the Gold Coast City Council, were used to compare breed distributions of cats in the study with those

161 in the registry. Registration data for the year 2014 were used (n=14,017 cats of which 13,975 had
162 identifiable breeds). The 13,975 council-registered cats were categorised into the four breed groups as
163 described above. Only study cats whose breed was recorded and whose owner's postcode was in Central
164 Brisbane, Ipswich, Gold Coast, (all in South East Queensland, Australia) and other locations within a radius
165 of 200 km of the Gold Coast (including in New South Wales, Australia) were used for these comparisons.
166 These To increase the validity of comparisons to registration data for 2014, only study cats whose owner's
167 record was created from 2005 to 2013 were used for these comparisons.

169 *Statistical analyses*

170 For each behavior problem, we calculated proportional morbidities - the proportions of study cats with a
171 particular behavior problem. For specific behavior problems where at least 39 cats were affected, we then
172 compared proportional morbidities between subsets of cats based on exposure (breed group, age group, sex
173 and socioeconomic status of the owner's postcode), generating proportional morbidity ratios. Statistical
174 power for comparisons of behavior problems where less than 39 cats were affected was minimal, except for
175 implausibly large effects, so these proportional morbidities were not compared for these problems. For each
176 comparison we selected a reference category; for example, for breed group, group 4 was selected as the
177 reference category. Proportional morbidities for a particular behavior problem described the proportion of all
178 cats with any behavior problems that had that particular behavior problem. Assuming no bias and
179 disregarding statistical variability, proportional morbidity is higher for one group (e.g. one breed category)
180 than another if: a) that group is at higher risk of that particular behavior problem, b) that group is at lower
181 risk of the other behavior problems, or c) both. Proportional morbidity ratios were estimated using
182 generalised linear models with log link and binomial error distributions, fitted using the -glm- command in
183 Stata (version 13, StataCorp, College Station, Texas, USA). For each behavior problem, overall univariable
184 effects of each exposure were assessed using likelihood ratio tests, and exposure categories were compared
185 to the reference category using Wald tests.

186 Distributions of study cats across breed groups was compared to the breed distribution expected
187 based on the proportions of Council registrations of each breed group using goodness-of-fit log likelihood

ratio chi-square tests for multinomial data. These were performed with the `-mgofi-` command in Stata. Exhaustive enumeration exact tests were used except when assessing the breed distribution for all 867 cats, when the large sample chi-square test was used. These 867 cats were those for which the breed was recorded, the owner's postcode was within a radius of 200 km of the Gold Coast and the owner's record was created from 2005 to 2013. For each of the 10 behavior problems where the overall goodness-of-fit p-value was <0.05 and for any behavior problem (i.e. using all 867 cats), for each of the 4 breed groups, the proportion of cats in any one breed group was compared with that expected proportion based on council registrations using the same methods as described above. These 44 p-values were adjusted for multiple pairwise comparisons using the Benjamini-Hochberg step-up False Discovery Rate method, with the Etcetera module in WinPepi (version 11.43; Abramson, 2011).

Results

In total, 1,708 cats were initially enrolled. Of these, 152 were excluded because of either incomplete description of the behavioral problem ($n=148$) or non-Australian postcodes ($n=4$). Analyses were performed on the remaining 1,556 cats. Of the 1556 study cats, 80.5% ($N=1253$) were from Queensland, 7.0% ($N=109$), New South Wales, 3.9% ($N=61$), Victoria, 1.7% ($N=26$), Western Australia, 0.7% ($N=11$), South Australia, 0.4% ($N=6$), Tasmania, 0.3% ($N=5$), Australian Capital Territory, 0.2% ($N=3$) from Northern Territory and 5.3% of unknown origin ($N=82$).

Sixteen percent ($N=244$) of the cases were in breed group 1 (Persian and similar), 7% ($N=106$) group 2 (Siamese and similar), 25% ($N=388$) group 3 (Burmese and similar), and 52% ($N=815$) group 4 (Companion). The study population consisted of 57% males ($N=833$) and 43% females ($N=640$). Fifteen % were younger than 1 year ($N=229$), 13% between 1 and 2 years ($N=201$), 58% between 2 and 9 years ($N=864$), and 14% were older than 9 years ($N=207$). Of respondents reporting work hours, 31% of the cat owners were away from home for 20 - 40 hours per week ($N=154$), 31% of them were away 40 - 60 hours ($N=73$), 18% were mostly home ($N=122$), and 20% reported to be at home at variable times ($N=83$). Twenty four percent ($N=355$) of the cat owners scored below 1000 on the relative socioeconomic status index, 23% ($N=343$) between 1000 and 1039, 28% ($N=404$) between 1040 and 1079, and 25% ($N=365$) 1080 or more.

215 The most common behavior problems reported were 'house soiling - with urine only' (25% of all
216 cases; N=384), 'aggression - to familiar people' (13%; N=203), 'aggression -between familiar cats' (8%;
217 N=129), 'anxious or fearful' (8%; N=125), 'excessive vocalising' (6%; N=87), and 'house soiling with urine
218 and faeces' (6%; N=86). Of all behavior problems reported, 38% (N=584) were about different categories of
219 house soiling, and 33% (N=459) about different categories of aggression (Table 1).

220 When comparing proportional morbidities of behavior problems by breed group, the behavior
221 problem 'aggression-predatory' was only reported in breed group 4 (companion) (n=9). Breed group 1
222 (Persian) had lower proportional morbidity for aggression between familiar cats when compared with breed
223 group 4 (P=0.020) (Table 2). Relative to Breed group 4 cats, breed group 3 cats had lower proportional
224 morbidity for aggression to familiar people (P=0.054) and to unfamiliar people (P=0.048), and higher
225 proportional morbidity for pica and oral compulsions (P=0.002). Relative to breed group 4 cats
226 (companion), Breed group 1 (Persian type) and Breed group 2 (Siamese type) cats had higher proportional
227 morbidity for house soiling with urine only (P<0.001), and Breed group 1 had higher proportional morbidity
228 for house soiling with urine and faeces (P<0.001).

229 Proportional morbidities for behavior problems cats aged < 1 year, 1 to < 2 and 2 to < 9 years are
230 shown in Table 3. Relative to cats aged <1 year, cats aged 1 to < 2 years and 2 to <9 years showed more
231 aggression to unfamiliar cats (P=0.004). Relative to cats aged <1 year, cats aged 2 to < 9 years also showed
232 more aggression to familiar cats (P=0.011), but less house soiling with faeces only (P=0.007) and house
233 soiling with urine and faeces (P=0.042). Aggression to familiar people was less common (P<0.001) but
234 mixed aggression more common (P=0.002) in cats aged 2 and older than in younger cats. Cats aged 9 or
235 more years showed more excessive vocalising (P<0.001) but less pica and oral compulsion (P<0.001)
236 relative to cats ages <1 year.

237 Proportional morbidities for behavior problems by cat sex and neuter status are shown in Table 4.
238 Proportional morbidities for aggression between familiar cats and overgrooming/self-harming were lower in
239 males than females (P=0.001 and P=0.022 respectively). In contrast, proportional morbidities for excessive
240 vocalization and house soiling with urine only were higher in males (P=0.016 and P<0.001 respectively).

241 For most behavior problems, there was no significant association with socioeconomic status of the
242 owner's postcode. Only the proportional morbidity for anxiety or fearfulness was higher in cats whose
243 owners had postcodes associated with socioeconomic status scores in the groups 1040 to <1080 and ≥ 1080
244 (10% in both groups), relative to those from less advantaged areas i.e., with scores <1000 (4%; $P=0.007$).

245 There was no significant association of any behaviors with work routine, but working schedules were
246 not reported for 74% (1,154 out of 1,556) of respondents. House soiling with urine only was commonly
247 reported by respondents who worked (18%, $n= 20$ -40 hours per week away from home; 12%, $n=, 40$ -60
248 hours per week away) and also respondents who were mostly home (13%, $n=$). In contrast, respondents who
249 had variable shifts, reported 'aggression to familiar people' the most (19%).

250 When comparing the distribution of behavior problems of the cats in the Gold Coast area ($n=867$) in
251 different breed groups to that expected based on the distribution of Gold Coast city council-registered cats,
252 'aggression between familiar cats', 'aggression to familiar people' and 'excessive vocalising' were more
253 often reported in breed group 3 (Burmese type), and less reported in breed group 4 (Companion cats) than
254 expected (both $p<0.001$) (Table 5). 'Anxious or fearful' was less often reported in breed group 4 than
255 expected ($P=0.027$). 'House soiling - with urine only' was higher than expected for breed group 1, 2, and 3
256 and lower than expected for breed group 4 ($P<0.001$). 'House soiling-spraying' was overrepresented in
257 Breed groups 2 and 3 (Siamese and Burmese types) and underrepresented in breed group 4 ($P<0.001$).
258 'House soiling – inappropriate urination or spraying' was lower in Breed group 4 than expected ($P=0.016$).
259 'House soiling with urine and faeces' was overrepresented in breed group 1 (Persian type) and
260 underrepresented in breed group 4 (Companion cats) ($P<0.001$). Cats in breed group 2 (Siamese type) were
261 more likely to be reported with the problem 'overgrooming/self-harming' than expected ($P=0.028$). 'Pica
262 and oral compulsions' was over-represented in breed group 3 and under-represented in breed group 4
263 ($P<0.001$). 'Roaming and escaping' occurred more often than expected in breed group 3 ($P=0.029$). Overall,
264 behavior problems were higher than expected in breed group 1, 2, and 3 and breed group 4 had fewer
265 behavior problems than expected ($P<0.001$).

267 Discussion

268 Behavior problems in pets are common reasons for owners to consult a veterinarian, common reasons for
269 owners relinquishing the animal for adoption, and common reasons for euthanasia. The most common
270 behavior problems reported in our study were 'house soiling - with urine only' (25% of all cats with
271 behavior problems; N=385), 'aggression - to familiar people' (13%; N=203), 'aggression -between familiar
272 cats' (8%; N=129), 'anxious or fearful' (8%; N=125), 'excessive vocalising' (6%; N=87), and 'house soiling
273 with urine and faeces' (6%; N=86). Of all behavior problems reported, 38% were related to house soiling
274 (N=586), and 33% to aggression (N=509). We detected significant differences between groups only for
275 house soiling, aggression, and overgrooming/self-harming. The problems we found to be most frequently
276 reported were also the most commonly reported behavior problems in other studies (e.g. Bamberger and
277 Houpt, 2006; Association of Pet Behavior Counsellors,2003, as cited in Heath, 2007) and most often
278 mentioned as reasons for relinquishment (Salman, 2000). As in our study, Amat et al. (2009) found
279 aggression and inappropriate elimination to be the two most reported behavior problems, but in reverse order
280 (47 and 39%, respectively). In contrast, Heidenberger (1997) found anxiety, as described by cat owners, to
281 be the biggest problem, followed by scratching furniture, and then followed by house soiling, then feeding
282 problems, and then aggression

283 Our classifications of behavior problems are based on owners' reports and therefore are subject to
284 possible reporting bias and misclassification errors. Personal perception defines the concept of a 'problem'.
285 Shore et al. (2008) asked 170 dog and cat owners about perceptions of behavior problems and found
286 behaviors directly affecting the owners were perceived as most severe; those involving the destruction of
287 belongings were next in perceived severity; and those affecting only the animal were rated as least severe.
288 Given these patterns and our methods for handling data, this report may present a simplified portrait of feline
289 behavioural concerns. In our study, breed was a contributory factor for aggressive behavior. Proportional
290 morbidity for aggression to familiar cats was lower amongst cats in breed group 1 (Persian et al.) those in
291 breed group 4 (companion cats). Veterinarians in Japan have classified Persians as less aggressive to other
292 cats than most other cat breeds there (Takeuchi and Morio 2009). Bamberger and Houpt (2006) found
293 Siamese cats (in our study grouped in breed group 2) were predisposed to behave more aggressively, and
294 domestic shorthairs (in our study grouped in breed group 4) tended to behave less aggressively in the

295 Animal Behavior Clinic population at Cornell University, compared with the Cornell University Hospital for
296 Animals population. We did not find breed group 2 to be more or less often reported to be aggressive as
297 compared with breed group 4, and we found aggression between familiar cats more common in breed group
298 4 (companion) rather than 1 (Persian type). Aggression to familiar people was less common in cats in breed
299 group 3 (Burmese type) as compared with breed group 4 (companion). As in our study, Ramos and Mills
300 (2009) found mixed breeds (breed group 4 in our study) more likely to be aggressive. When then comparing
301 the number of records of aggression in cats in the four breed groups in the Gold Coast area to the number of
302 cats in those breed groups expected based on council registrations we found aggression between familiar
303 cats and aggression to familiar people to be less often reported in breed group 4 (companion) and more often
304 reported in breed group 3 (Burmese et al.), demonstrating that that the popularity of certain breed groups
305 may influence prevalence of behavior problems.

306 Older cats were more likely to be reported for aggression to both familiar and unfamiliar cats but less
307 likely for aggression to familiar people, which may indicate increasing tolerance of familiar people but
308 reduced tolerance of other cats. Female cats were more often aggressive to familiar cats, Hart and Cooper
309 (1984) found that in cats neutered prior to puberty, males engaged in spraying and fighting more than female
310 cats, but Barry and Crowell-Davis (1999) found no difference in indoor cats. In a retrospective study of a
311 small (n = 48) sample of clinical cases, Lindell et al. (1997) found that males were more likely to be
312 aggressive than females. Amat et al. (2009) found intact females exhibited more aggressive behavior than
313 neutered females. Both our study and that of Amat et al. (2009) found house soiling with urine to be the
314 most common soiling problem reported (66 and 59%, respectively), followed by house soiling with urine
315 and faeces (15 and 32%, respectively) and faeces only least often reported (8 and 9%, respectively). House
316 soiling may be related to factors such as not feeling safe (Heath, 2007), attention seeking (Casey, 2009),
317 agonistic interactions with cats in the neighbourhood or the household (Pryor et al., 2001), inadequate
318 opportunity to go outdoors (Pryor et al., 2001), aversions to (Amat et al., 2009) or too few (Heath, 2007)
319 litter trays. Both Amat et al. (2009) and our study found Persian cats were predisposed to house soiling
320 problems. In contrast, Bamberger and Houpt (2006) found Siamese cats (our breed group 2) displayed more
321 house soiling and domestic shorthairs (in breed group 4) displayed less house soiling problems. We found

house soiling with only urine more often reported in breed groups 1, 2, and 3 and less often in breed group 4 in the Gold Coast area, when compared to the number of cats in those breed groups expected based on council registrations. House soiling with urine and faeces was more often reported in breed group 1 (Persian) and less often reported in breed group 4 (companion). Age also had an effect on house soiling problems and was less common in cats aged 2 to < 9, compared with younger cats. We found 'anxious or fearful' behavior less often reported in breed group 4 (companion) than expected based on council registered cats. Lack of socialization (Hunthausen and Seksel, 2002) and early handling (Bradshaw, 1992) is often associated with anxiety. We found that anxiety/fearful behavior to be more associated with owners whose postcodes had socioeconomic status scores in groups 1040 to <1080 and ≥ 1080 , relative to those with scores in the <1040 group. It is possible that people with a higher socioeconomic status are more able to seek professional help and have higher expectations for social behaviour in their cats. Excessive vocalising was less often reported in breed group 4 (Companion) and more often in breed group 3 (Burmese type) in the Gold Coast area when compared to the number of cats in those breed groups expected based on council registrations. Schneck and Caravan (1991) and Case (2003) found Siamese cats (in breed group 2) vocalized more, and Edwards et al. (2007) found oriental cats (also in breed group 2) vocalize more than other breeds. Males were more reported with the behavior problem excessive vocalizing than females. Overgrooming/self-harming was rare (3% of cats) compared with other behavior problems in our study, but more often reported in females rather than males and more often in breed group 2 (Siamese type) than other breed groups. Roaming and escaping confinement were rare but more often reported for cats in breed group 3 (Burmese type) compared with the number of cats in that breed group expected based on council registrations. Pica and oral compulsions were more often reported in breed group 3 (Burmese type) and less often in breed group 4 (Companion) in the Gold Coast area when compared to the number of cats in those breed groups expected based on council registrations, supporting the results of Bamberger and Houpt (2006). Our study suggests that age is a contributory factor. Pica and oral compulsions were less often reported in the age class >9 years compared with kittens (<1 year). Bradshaw et al. (1992) found that stress of rehoming could be a trigger for pica. Since pica and oral compulsions seems to be restricted to certain breed groups, there is probably a genetic basis, triggered by stress susceptibility.

349 Anxious or fearfulness behavior was the only behavior which was associated with socioeconomic
350 status, and no behaviors were associated with work routine. People who relinquished animals for non-
351 personal issues (mostly behavior problems) have been found to be less well educated (associated with lower
352 socioeconomic status) and have a lower income than people relinquishing for personal issues (Scarlett et al.
353 (1999), suggesting that there could be a relationship between socioeconomic status and behavior problems.
354 Our data suggest that regardless of socioeconomic status, owners seek assistance for problem behaviors that
355 most adversely affect them such as house soiling and aggression, while owners with higher income (and
356 likely more education) also seek assistance for behaviors that may affect them less. All behaviour problems
357 are concerns for cat welfare.

359 **Conclusions**

360 We identified a range of factors that were significantly associated with behavior problems in cats. Behavior
361 problems in domestic cats where the owners seeks behavioral expert advice most commonly relate to house
362 soiling and aggression. Overall, behavior problems occurred more commonly in breed groups 1 (Persian
363 type), 2 (Siamese type), and 3 (Burmese type) and less commonly in breed group 4 (Companion cats)
364 compared to that expected based on council registrations. Older cats showed increasing tolerance of familiar
365 people but reduced tolerance of other cats. Males were more likely to present with excessive vocalisation
366 and house soiling with urine and less likely to present with aggression between familiar cats.
367 Anxious/fearfulness behavior was associated with socioeconomic status, with increased proportional
368 morbidity amongst cats residing in areas of greater relative social advantage. Work routine was not
369 associated with any behavior problems. We conclude that breed, age and sex, and social advantage of the
370 area in which the cat lives are risk factors for specific behavior problems. Elucidation of risk factors for
371 behavior problems in cats is possible by careful evaluation of referrals to behavior clinics.

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377 this study. There are no other conflicts of interest.

378

379 Authorship statement

380 The idea for the study was conceived by Clive Phillips and Cam Day. The study was performed by Agnes
381 Wassink-van der Schot, in consultation with John Morton, Jacquie Rand, Cam Day and Clive Phillips. The
382 data was collected by Cam Day. The data were analyzed statistically by John Morton and Agnes Wassink-
383 van der Schot. The paper was written by Agnes Wassink-van der Schot, in consultation with John Morton,
384 Jacquie Rand, Cam Day and Clive Phillips.

385

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482 Table 1. Distribution of cats by nature of behavior problems for cats with behavior problems (n = 1,556)
 483 that were identified from records of a Brisbane companion animal behavior clinic after contacts between
 484 2001-2013.

| Behavior problem | n | % |
|---|----------|----------|
| <u>Aggression</u> | | |
| - predatory | 9 | 1 |
| - between familiar cats | 129 | 8 |
| - to dogs | 5 | <1 |
| - to familiar people | 203 | 13 |
| - to unfamiliar cats | 54 | 3 |
| - to unfamiliar people | 46 | 3 |
| - mixed | 57 | 4 |
| - unspecified | 6 | <1 |
| Anxious or fearful | 125 | 8 |
| Assimilation with new baby | 2 | <1 |
| Assimilation with new home or new cats | 16 | 1 |
| Attention seeking | 47 | 3 |
| Clawing, vertical scratching | 18 | 1 |
| Excessive vocalising | 87 | 6 |
| Grieving | 7 | <1 |
| <u>House-soiling</u> | | |
| - with faeces only | 48 | 3 |
| - with urine only | 385 | 25 |
| - with urine and faeces | 86 | 6 |
| - unspecified | 67 | 4 |

| | | |
|--------------------------------|-------------|------------|
| Hyperactive, boisterous | 21 | 1 |
| Overgrooming/self-harming | 39 | 3 |
| Pica and oral compulsions | 56 | 4 |
| Roaming, escaping, confinement | 34 | 2 |
| Behavior - other | 9 | 1 |
| Total | 1556 | 100 |

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488 Table 2. Proportional morbidities (% of cats with behavior problems that had each specific behavior
 489 problem) for 1556 cats by breed groups (defined by the Australian Cat Federation Inc (ACF, 2014)) with
 490 significant ($P \leq 0.05$) breed effects.

| Behavior problem | Breed group 1 | Breed group 2 | Breed group 3 | Breed group 4 | Breed not specified | P-value | |
|---------------------------|---------------------------|---------------------------|---------------------------|-----------------------------|---------------------|----------------------|------------------------|
| | (Persian type) (n=244) | (Siamese type) (n=106) | (Burmese type) (n=388) | (Companion pets) (n=814) | (n=4) | Overall ¹ | Pair-wise ² |
| Aggression | | | | | | | |
| - between familiar cats | 4 | 6 | 10 | 9 | 0 | 0.020 | 1 |
| - to familiar people | 12 | 9 | 10 | 15 | 0 | 0.054 | 3 |
| - to unfamiliar people | 2 | 1 | 2 | 4 | 25 | 0.048 | 3 |
| House soiling | | | | | | | |
| - with urine only | 32 | 36 | 26 | 21 | 25 | <0.001 | 1,2 |
| - with urine and faeces | 12 | 5 | 4 | 4 | 0 | <0.001 | 1 |
| Pica and oral compulsions | 4 | 3 | 7 | 2 | 25 | 0.002 | 3 |

491

492 ¹ Overall likelihood ratio test univariable p-values for associations between breed and proportional
 493 morbidity (proportion of cats with behavior problems that had the specific behavior problem); only assessed
 494 for specific behavior problems affecting at least 39 cats.

495 ² Categories where the percentage of cats that had the specific behavior problem differed significantly
 496 (Wald $P < 0.05$) from that in Breed group 4.

497

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499

500 Table 3. Proportional morbidities (% of cats with behavior problems that had each specific behavior
 501 problem) for 1,556 cats by cat age. Within rows, bolded proportional morbidities differ significantly
 502 (P<0.05) from those for <1 year.

| Behavior problem | < 1 yr | 1 to < 2 yr | 2 to < 9 yr | ≥ 9 yr | Age not specified | P-value | |
|---------------------------|---------|-------------|-------------|---------|-------------------|----------------------|--------------------------|
| | (n=229) | (n=201) | (n=864) | (n=207) | (n=55) | Overall ¹ | Pair-wise ^{2,3} |
| Aggression | | | | | | | |
| - bet. familiar cats | 4 | 7 | 10 | 7 | 11 | 0.011 | 3 |
| - to unfamiliar cats | 0 | 4 | 5 | 2 | 2 | 0.004 | 2;3 |
| - to familiar people | 18 | 17 | 13 | 6 | 9 | <0.001 | 3,4 |
| - mixed | 0 | 2 | 5 | 5 | 0 | 0.002 | 3,4 |
| Excessive vocalising | 3 | 3 | 5 | 14 | 4 | <0.001 | 4 |
| House-soiling | | | | | | | |
| - with faeces only | 4 | 5 | 2 | 6 | 0 | 0.007 | 3 |
| - with urine only | 24 | 17 | 28 | 20 | 25 | 0.005 | - |
| - with urine/faeces | 9 | 5 | 4 | 7 | 2 | 0.042 | 3 |
| Pica and oral compulsions | 10 | 6 | 2 | 1 | 2 | <0.001 | 4 |

503 ¹ Overall likelihood ratio test univariable p-values for associations between age and proportional morbidity
 504 (proportion of cats with behavior problems that had the specific behavior problem); only assessed for
 505 specific behavior problems affecting at least 39 cats.

506 ² 2 refers to cats with an age of 1 to < 2 yrs; 3 to cats with an age of 2 to < 9 yrs; and 4 to cats with an age
 507 of ≥ 9 yrs.

508 ³ Categories where the percentage of cats that had the specific behavior problem differed significantly
 509 (Wald P <0.05) from that in cats <1year.

510

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512 Table 4. Proportional morbidities (% of cats with behavior problems that had each specific behavior
 513 problem) for 1556 cats by cat sex and neuter status (F female cats with neuter status not recorded, FD
 514 desexed females, FE entire females, M males with neuter status unknown, MD desexed males) and behavior
 515 problem. No males were known to be entire.

| | F (n=39) | FD (n=581) | FE (n=20) | Females pooled (n=640) | M (n=41) | MD (n=792) | Males pooled (n=830) | Sex not specified (n=83) | P-value ¹ |
|---------------------------|-------------|---------------|--------------|------------------------------|-------------|---------------|----------------------------|--------------------------------|----------------------|
| Aggression | | | | | | | | | |
| - between familiar cats | 5 | 11 | 5 | 11 | 5 | 6 | 6 | 13 | 0.001 |
| Excessive vocalising | 8 | 4 | 0 | 4 | 2 | 7 | 7 | 4 | 0.016 |
| House-soiling | | | | | | | | | |
| - with urine only | 15 | 19 | 30 | 20 | 17 | 29 | 28 | 29 | <0.001 |
| Overgrooming/self-harming | 0 | 4 | 0 | 4 | 5 | 2 | 2 | 0 | 0.022 |

516 ¹ Overall univariable *p*-values for associations between cat sex (female [F, FD and FE combined] versus
 517 male [M and MD combined]) and proportional morbidity (proportion of cats with behavior problems that
 518 had the specific behavior problem); only assessed for specific behavior problems affecting at least 39 cats.

519
520

521 Table 5. Distribution of breeds* for 13,975 cats registered with the Gold Coast City Council in 2014, and for
 522 867 cats reported as having behavior problems.

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| | No. cats | Breed group 1* (%) (Persian et al.) | Breed group 2* (%) (Siamese et al.) | Breed group 3* (%) (Burmese et al.) | Breed group 4* (%) (Companion cats) | P-values | |
|--------------------------------|----------|--|--|--|--|----------------------|------------------------|
| | | | | | | Overall ¹ | Pair-wise ² |
| Council registrations | 13,975 | 12 | 3 | 11 | 75 | | |
| Aggression | | | | | | | |
| - between familiar cats | 78 | 9 | 8 | 27 | 56 | <0.001 | 3,4 |
| - to familiar people | 109 | 16 | 6 | 23 | 55 | <0.001 | 3,4 |
| Anxious or fearful | 71 | 15 | 7 | 18 | 59 | 0.027 | 4 |
| Excessive vocalising | 45 | 20 | 9 | 29 | 42 | <0.001 | 3,4 |
| House-soiling | | | | | | | |
| - with urine only | 209 | 22 | 11 | 26 | 41 | <0.001 | 1,2,3,4 |
| - with urine and faeces | 56 | 39 | 4 | 18 | 39 | <0.001 | 1,4 |
| Overgrooming self-harming | 18 | 6 | 17 | 22 | 56 | 0.028 | 2 |
| Pica and oral compulsions | 38 | 16 | 8 | 53 | 24 | <0.001 | 3,4 |
| Roaming, escaping, confinement | 16 | 13 | 0 | 38 | 50 | 0.029 | 3 |
| Behavior - other | 6 | 67 | 0 | 33 | 0 | <0.001 | 1,4 |
| Any behavioral problem | 867 | 17 | 7 | 26 | 50 | <0.001 | 1,2,3,4 |

523 ¹ Overall *p*-value for distribution of cats across groups compared to that expected based on council
 524 registrations; a low *p*-value provides evidence that the distribution of cats across breed groups differs from
 525 that expected.

526 ² Groups where the percentage of affected cats differed significantly (*P* adjusted for multiple pair-wise
 527 comparisons <0.05) from that expected based on council registrations.

528 * Grouped as defined by the Australian Cat Federation Inc (ACF, 2014).

- We model 1556 behavior problems recorded over 12 years in a cat behavior clinic
- House soiling by urination and aggression to familiar people were most common
- We examine risk factors for the behavior problems from demographic information provided
- Persians had reduced risk of aggression and increased risk of house soiling
- Older cats were more tolerant of familiar people but less tolerant of other cats

Cat Questionnaire

Enter your Name and Address details below. (Fields with * need completion for form to submit)

First Name*

Last Name*

Email Address*

Work Phone

Mobile

Fax

Address

Address 2

Address 3

Suburb

State

Zip Code

Country

Your Lifestyle: Your lifestyle is shared by your pets and vice versa. Obtaining information about this helps to make tailored behaviour solutions that work.

No. Infants (under 5 yrs) at home?

 Unknown 0 1 2 3 >3

No. Children (5-15 years) at home?

 Unknown 0 1 2 3 >3

No. Adults (15-60ys) at home?

 Unknown 0 1 2 3 >3

No. Seniors (over 60 yrs) at home?

 Unknown 0 1 2 3 >3

What is your family's work routine?

- Unknown
 Mostly home
 Variable attendance (shifts)

- Mostly 20 - 40 hours away
 Mostly 40 - 60 hours away
-

Pet's lifestyle when you are home

- Unknown
 House confined
 Mostly an inside pet
 An inside and outside pet
 Mostly an outside pet
 Entirely an outside pet
-

Pet's lifestyle when you are NOT home

- Unknown
 House confined
 Mostly an inside pet
 An inside and outside pet
 Mostly an outside pet
 Entirely an outside pet
-

Is the pet you are worried about a dog?

- Yes No
-

And/or a cat?

- Yes No
-

Your Pet's Details:- Please complete the following details about your pet(s). If you have more than one pet, give the details of the pet with the biggest problem first. Then add similar details for your other pet(s) in the field provided

Pet Name

Pet Breed

Pet Sex

- Unknown
 Male desexed
 Male entire
 Female desexed
 Female entire
-

Pet Birth Date (approx)

Age of pet when obtained

- Unknown
 < 6 weeks
 Btw 6 and 12 weeks
 Btw 12 and 6 months

- Btw 6 and 12 months
- Btw 12 months and 2 years
- After two years of age

What behaviour do you want to solve?

- Aggression to family
- Aggression to visitors
- Aggression to people met when out
- Aggression to other dogs I own
- Aggression to dogs met when out
- Aggression to cats, livestock, wildlife
- Barking when I am home
- Barking when I am away
- Boisterous and disobedient
- Destructive, chewing, digging

- House-soiling
- Pacing, spinning, tail-chasing
- Escaping and roaming
- Noise phobias
- Separation anxiety
- Fearful, timid, generally anxious
- Attention seeking
- Eating unusual objects
- Problem not listed

Please do this bit! Add details of other pets and fully describe your concern here

This field needs a response to allow form submission. If you indicate you need a consultation service we will contact you. If you select web membership, you have the option of asking for assistance or not. If you prefer the free DIY system we are unlikely to contact you due to the number of requests we receive. Thanks for your understanding!

What form of assistance would you prefer?

- Full Therapy House call
- Full Therapy Clinic Visit
- Clinic Assessment
- Tele-Assist Service
- Web Membership DIY
- Free DIY - I don't need to be contacted.

Please enter how you find us. If you were referred by a vet or pet care professional please enter details here

Who referred you to us?

Click the submit button - you should then proceed to a Thank You page. If nothing appears to happen, scroll through the form to ensure all fields marked with * are completed. If successful, you should get an immediate automatic reply by email.

* Indicates field is required.

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