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The perception of cat stress by Italian owners

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1 **The perception of cat stress by Italian owners**

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13 **Highlights**

- 14 • Owner perceptions of their pet cat's welfare has been neglected in research
- 15 • One-hundred-ninety four owners were interviewed about the welfare of their cats
- 16 • Owners tend to overlook certain signs of stress regarded as crucial by behaviorists
- 17 • The preconceptions owners have about the ethology of normal cats affects the recognition of
- 18 stress

19

20

21

**Abstract**

22 **Abstract**  
23 The welfare assessment of owned pet cats has been neglected in research. The aim of this study was  
24 to assess owners' perception and recognition of impaired welfare in their own cats.

25 One-hundred-ninety four cat owners were interviewed face-to-face by a veterinary behaviorist,  
26 completing a 42-item questionnaire.

27 Most owners (71.1%/N=138) correctly included both physical and psychological features within  
28 their definition of stress, but 9.8% (19) thought that stress had no consequences for the cat.

29 When asked to rate the overall stress level of their own cats in a non-numerical scale based on  
30 frequency, 56.7% (N=110) chose low, 38.1% (N=74) chose medium, and 5.2% (N=10) chose high.

31 Owners whose cats played little or not at all were more likely to rate the level of stress of their cats  
32 as high (90.0%) than to rate it as low or medium (33.2%/64;  $\chi^2 = 13.290$ ;  $p < 0.001$ ). Similarly,  
33 owners whose cats showed over-grooming were more likely to rate the level of stress of their cats as  
34 high (30.0%/58 vs 7.6%/15;  $\chi^2 = 4.948$ ;  $p = 0.015$ ). The display of aggression or house-soiling was  
35 not associated with the owner's rating of stress level.

36 The number of signs recognized by respondents as potential indicators of stress in cats and the  
37 rating of the level of stress in their own cats were weakly correlated ( $\rho = 0.217$ ;  $p = 0.002$ ). This  
38 may be due to possible biases in the interviews as well as to an overall good welfare in the cat  
39 sample associated to a moderately good understanding of feline signs of stress in owners.

40 A principal components analysis applied to the listed signs of stress identified four components  
41 which were termed: body posture, social avoidance, house soiling, and self-directed behavior.

42 However, some of the signs that behaviorists regard as crucial in their anamnesis, such as scratching  
43 the furniture, freezing, mydriasis and recurrent cystitis, were the least recognized signs of stress by  
44 cat owners. Only very prominent, common or potentially disturbing behaviors such as excessive  
45 vocalization, posture with the ears back, and urinating out of the litter tray were regarded as  
46 potential signs of stress by more than two thirds of owners. These findings suggest that owners tend  
47 to overlook certain signs, and that owners' perception of stress partially depends on their false

48 preconceptions about cat normal ethology (e.g., playfulness, social relationships, aggression et  
49 cetera ). This ill-informed perception is likely to prevent owners from correctly indentifying, and  
50 intervening in, situations of poor welfare.

51

52 **Key words:** behavior; cat; owner; questionnaire; stress; welfare.

53

## 54 **Introduction**

55 Due to the huge discrepancy between the ancestral environment of the domestic cat and its modern  
56 day lifestyle as a pet, a wide range of potential stressors may give rise to poor welfare in this species  
57 (Casey & Bradshaw, 2005).

58 Welfare, based upon subjective states experienced by the animal, can be indirectly assessed using  
59 behavioral and physiological measures of stress (Casey & Bradshaw, 2005). Behavioral  
60 measurements are of particular interest for the assessment of welfare in pets, because they can be  
61 easily and noninvasively collected (Beerda et al., 1997, 1998).

62 Most of the research on the welfare of cats has focused on shelters and catteries (Vinke et al., 2014;  
63 Guy et al., 2014; Damasceno & Genaro, 2014). For example, animal behavior indicators have been  
64 used to confirm that husbandry practices are strongly correlated with body and coat condition  
65 (Arhant et al., 2015).

66 Compared with shelters, the welfare assessment of owned pet cats has been quite neglected in  
67 research. Being responsible for care-giving, cat owners strongly influence the welfare of their pets.  
68 In addition, when treating behavioral problems, behaviorists usually rely on the owner's  
69 descriptions and assessments of the pet in situations in which behaviorists themselves are not  
70 present. So, the role of owners in the evaluation and protection of pet welfare is crucial.

71 Owner-completed questionnaires are used in the assessment of behavior and welfare, based on the  
72 assumption that owners know their animals' behavior better than anyone else (Serpell and Hsu,  
73 2001).

74 Recent studies have investigated dog owners' perception of stress in their dogs through the use of  
75 questionnaires (Mariti et al., 2012) and have compared owner assessments with those of a  
76 behaviorist and with the behavioral analysis of video recordings of dogs (Mariti et al., 2015).  
77 Although owners can provide information that would otherwise not be easily accessible to people  
78 who were not acquainted with that specific animal, their ability to recognize subtle signs of stress in  
79 dogs and to identify the level of stress of their own dogs was called into question.  
80 To our knowledge, this kind of study has not been carried out in pet cats. So, the aim of the current  
81 study was to assess owners' perception and recognition of impaired welfare in their own cats.

82

### 83 **Materials and methods**

#### 84 *Protocol*

85 A questionnaire previously used for assessing the perception of stress in dog owners (Mariti et al.,  
86 2012) was adapted for this study, to create a 42-item questionnaire. A draft version was piloted on  
87 ten cat owners. Some minor adjustments were then made leading to the final questionnaire (Table  
88 1) Items were mostly multiple choice and included information about the owner and cat, the  
89 environment and husbandry, the cat's behavior and the owner's perception of stress.

90 When administering the final version of the questionnaire to the test population, cat owners were  
91 first briefly briefed about its operating methods and purpose (namely collecting data on cat  
92 management and behavior in Italy), and their written consent was collected. Respondents were  
93 recruited by personal contact and from the client databases of two veterinary clinics in Central and  
94 South Italy. For the latter, as performed by Mariti et al. (2015), clients bringing their cat to the vet  
95 for scheduled visits (e.g., vaccination) were selected, in order to avoid cats with known health  
96 problems. If respondents owned more than one cat, they were asked to answer the questions with  
97 reference to the oldest in the household. Each cat owner was interviewed face-to-face by one of two  
98 veterinary behaviorists who read out the items and recorded the answers provided by the  
99 respondent. In the case of multiple-choice items, the interviewer read the question and ticked the

100 answer chosen by the respondent. In the case of open questions (such as “how do you understand  
101 that your cat is stressed?” and “in which situations is your cat stressed?”), the interviewer wrote the  
102 respondent’s exact words and then reformulated a summarized answer, asking the respondent  
103 whether this accurately summarized what the respondent wanted to express. For the items “Is your  
104 cat stressed in X situation?” (for the list, see fig. 1) and “In your opinion, can X be a sign of stress  
105 in cats?” (for the list, see fig. 2), the question was repeated for a list of potentially stressful  
106 situations and feline signs of stress; owners who replied yes were also requested to attribute a score  
107 of 1 to 5.

### 108 *Participants*

109 The questionnaire was completed by 194 cat owners. Respondents were mainly women (145 versus  
110 49 men), in the range of 30-50 years old ( $38.5 \pm 13.4$ ), and educated (49.0%/95 high school,  
111 34.0%/66 advanced degree).

112 The population of cats was quite equally distributed for sex; 45.9%/89 female (41.8%/81 neutered  
113 and 4.1%/8 entire) and 54.1%/105 male (47.4%/92 neutered and 6.7%/13 entire). The cats were  
114 mostly adults ( $76.0 \pm 56.2$  months old) and of domestic short or long-haired breed (84.0%/163).  
115 Apart from those born at home ( $n = 7$ ), the age of adoption was very variable, the average being  $5.5$   
116  $\pm 10.9$  months old.

117 Only 8.2%/16 of cats lived with one owner, while most cats lived in a family with 2-4 members  
118 (79.9%/155). In 20.6%/40 of cases, there were children (0-12 years old) living in the house. The  
119 majority of cats lived with other animals in the household, especially dogs (62.3%/121) and other  
120 cats (73.6%/143). The total number of cats in the household, including the analyzed cat, varied from  
121 2 (33.6%/65) to 15 (0.7%/14); the number of cats in the same household was inversely proportional  
122 to the percentage of households with that composition (2 to 5 cats represented the 64.2%/121 of  
123 households).

124 Cats were almost equally divided between those who lived strictly indoors (45.4%/88) and those  
125 who had both indoor and outdoor access (50.5%/98). The remaining 4.1%/8 lived exclusively  
126 outdoors.

127 The majority of cats had the opportunity to access high places in household rooms (90.2%/175), but  
128 fewer than half of cats (40.2%/78) had a dedicated resting place that owners provided to them.  
129 There was a minimum of 1 litter-tray per cat in half of the households (52.6%/101). Most cats had  
130 free access to food (68.0%/132), with the remainder being fed more than once per day (twice:  
131 4.1%/8; 3 times: 19.1%/37; more than 3 times: 8.8%/17).

### 132 *Statistical analysis*

133 The statistical analysis was performed using the Chi-square test with Bonferroni correction (with  
134  $p=0.0125$  as the threshold for significance) in order to assess the possible presence of factors  
135 affecting the owner's rating of the level of stress in their cats. Spearman's rank test ( $p<0.05$ ) was  
136 used to explore potential correlations between the rating of the level of stress and the number of  
137 signs recognized by owners as feline indicators of stress. In addition, an exploratory principal  
138 component analysis (PCA) was carried out using the stress score (1-5) attributed by each owner to  
139 each listed sign of stress.

140

## 141 **Results**

### 142 *Cat behavior*

143 Almost half of the cats had shown aggression (45.4%/88) including biting (19.0%/37). The targets  
144 of aggression were usually dogs/cats (15.0%/29) or familiar people (24.1%/47).

145 Around one third of cats were described by their owners as playing little (28.4%/55) or not at all  
146 (7.7%/15), and a similar proportion showed house-soiling, including urine and feces (10.3%/20),  
147 only urine (8.2%/16) or only feces (9.8%/19) outside of the litter-tray. A small, but still notable,  
148 number of cats displayed overgrooming (8.8%/17).

### 149 *Perception of stress*



150 When asked, using a closed-question, about their definition of what constitutes stress, the majority  
151 of owners (71.1%/138) correctly included both physical and psychological features within their  
152 definition, while 15.5%/30 considered stress to be a purely psychological phenomenon, and 3.6%/7  
153 considered it to be only a physical phenomenon. Approximately one in ten owners (9.8%/19)  
154 thought that stress had no consequences for the cat.

155 When asked to rate the stress level of their own cats using the scale provided, 56.7%/110 chose low,  
156 38.1%/74 chose medium, and 5.2%/10 chose high.

157 Owners whose cats played little or not at all were more likely to rate the level of stress of their cats  
158 as high (90.0%/175) than to rate it as low or medium (33.2%/64;  $\chi^2 = 13.290$ ;  $p < 0.001$ ). Similarly,  
159 owners whose cats showed over-grooming were more likely to rate the level of stress of their cats as  
160 high (30.0%/58) than to rate it as low or medium (7.6%/15;  $\chi^2 = 4.948$ ;  $p = 0.015$ ). The display of  
161 aggression (70.0%/136 vs 44.0%85;  $\chi^2 = 2.583$ ;  $p = 0.108$ ) or house-soiling (30.0%/58 vs 19.6%38;  
162  $\chi^2 = 0.643$ ;  $p = 0.423$ ) was not associated with the rating of stress level.

163 The majority of respondents (76.6%/149) stated their cat was stressed in certain situations, while  
164 11.7%/23 considered their cats never to be stressed, and a further 11.7%/23 were not able to give an  
165 answer. However, when they were presented with a list of potentially stressful situations, 42 out of  
166 the 44 owners who had stated that their cats were never stressed, or who were unable to answer  
167 selected at least one situation that they regarded as potentially stressful for their cat. The  
168 percentages of respondents considering the listed situations as stressful for their own cat are  
169 reported in fig. 1.

170 Owners were also presented with a list of potential signs of stress in cats, as previously described in  
171 the cat-stress score for caged or confined cats (Kessler & Turner, 1997) and a set of undesirable  
172 behaviors commonly regarded as feline stress indicators (Casey & Bradshaw, 2005; Mills et al.,  
173 2014; Amat et al., 2015). Owners were asked to evaluate whether each sign was generally indicative  
174 of stress in a cat (the results are reported in fig. 2).

175 The Spearman's rank test revealed a significant correlation between the number of signs recognized  
176 by respondents as possible indicators of stress in cats and the rating of the level of stress in their  
177 own cats, but the correlation was weak ( $\rho = 0.217$ ;  $p = 0.002$ ).

178 Using the 1 to 5 score attributed by owners to the listed signs of stress, a Principal Components  
179 Analysis (PCA) with varimax rotation was carried out. A good model was obtained ( $KMO = 0.855$ ;  
180  $p < 0.001$ ) and most of the variance was explained by four components (total variance explained =  
181 61.6%/120; see table 2). The first component included ears back, tail close to the body, mydriasis,  
182 panting and trembling; this component was named "body posture". The second component included  
183 not staying in the room with other animals, not eating in their presence, hiding and showing  
184 aggressive behavior when scolded; this principal component was named "social avoidance". "House  
185 soiling" represented a component on its own, with loadings from feces in an inappropriate place  
186 and urine in an inappropriate place. Overgrooming, recurrent cystitis, hypervocalizing and freezing  
187 all showed positive loadings for the fourth component, and scratching the furniture had a negative  
188 loading. This component was therefore a combination of more disparate signs, perhaps indicating  
189 inhibition, and the title "self-directed behavior" was chosen as it summarized the main aspects.

190

## 191 **Discussion**

192 "Stress" is a general term that is understood by most people but which has many nuances.

193 As it is used in scientific literature, the term stress is an ambivalent phenomenon that includes both  
194 a positive form (eustress) and two forms of negative stress (overstress and distress; Selye, 1974).

195 However, the word stress was borrowed from engineering by Selye in 1936 to describe the  
196 nonspecific response of the organism to a noxious stimulus and, since then, stress tends to be  
197 generally associated with negative factors, and specifically with describing the response of an  
198 organism to an internal or external threat (Selye, 1936).

199 This study deals with the perception that owners may have of cat stress and it did not aim to assess  
200 the welfare of pet cats or diagnose their behavioral problems. For this reason, the tools were

201 constructed to be simple enough that they could be understood by average cat owners. For instance,  
202 the word stress was used in the questionnaire instead of the word welfare, because stress was  
203 considered to be more commonly used and more easily understood by average Italian cat owners  
204 (welfare does not have a translation in Italian, only the term well-being exists). The description of  
205 cat behavior was kept as simple as possible and, where necessary, the interviewer could help the  
206 respondent by using other words. In order to get more reliable information, some questions focused  
207 on the same topic were repeated and expressed differently (as suggested by Mariti et al., 2015).

208 The use of a face-to-face interview, compared with other means of data collection, presents some  
209 advantages and disadvantages (for a review see Opdenakker, 2006). In the current study the face-to-  
210 face method was chosen because it involves a synchronous communication, that makes the  
211 interviewee's answer more spontaneous and without an extended reflection (Opdenakker, 2006).

212 Bias coming from the interviewer can be diminished by using an interview protocol (e.g. a  
213 structured questionnaire) and through the awareness of the interviewer of this effect (Opdenakker,  
214 2006). However, the use of a face-to-face interview does have disadvantages, such as being time  
215 and cost-consuming, which reduces the number of participants.

216 This study represents a first attempt to gather information on how owners perceive stress in their  
217 own cats, and therefore the findings have to be interpreted cautiously. Due to the relatively low  
218 number of interviewees and to the specific recruitment area, there are limitations in interpreting and  
219 in generalizing results.

220 Many factors, such as sex, education and age, can affect the way people perceive and relate to  
221 animals; for example influencing empathy (Taylor and Signal, 2005) or interaction style (Herzog,  
222 2007). However, the population recruited in the present study (mainly educated, adult, female  
223 owners) reflects a common profile of cat owners (Murray et al., 2010); this increases the likelihood  
224 that our sample is representative of the wider population of cat owners. Other factors, such as  
225 having children, seem to affect the ability of owners to recognize and rate stress in their pets  
226 (Carlone et al., 2015), and cultural and individual features are likely to affect the psychology of

227 ownership. All these matters have implications for pet welfare, but they are beyond the scope of the  
228 present study, and investigating the effect of the owner's characteristics on their perception of cat  
229 welfare will require further research.

230 Our first key finding is that most owners were able to identify the correct definition of stress in a  
231 closed-question, which included both physical and psychological features, and the possibility that  
232 stress can have detrimental effects on the cat. However, one in ten owners thought that stress had no  
233 consequences for the cat, which suggests that those owners will not apply any interventions to  
234 reduce it.

235 When asked to rate the level of stress experienced by their own cat by using a provided scale, most  
236 owners stated that their cats were stressed rarely or only in specific situations. Few owners  
237 (5.2%/10) reported that their cats were highly stressed, and this answer corresponded with the  
238 owners' opinion that their cats were often or always stressed. This proportion may seem to be low  
239 but, considering that seven million people in Italy own at least one cat (source: Eurispes, 2014), it  
240 corresponds to hundreds of thousands of cats living in potentially very poor welfare conditions.  
241 This suggests that the welfare of pet cats is a highly important issue, with a need for much work on  
242 their protection, especially in improving the owner's knowledge about, and ability to provide for,  
243 their needs. Our findings are particularly alarming in light of the fact that none of the interviewed  
244 owners were recruited through a behavioral service. This suggests that these owners were not  
245 actively asking for advice on how to improve their cats' welfare. In addition, the reported  
246 proportion of cats living in poor welfare conditions is probably an underestimation, as it is more  
247 likely that owners underestimate rather than overestimate stress and welfare problems. The data  
248 may have been compromised by participant bias, especially as it was collected in an interview, was  
249 not anonymous and the participants knew the study purpose. Thus some participants consciously or  
250 subconsciously may have provided answers they think the investigator wants, or to avoid being  
251 perceived by the interviewer as a bad owner of a stressed cat. This bias may also be responsible for  
252 the weak correlations between the number of recognized signs of stress and the level of stress as

253 assessed by the participating cat owners. Such weak correlation may be depend on other reasons,  
254 e.g. an overall good management of cats (feeding times, hiding places etc.) leading to few cases of  
255 very low welfare associated to a moderately good understanding of feline stress signals by  
256 interviewed owners. However, when assessing the welfare of cats, as well as during a behavioral  
257 consultation, veterinarians should aim to an accurate description of the cat's behavior and of the  
258 situation rather than just relying on the owners' evaluation.

259 Behavioral changes associated with stress can be very annoying for owners, especially if this  
260 involves aggression, compulsive disorders, urine marking (Amat et al., 2015; Skerrit & Jemmet,  
261 1980) or scratching the furniture (Mengoli et al., 2013). In contrast, stress often inhibits the  
262 performance of normal behaviors, so owners may not be aware of the discomfort being experienced  
263 by their cat (Amat et al., 2015).

264 Some of the signs that behaviorists regard as crucial in their anamnesis, such as scratching multiple  
265 items of furniture, freezing, mydriasis and recurrent cystitis, were the least recognized signs of  
266 stress in cat owners. Only prominent, common or potentially disturbing behaviors such as excessive  
267 vocalization, ears back and urinating out of the litter tray were regarded as potential signs of stress  
268 by more than 2 out of 3 owners. It is also remarkable that panting, trembling, avoiding other  
269 animals, and baldness caused by over-grooming were not signs of stress recognized by half of  
270 respondents (and other owners admitted that they did not know whether or not they were potential  
271 signs of stress). Signs of stress usually are not pathognomonic, so a specific behavior can be  
272 ambiguous, expressing different inner states (e.g. excitement or stress) or due to various physical  
273 causes; for example, overgrooming can be due to stress as well as to parasitism or environmental  
274 contamination (Mariti et al., 2015). Similarly, scratching the furniture can be normal, especially if  
275 the cat is not provided with a scratching post, or it can be a sign of stress when the behavior  
276 presents certain feature (sudden onset, involvement of multiple items etc.). However, this study  
277 showed that many cat owners did not know that such behaviors could also be indicative of stress.  
278 These findings suggest that owners often have a very limited knowledge about cat behavior, similar

279 to findings in dog owners by Mariti et al. (2012). This is likely to prevent owners from properly  
280 assessing and intervening in situations of poor welfare.

281 Behaviorists know that there is a strong link between welfare and behavioral problems, but this  
282 perspective does not seem to be shared by owners: the statistical analysis revealed that the presence  
283 of aggression and house soiling did not influence the owner's rating of stress level. Owners were  
284 instead more likely to rate stress as high if their cats played little or not at all, or if they showed  
285 over-grooming. Such findings are probably related to the preconceptions owners have of a cat's  
286 normal behavior; cats are regarded as playful, so when cats do not play it means there is a problem,  
287 whilst displaying aggression, even towards familiar people, is probably considered "normal" in cats  
288 and not possibly indicative of poor welfare. The hypothesis that an owner's ability to recognize  
289 behavioral signs of stress is related to their interpretation of cat ethology is corroborated by the  
290 results of the PCA. This indicates that certain owners attached more importance than others to  
291 socially-induced stress; some owners probably considered cats as non social animals and therefore  
292 considered the avoidance of other animals as normal and not stressful in domestic cats. It is not  
293 entirely surprising that the display of house soiling did not affect the rating of stress level, and that  
294 it represented a component on its own in the principal component analysis, as owners interpret this  
295 behavior in a number of ways, from being a prank to being a medical problem.

296 Notably, the percentage of people answering "I don't know" to questions was generally very high.  
297 This could be due to an inability to judge the cat's emotional state, but it could be due to other  
298 factors such as not having seen the cat in that situation.

299 Behaviorists believe that the stressors most commonly encountered by cats include changes in the  
300 environment (both physical and social changes), inter-cat conflict, a poor human-cat relationship,  
301 the cat's inability to perform highly motivated behavior patterns (e.g. a barren environment) (Amat  
302 et al., 2015), and lack of control and predictability (Carlstead et al., 1993). In the home  
303 environment, both changes in the husbandry routine and inconsistency in the owner's reaction to the  
304 cat's behavior may cause chronic stress (Amat et al., 2015). In the current study these factors were

305 recognized as potentially stressful by fewer than 40% of respondents, highlighting the importance  
306 of educating owners about what to do, and what to avoid doing, in order to optimize their cat's  
307 welfare.

308 It is not surprising that the situations considered by owners to be the most stressful were going to  
309 the veterinary clinic and travelling. In a recent study (Mariti et al., 2016a), it was found that cat  
310 welfare is impaired throughout all phases of a visit to the veterinary clinic, from leaving the house  
311 to returning back home, and it has a negative impact on the cat's response to all other experiences  
312 of transport. Considering its numerical importance and its negative impact on health assessment, the  
313 protection of cat welfare at the veterinary clinic is imperative for everybody involved in cat  
314 management and concerned with animal welfare. Although recent studies suggest that examinations  
315 at home are less stressful for cats (Nibblett et al., 2015), this is not always possible and it is not the  
316 only solution. There is in fact growing evidence that providing simple, standardized advice to kitten  
317 owners at the first veterinary check is effective in preventing welfare and behavioral problems in  
318 adult cats. This includes building the cat's tolerance to handling and the procedures that make up  
319 the veterinary examination (Gazzano et al., 2015). In addition, the behavior of veterinary surgeons  
320 can be addressed in order to minimize stress during the veterinary visit (Mariti et al., 2016a; Nuti et  
321 al., 2016).

322 An owner's ability to recognize behavioral signs of stress is important, as it enables the owner to  
323 help the animal to avoid stressful situations, and it favors a rapid recovery of psycho-physical  
324 homeostasis by interrupting the progression to overstress and distress. As already found in dogs  
325 (Mariti et al., 2012), our findings show that some owners already help in protecting the welfare of  
326 their pets, but that many owners would benefit from additional education to improve their ability to  
327 interpret their pets' behavior and to know where help is available. However, general veterinary  
328 practitioners may not be well versed in the assessment of pet welfare and behavior (e.g. for Portugal  
329 see Da Graça Pereira et al., 2014; and for Italy see Mariti et al., 2016b), so both they and pet owners

330 would benefit from further education provided by behaviorists (Gazzano et al., 2015; Mariti et al.,  
331 2016a).

332

### 333 **Conclusions**

334 The majority of cat owners know what the term stress means, but they often do not know how to  
335 recognize whether their cat is stressed and they tend to overlook certain signs. The understanding of  
336 potential signs of stress by cat owners seems to depend partially on the preconceptions that owners  
337 have about cat normal ethology. Though there were similarities found between dog and cat owners  
338 in the recognition of signs of stress, a difference did emerge. For dogs, the signs most frequently  
339 missed were the subtle behaviors, whilst for cats the unrecognized signs were those behaviors  
340 perceived by owners as normal for the species.

341

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345 September-3rd October 2015, Bristol (UK).

346 The idea for the article was conceived by C. Mariti and A. Gazzano. The experiments were  
347 designed by C. Mariti, C. Sighieri, S. Diverio and A. Gazzano. The experiments were performed by  
348 F. Guerrini and V. Vallini. The data were analyzed by C. Mariti and J.E. Bowen. The article was  
349 written by C. Mariti, A. Gazzano, J. Fatjò, and J.E. Bowen. All authors have approved the final  
350 article.

351

### 352 **Ethical considerations**

353 Under the requirements of the host institution this study did not require ethical approval. However,  
354 prior to data collection participants were briefed about the process and how data would be used and  
355 that no personally identifying data would be collected. Their written consent was obtained. On



356 reflection, a debriefing sheet should have been provided, advising participants of cat signs of stress  
357 and where to seek help if they were concerned about their cat's welfare. This would have provided a  
358 more robust ethical approach to the welfare of the human participants and their cats.

359

#### 360 **Conflict of interest**

361 We have read and understood this journal's policy on declaration of interests and declare that we  
362 have no competing interests.

363

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386 [domestici-i-pi%C3%B9-cari-amici-di-sempre](http://www.eurispes.eu/content/rapporto-italia-2014-capitolo-4-scheda-37-animali-domestici-i-pi%C3%B9-cari-amici-di-sempre).
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- 430
- 431

432 Table 1: the questionnaire used to interview cat owners.

433

Owner details	1) Age:..... 2) Gender: <input type="checkbox"/> male <input type="checkbox"/> female 3) Education: <input type="checkbox"/> degree <input type="checkbox"/> high school <input type="checkbox"/> middle school <input type="checkbox"/> other
Cat details	4) Name:..... 5) Age (in months): ..... 6) Breed:..... <input type="checkbox"/> domestic short or long hair cat 7) Age at adoption (in days): ..... 8) Sexual status: <input type="checkbox"/> entire male <input type="checkbox"/> neutered male <input type="checkbox"/> entire female <input type="checkbox"/> spayed female
Cat environment and management	9) How many people live in the same house where the cat live? 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> other ..... 10) Are there children in the household? <input type="checkbox"/> yes <input type="checkbox"/> no How old are the children? <input type="checkbox"/> 0-1 year old <input type="checkbox"/> 1.5-3 year old <input type="checkbox"/> 3.5-6 year old <input type="checkbox"/> 6.5-9.5 year old <input type="checkbox"/> 10-12 year old 11) Does the cat live with other animals? <input type="checkbox"/> yes <input type="checkbox"/> no a) If yes, which ones? <input type="checkbox"/> cats (n=...) <input type="checkbox"/> dogs (n=...) <input type="checkbox"/> other 12) Where does the cat live? <input type="checkbox"/> strictly indoors <input type="checkbox"/> indoors + outdoors <input type="checkbox"/> strictly outdoors 13) Has the cat a dedicated resting place? <input type="checkbox"/> yes <input type="checkbox"/> no 14) Can the cat access high places in the house (e.g. on the furniture) ? <input type="checkbox"/> yes <input type="checkbox"/> no 15) How many litter-trays are available to the cat/group of cats? <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> other ..... 16) Has the cat free access to food? <input type="checkbox"/> yes <input type="checkbox"/> no If no, how many times per day do you provide food to the cat? <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> other .....
Cat behavior	17) Does your cat play? <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> little 18) Has your cat displayed any aggressive behaviors? <input type="checkbox"/> yes <input type="checkbox"/> no If yes, what kind of behavior has the cat shown? <input type="checkbox"/> hissing <input type="checkbox"/> scratching <input type="checkbox"/> biting <input type="checkbox"/> other ..... 19) Does the cat defecate at home out of the litter-tray? <input type="checkbox"/> yes <input type="checkbox"/> no 20) Does the cat urinate at home out of the litter-tray? <input type="checkbox"/> yes <input type="checkbox"/> no 21) Does the cat show overgrooming? <input type="checkbox"/> yes <input type="checkbox"/> no

Perception of stress	<p>22) Do you ever notice that your cat is stressed? <input type="checkbox"/> yes <input type="checkbox"/> no</p> <p style="padding-left: 40px;">If yes, how do you understand that your cat is stressed? .....</p> <p>23) Are there any situations in which your cat is stressed?</p> <p style="text-align: center;"><input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> I don't know</p> <p style="padding-left: 40px;">If yes, in which situations is your cat stressed? .....</p> <p>24) Is your cat stressed in the following situations?</p> <ul style="list-style-type: none"> <li>✓ Visiting the veterinary clinic <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> I don't know <ul style="list-style-type: none"> <li>▪ If yes, how much is your cat stressed in this situation (1=not at all; 5= very much)? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> <li>✓ When a stranger enters the house <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> I don't know <ul style="list-style-type: none"> <li>▪ If yes, how much? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> <li>✓ In case of loud noises <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> I don't know <ul style="list-style-type: none"> <li>▪ If yes, how much? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> <li>✓ During a thunderstorm <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> I don't know <ul style="list-style-type: none"> <li>▪ If yes, how much? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> <li>✓ When travelling (e.g. by car) <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> I don't know <ul style="list-style-type: none"> <li>▪ If yes, how much? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> <li>✓ In a novel environment <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> I don't know <ul style="list-style-type: none"> <li>▪ If yes, how much? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> <li>✓ If kept in a limited space <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> I don't know <ul style="list-style-type: none"> <li>▪ If yes, how much? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> <li>✓ In contact with animals of other species <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> I don't know <ul style="list-style-type: none"> <li>▪ If yes, how much? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> <li>✓ In contact with other cats of the same sex <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> I don't know <ul style="list-style-type: none"> <li>▪ If yes, how much? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> <li>✓ In contact with other cats regardless of their sex <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> I don't know <ul style="list-style-type: none"> <li>▪ If yes, how much? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> <li>✓ When handled <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> I don't know <ul style="list-style-type: none"> <li>▪ If yes, how much? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> <li>✓ When furniture/decorations are modified <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> I don't know <ul style="list-style-type: none"> <li>▪ If yes, how much? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> <li>✓ If the cat is not allowed to go out when asking <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> I don't know <ul style="list-style-type: none"> <li>▪ If yes, how much? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> </ul> <p>25) In your opinion, which of the following are potential signs of stress in the domestic cat:</p> <ul style="list-style-type: none"> <li>✓ urinating in inappropriate places (out of the litter tray, e.g on the bed, sofa, carpet) <input type="checkbox"/> <ul style="list-style-type: none"> <li>yes <input type="checkbox"/> no <input type="checkbox"/> I don't know</li> <li>▪ If yes, how much stressed is a cat showing this sign (1=not at all; 5= very much)? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> <li>✓ defecating in inappropriate places (out of the litter tray, e.g on the bed, sofa, carpet) <input type="checkbox"/> <ul style="list-style-type: none"> <li>yes <input type="checkbox"/> no <input type="checkbox"/> I don't know</li> <li>▪ If yes, how much? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> <li>✓ trembling <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> I don't know <ul style="list-style-type: none"> <li>▪ If yes, how much? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> <li>✓ hypervocalizing <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> I don't know <ul style="list-style-type: none"> <li>▪ If yes, how much? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> <li>✓ recurrent cystitis <input type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> I don't know <ul style="list-style-type: none"> <li>▪ If yes, how much? <input type="checkbox"/>1 <input type="checkbox"/>2 <input type="checkbox"/>3 <input type="checkbox"/>4 <input type="checkbox"/>5</li> </ul> </li> </ul>
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- ✓ overgrooming to baldness  yes  no  I don't know
  - If yes, how much? 1 2 3 4 5
- ✓ not staying in the room with other animals  yes  no  I don't know
  - If yes, how much? 1 2 3 4 5
- ✓ showing dilated pupils (mydriasis)  yes  no  I don't know
  - If yes, how much? 1 2 3 4 5
- ✓ not eating in the presence of other animals  yes  no  I don't know
  - If yes, how much? 1 2 3 4 5
- ✓ scratching the furniture  yes  no  I don't know
  - If yes, how much? 1 2 3 4 5
- ✓ showing ears back  yes  no  I don't know
  - If yes, how much? 1 2 3 4 5
- ✓ having the tail close to the body  yes  no  I don't know
  - If yes, how much? 1 2 3 4 5
- ✓ panting  yes  no  I don't know
  - If yes, how much? 1 2 3 4 5
- ✓ aggressive when scolded  yes  no  I don't know
  - If yes, how much? 1 2 3 4 5
- ✓ staying alone/hiding  yes  no  I don't know
  - If yes, how much? 1 2 3 4 5
- ✓ freezing  yes  no  I don't know
  - If yes, how much? 1 2 3 4 5

26) Which definition of stress you believe is the most correct?

stress is a short or long alteration of the physical balance of the cat

stress is a short or long alteration of the psychological balance of the cat

stress is a short alteration of the psycho-physical balance without consequences on the cat

stress is a short or long alteration of the psycho-physical balance that can lead to health problems in the cat

27) Which is the level of stress in your own cat?

high (the cat is often stressed)

medium (the cat is stressed only in specific situations)

low (the cat is seldom stressed)

436 Table 2: Results of the Principal Component Analysis on the 1-5 score to the possible signs of  
 437 feline stress.

	Component			
	1	2	3	4
Ears back	0.775 <sup>1</sup>	0.173	0.112	0.118
Tail close to body	0.766 <sup>1</sup>	0.124	0.254	
Mydriasis	0.709 <sup>1</sup>	0.299		
Panting	0.609 <sup>1</sup>	0.101	0.267	0.353
Trembling	0.438 <sup>1</sup>		0.303	0.283
Not staying in a room with other animals	0.275	0.725 <sup>2</sup>	0.279	0.150
Aggressive when scolded	0.193	0.699 <sup>2</sup>		
Not eating in the presence of other animals	0.167	0.628 <sup>2</sup>	0.323	
Stay alone/hiding	0.139	0.582 <sup>2</sup>		
Faeces in inappropriate place	0.143	0.230	0.894 <sup>3</sup>	0.149
Urine in inappropriate place	0.183	0.204	0.889 <sup>3</sup>	0.151
Scratching the furniture		0.401		-0.704 <sup>4</sup>
Recurrent cystitis		0.468	0.172	0.677 <sup>4</sup>
Overgrooming to baldness	0.230	0.237	0.421	0.624 <sup>4</sup>
Hypervocalizing	0.364	0.264		0.435 <sup>4</sup>
Freezing	0.320	0.352		0.427 <sup>4</sup>

438 <sup>1</sup>=Component 1, named "body posture"; <sup>2</sup>= Component 2, named "social avoidance"; <sup>3</sup>=  
 439 Component 3, named "housesoiling"; <sup>4</sup>= Component 4, named "self-directed behavior"

440

441 Fig. 1: Percentages of owners who answered “yes”, “no” or “I don’t know” to the item “Is this  
442 situation stressful for your cat?”.

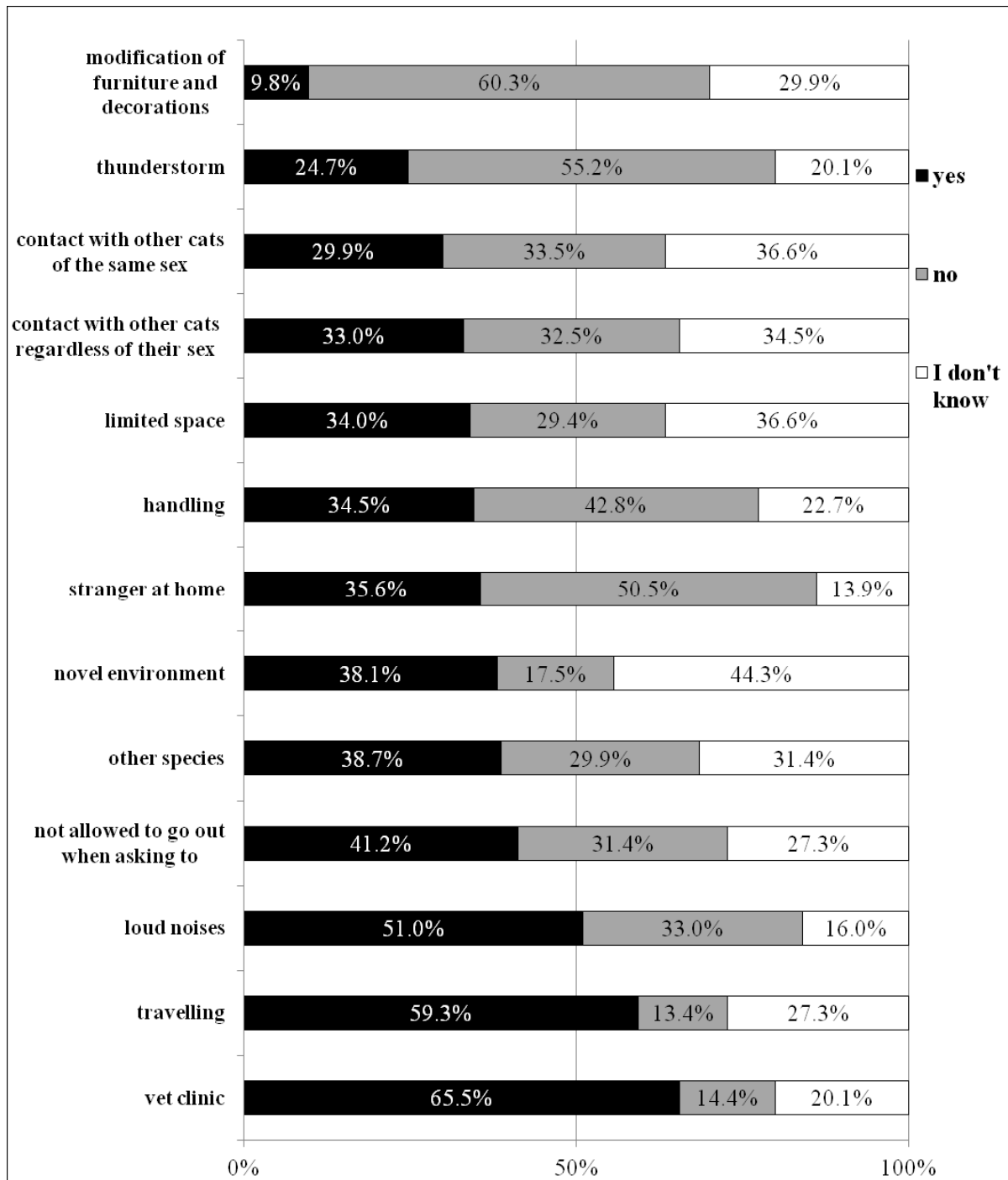
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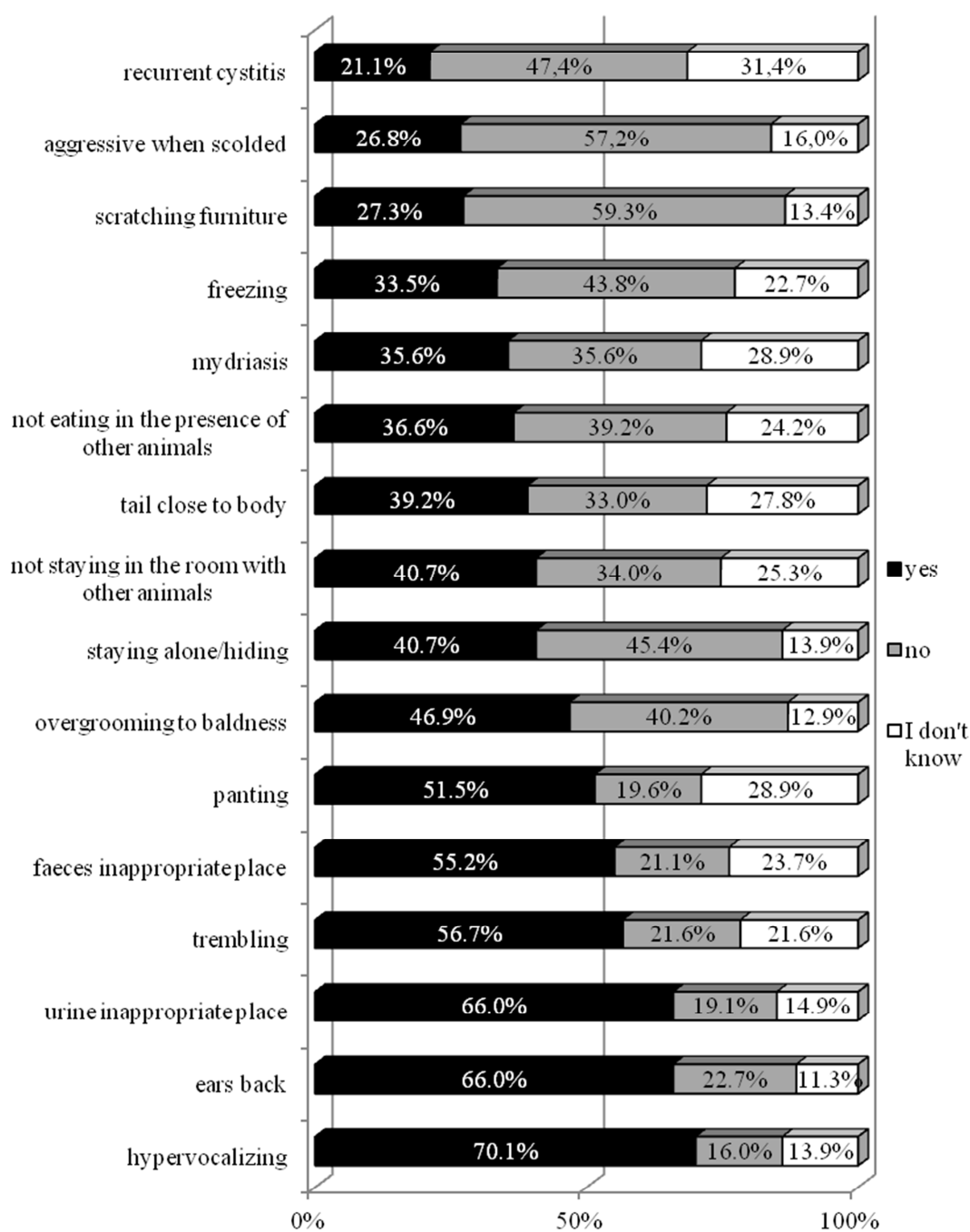
444 Fig. 2: Percentages of owners who answered “yes”, “no” or “I don’t know” to the item “Is this a  
445 possible sign of stress in domestic cats?”.

446

ACCEPTED MANUSCRIPT







**Highlights**

- Owner perceptions of their pet cat's welfare has been quite neglected in research
- One-hundred-ninety four owners were interviewed about the welfare of their cats
- Owners tend to overlook certain signs of stress regarded as crucial by behaviorists
- The preconceptions owners have about cat normal ethology affects the recognition of stress