

## Manuscript Details

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### Abstract

This paper was designed to assess the effect of puppies and juvenile dogs' attendance at puppy classes on the behavior of the dogs at their adult age. For this purpose, 80 dogs, (32 of which had attended puppy classes and the other 48 had not) were evaluated using the C-BARQ that was filled out by owners one year after the completion of the puppy training. Those dogs that attended classes were categorized as puppies ( $\leq 3$  months) ( $n=15$ ), and juveniles ( $>3$  months) ( $n=17$ ). Ordinal regression models were used to estimate the influence of puppy classes on the different behavioral traits assessed by the C-BARQ. The results indicated that both puppies and juveniles that have attended classes had more favorable scores for family-dog aggression, trainability, non-social fear and touch sensitivity. The study showed that attending puppy class may be important for socialization with other puppies and people which could have an association with the dog's long-term behavior.

**Keywords** dogs, puppy classes, C-BARQ, ordinal regression, behavior problems

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- Effects of puppy classes on adulthood behavior of dogs were assessed
- 80 dogs (32 of which attended puppy classes and 48 did not) were evaluated
- Classes were related to family-dog aggression and non-social fear
- In addition were related to trainability, excitability and touch sensitivity
- Classes were important for social exposure and had an effect on the long-term behavior

1           **Association between puppy classes and adulthood behavior of the dog**

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15          (A. González-Martínez)

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22 **Abstract**

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24 attendance at puppy classes on the behavior of the dogs at their adult age. For this purpose,  
25 80 dogs, (32 of which had attended puppy classes and the other 48 had not) were evaluated  
26 using the C-BARQ that was filled out by owners one year after the completion of the  
27 puppy training. Those dogs that attended classes were categorized as puppies ( $\leq 3$  months)  
28 ( $n=15$ ), and juveniles ( $>3$  months) ( $n=17$ ). Ordinal regression models were used to  
29 estimate the influence of puppy classes on the different behavioral traits assessed by the  
30 C-BARQ. The results indicated that both puppies and juveniles that have attended classes  
31 had more favorable scores for family-dog aggression, trainability, non-social fear and  
32 touch sensitivity. The study showed that attending puppy class may be important for  
33 ~~socialization with other puppies and people~~ social exposure with other puppies and people  
34 which could have an association with the dog's long-term behavior.

35 *Key words:* dogs, puppy classes, C-BARQ, ordinal regression, behavior problems

36

## 37 4. Introduction

38 Undesirable behavior, including normal canine behaviors that are undesirable to owners  
39 and abnormal behaviors, is a common problem in the domestic dog population. Behavior  
40 problems constitute a risk factor for relinquishment of dogs to an animal shelter and  
41 subsequent euthanasia (Patronek et al., 1996); also, some behavior-related pathologies,  
42 such as separation anxiety, present a state of compromised welfare for the dogs  
43 experiencing it (Horwitz, 2002). Previously published data showed great variation in  
44 terms of the prevalence of behavioral problems, but it has been estimated that between  
45 40% and 87% of dogs might exhibit some of these conditions (Voith, 1985, Campbell,  
46 1986, Gonzalez et al., 2011).

47 Many dog owners are not aware of normal puppy or adult dog behavior, what can be  
48 expected when raising them, and how to deal with any potential problems that may arise  
49 (Landsberg et al., 2013, Gazzano et al., 2008). Both genetic and environmental factors  
50 influence behavioral development (Scott and Fuller, 1965). Several studies highlight the  
51 importance of the socialization period (Fox, 1978) and poor or inadequate training effects  
52 in the appearance of behavior problems (Blackwell et al., 2008, Herron et al., 2009).  
53 Therefore, the exertion of an appropriate handling of social and environmental exposures  
54 during the initial stages of their physical and psychological growth may help decrease the  
55 appearance of behavioral issues during an animal's adulthood.

56 A puppy's early environment may have a profound effect on its future behavior.  
57 Appropriate socialization and habituation during the early weeks of life is essential for  
58 the lifelong well-being of dogs (Sforzini et al., 2009). The socialization period often  
59 described in dogs is the “sensitive” phase occurring between approximately 3 and 13  
60 weeks of age, although it can vary slightly for different breeds and individuals (Serpell  
61 and Jagoe, 1995). During this period, dogs can form relationships with members of  
62 various species, as well as their own. It is also a time when the puppy begins to become  
63 familiar with animals and humans and they develop social skills and become less reactive  
64 to novel stimuli (Scott, 1962). So, an undersocialized-under-exposed puppy may become  
65 increasingly fearful of novel situations and people (Serpell and Jaoc, 1995; Landsberg,  
66 2013).

67 Since the socialization of young dogs has such a remarkable influence on subsequent  
68 adult behavior patterns, it is important for the dog owner and the veterinarian to be  
69 familiar with the normal process. Various studies have shown that increased social  
70 contact with humans and training improve welfare as predictability and control over the  
71 environment increased through consistent interactions with people and training (Wells,  
72 2004; Coppola et al., 2006; Luescher, 2008, Battaglia, 2009).

73 Proper socialization combined with positive reinforcement-based training in the context  
74 of a group puppy class (PC) could help puppies grow into well-adjusted pets. Classes  
75 provide critical socialization time with a variety of people and other puppies. Studies  
76 clearly demonstrate that when owners invest in training classes, they are much more likely  
77 to keep their pets (Duxbury et al., 2003).

78 The aim of the present study was to assess the effect of puppies' attendance in PC  
79 programs on the behavior of the dogs in their adult age (as measured by the C-BARQ  
80 questionnaire)

81

## 82 **2. Materials and methods**

### 83 **2.1. Animals surveyed**

84 The study was carried out at the Veterinary Teaching Hospital "Rof Codina" (VTHRC)  
85 (Veterinary Faculty of Lugo), which is the referral center for the veterinary clinics in  
86 Northwest Spain.

87 It included 80 puppies, born between 2012-2014, 32 of which attended PC. The remaining  
88 48 were dogs born in the same period but did not attend classes and whose owners  
89 submitted the complete questionnaire for behavioral evaluation in addition to some other  
90 general data also required. These were recruited through social networks or e-mail and  
91 they were not given any information about behavior by VTHRC.

92

### 93 **2.2. Puppy classes**

94 The PC, carried out in the VTHRC, were devised for dogs between 2 and 9 months. Two  
95 groups of dogs were considered depending on the age at which they started the classes:

96 puppies (dogs  $\leq$  3 months) and juveniles (dogs older than 3 months). In any case, the age  
97 difference between dogs in each PC never exceeded one month.

98 Classes never exceeded the number of 5 dogs and they were matched according to age  
99 (as mentioned) and size. The classes took place during 6 consecutive weeks, 1 hour per  
100 week on the same day each week.

101 The classes were conducted by the veterinary behaviorist responsible for the Clinical  
102 Ethology services of the VTHRC. Also, some volunteer faculty students took part in the  
103 sessions under the supervision of the veterinary behaviorist referred to above. All the  
104 sessions were run according to the following pattern:

105 1) Game: It started with about 15 minutes of supervised play session, while, some advice  
106 about positive training, housetraining, canine behavior, canine social communication, and  
107 prevention of behavior problems were given to the owners. The number of puppies that  
108 participated at the same time in the play session were variable (2 to 4) depending on how  
109 they played together. Also, before the game session, all dogs arrived on lead and greeted  
110 each other by pairs also on lead. Puppies were let off only when owners were instructed  
111 to do so.

112 2) Positive training: Short training sessions. The exact length of each session was set  
113 according to the dog's ability to concentrate. Dogs were taught using food lure training  
114 to sit, lay down, stay, recall on command, and walk without pulling on leash. Food lure  
115 training is an easy, nonforce-free method for teaching obedience commands that  
116 involves the use of small bits of food for training lures and reinforcements (Landsberg et  
117 al., 2013).

118 3) Rest: There was a recess after the positive training session during which, if possible,  
119 the outside area was available for individual dogs to defecate or urinate if they wished.  
120 This contributed to more hygienic behavior during the sessions.

121 4) Interaction with people and handling: The interaction was based on a positive  
122 habituation of the puppies to the people through the use of positive reinforcement. During  
123 the first sessions, volunteers rewarded the dogs when they approached them and while  
124 they petted them gently. In addition, in advanced sessions, more invasive manipulation  
125 was carried out such as abdominal palpation and examination of the ears/ extremities,

126 always avoiding the dogs becoming uncomfortable with the procedure. Discomfort was  
127 recognized when the dogs showed stress signs (i.e. licking of the lips, panting, yawning),  
128 avoided interactions or did not eat treats. At the end of the program, the attending  
129 volunteers wore different clothing (gowns, helmets, hats, veterinary pajamas, also carried  
130 walking sticks, etc.). In this regard it was interesting to rely on a variety of people in terms  
131 of conformation, gender and age.

132 5) Game: The sessions finished with a few minutes of controlled play among the puppies  
133 where all puppies were let off lead at the same time.

### 134 ~~2.3.~~ *Behavior assessment and data collection*

135

136 Behavioral information about the dogs was obtained by means of the Canine behavioral  
137 Assessment and Research Questionnaire (C-BARQ), a validated questionnaire developed  
138 by Hsu and Serpell (Hsu and Serpell, 2003) that was administered one year after the  
139 completion of the PC.

140 This questionnaire consists of 100 questions describing the different ways in which dogs  
141 typically respond to common events, situations, and stimuli in their environment. These  
142 are finally grouped into 14 behavioral traits: stranger-directed aggression, owner-directed  
143 aggression, dog-directed aggression, dog-directed fear, familiar dog aggression,  
144 trainability, chasing, stranger-directed fear, nonsocial fear, separation-related problems,  
145 touch sensitivity, attachment/attention seeking, excitability and energy (Table 1). All  
146 these traits are expressed on a 0 to 4 scale in which 0 indicated no sign of such behavior  
147 and 4 indicated a severe form of the behavior.

148 Along with the C-BARQ questionnaire, the following data were collected: morphotype  
149 (small: <15 kg, medium: 15-30 kg, large: >30 kg), age, sex, age at the time and place of  
150 acquisition, entire or neutered (if neutered the age of neutering and the reason for  
151 neutering), dog activity pattern (we inquired whether the dog performs some other activity  
152 such as agility, dog jogging, dog trekking, dog biking, mushing or other), number of dogs  
153 that the owner had previously owned, and two more questions were added to C-BARQ:  
154 if the dog had attended PC and in the case that a dog had attended PC, the age at starting.  
155 The descriptive statistics for these variables are presented in Table 2.

156

### 157 ~~2.3.~~ *Statistical analysis*

158

159 Ordinal regression models were used to estimate the influence of PC on the response  
160 variable: C-BARQ score for the different traits. Besides, the following explanatory  
161 variables were considered in the models: morphotype, age, gender, age at the time and  
162 place of acquisition, entire or neutered (if neutered the age of neutering and the reason  
163 for neutering), dog activity pattern (if the dog perform some exceptional activity or not),  
164 number of dogs that owner had previously owned, and in the case that a dog had attended  
165 PC, the age at starting PC. The interaction terms between neutered and neutered at  $\leq 6$   
166 months and between attending PC and attending at  $\leq 3$  months (approximately when  
167 socialization period finished) were also included; these variables had the value 1 if the  
168 dogs attended classes or were castrated before the age mentioned and 0 in any other case.

169 One model was performed for each of the following C-BARQ traits: stranger-directed  
170 aggression, owner-directed aggression, dog-directed aggression, dog-directed fear,  
171 familiar dog aggression, trainability, chasing, stranger-directed fear, nonsocial fear,  
172 separation related problems, touch sensitivity, attachment/attention seeking, excitability  
173 and energy.

174 For the study, scores obtained on each of the traits were divided into five categories:

175 0: C-BARQ score = 0

176 1: C-BARQ score >0 to 1

177 2: C-BARQ score >1 to 2

178 3: C-BARQ score >2 to 3

179 4: C-BARQ score >3 to 4

180 Therefore, the following odds were modeled:

181 - C-BARQ score 0,1,2,3 vs 4

182 - C-BARQ score 0,1,2 vs 3, 4

183 - C-BARQ score 0,1 vs 2,3, 4

184 - C-BARQ score 0 vs 1,2,3, 4

185 The ordinal regression model provides the odds ratios that indicate the odds of being in  
186 the higher levels of the C-BARQ score (relative to being in or below a given score). In

187 addition, for the models, when a variable changed the effect of the remaining coefficients  
188 by 10% or more it was considered a confounder and stayed in the model, regardless of its  
189 level of significance.

190 The parallel line test was used to assess the hypothesis of proportionality. Ordered logistic  
191 regression assumes that the coefficients that describe the relationship between the lowest  
192 versus the higher categories of the response variable are the same as those that describe  
193 the relationship between the next lowest category and all the higher categories.

### 194 **3. Results**

195 Descriptive statistics (mean and median) obtained in the studied population for the traits  
196 considered in the C-BARQ are presented in Table 3.

197 According to the regression models, no relationship was found between attending PC and  
198 stranger-directed aggression, owner-directed aggression, dog-directed aggression, dog-  
199 directed fear, separation-related problems, chasing, stranger-directed fear,  
200 attachment/attention seeking or energy.

201 With regard to familiar dog aggression, the regression model indicated that the number  
202 of dogs that did not attend classes achieving a higher C-BARQ score was approximately  
203 2.6 times higher than the number of dogs that had attended ( $p=0.040$ ). Higher scores were  
204 also achieved by not neutered dogs in comparison to neutered (3.3 times higher,  $p=0.010$ )  
205 (Table 4). The other variables considered, all of which were not significant, were  
206 excluded from the model; the same procedure was followed in subsequent models.

207 Ordinal regression also indicated that the odds of dogs attending PC having a higher score  
208 on trainability is 3.0 times higher than the odds of dogs not attending ( $p=0.022$ ) (Table  
209 4). In this model, for the analysis the values of the predictor variable were inverted to  
210 facilitate interpretation.

211 Not attending PC also increased (by 2.8 times,  $p=0.025$ ) the odds of having a higher score  
212 regarding non-social fear. Classes were also related to “touch sensitivity”. Not attending  
213 classes increased the odds of being in a higher level of the C-BARQ score by a factor of  
214 3.1 ( $p=0.017$ ) (Table 4).

215 Finally, regression showed that PC were not related to excitability. However, the  
216 interaction term between attending PC and attending at  $\leq 3$  months was significant

217 indicating that attending classes before this age has a protective effect (OR=5.7, p=0.053);  
218 although the influence was not significant, it was very close to the margin of statistical  
219 significance. Similarly, the variable age at acquisition remained in the model because its  
220 exclusion modifies significantly the other model coefficients. A higher age at the time of  
221 acquisition (expressed in months) was associated with an increase in the odds of having  
222 higher scores for excitability, with an odds ratio of 1.3, p =0.062 (Table 4).

223 For all the models the parallel lines test was not a significant indication that the  
224 proportional odds assumption holds.

225

#### 226 4. Discussion

227 The primary aim of this study was to determine the effect of PC on the appearance of  
228 behavioral problems in adult dogs by administering CBARQ questionnaire one year after  
229 the completion of the PC.

230 There are few studies that have used validated tools in adult dogs that previously had  
231 attended PC. Previous to our research, only Kutsumi et al. (2015) had a standardized  
232 assessment tool like ~~used~~ the CBARQ questionnaire in such studies. ~~Therefore,~~ there are  
233 a lot of many differences between PC research methodology including tools used in the  
234 behavioral problems' diagnosis, the protocol to perform PC, population and the  
235 parameters measured. Due to the fact that the differences between PC studies are  
236 considerable, the discussion of results of PC research must be ~~taken carefully~~ considered  
237 (Howell et al., 2015).

238 ~~Even though the CBARQ is a validated questionnaire, a~~ possible limitation of the study  
239 may be that the survey was distributed on-line. ~~Therefore,~~ the dogs were not assessed by  
240 a veterinary behaviorist and medical problems couldn't be ruled out.

241 As shown in other studies, The same as in other studies, better performance in trainability  
242 was shown in dogs that attended PC (Seksell, 1998; Kutsumi et al., 2012). During the  
243 training sessions, the dogs' owners were instructed ~~on the consequences about the risks~~  
244 of the use of punishment, confrontational methods, choke collars and negative  
245 reinforcement. Consequently, the welfare of these dogs was less likely to be negatively  
246 affected, and similarly, the bond between owner and dog was strengthened (Schilder and  
247 van der Borg, 2003; Blackwell et al., 2008; Herron et al., 2009; Grohmann et al., 2013;

248 Deldalle et al., 2014). ~~TA~~Also, the attendance at puppy socialization classes ~~was~~has been  
249 related to a higher retention at home (Duxbury et al., 2003) as it facilitates dog-owner  
250 coexistence. Better education of the pet provides the owner with the necessary tools to  
251 control excitability and other aspects of poor behavior. In fact, this study has shown that  
252 the puppies under the age of three months that attend classes tend to be less excitable  
253 (although the difference was not significant at the 0.05 level, was close to the margin of  
254 statistical significance) and therefore problems of dog-owner coexistence are reduced. In  
255 addition, information given to the owners was important to avoid a lack of understanding  
256 of what the owners are trying to communicate, inconsistencies in how the family responds  
257 to the pet's behavior, inconsistencies in training, and the use of punishment that can lead  
258 to conflict, increasing anxiety, and uncertainty in the dog (Landsberg et al., 2013). A  
259 previous study also showed that counseling owners at the time of pet acquisition may thus  
260 have beneficial effects in the prevention of inappropriate behaviors (Herron et al., 2007).  
261 Other studies (Arhant et al., 2010) showed that a more frequent use of punishment was  
262 associated with increased aggression and excitability.

263 Contrary to previous research, this study found not only differences between groups for  
264 trainability (Seksel et al., 1998; Batt et al., 2008) but also for touch sensitivity, that is  
265 diminished in PC dogs, probably in relation with handling sessions. It could be very  
266 beneficial for the veterinary staff because these dogs are more likely to be willing to be  
267 handled or physically examined and feel lower stress in clinical sessions.

268 This study showed that dogs that attended PC were less likely to show nonsocial fear.  
269 This could be related to positive interactions that dogs had during classes (with different  
270 stimuli and gradual exposure to them), the recommendations given to the owners on how  
271 to socialize the pet, and even the journey to the place where the classes take place (that  
272 already implies a moderate exposure to external stimuli). In addition, it should be noted  
273 that non-social fear has a high prevalence in the studied area (González et al., 2011),  
274 which makes prevention even more important. A previous study also suggested the  
275 importance of early environment, as well as the time of acquisition, and the exposure to  
276 particular noises acting as risk factors for specific noise fears (Blackwell et al., 2013).

277 Interestingly, PC dogs showed less interdog family aggression than the other dogs. This  
278 could be influenced by the acquisition of better social skills in the PC. Maybe the  
279 controlled play between dogs could be helpful in the acquisition of such skills.

280 Furthermore, the advice given to the owners about social behavior and avoidance of  
281 punishment could be useful to avoid aggression between dogs. Fox and Stelzner (1967)  
282 compared groups of puppies with different lengths of isolation from littermates. Puppies  
283 that were hand raised and had no contact with other puppies until 12 weeks of age showed  
284 the greatest deficit in social behavior and reactions to conspecifics. The hand-reared  
285 puppies showed little oral manipulation and they were non-vocal, non-aggressive, and  
286 passive with peers, but quickly became aggressive, by 15 weeks of age, toward their peers  
287 following their introduction and rarely engaged in group play. Another study examining  
288 canine aggression by Roll and Unshelm (1997) found that 44% of dog-aggressive dogs  
289 had zero to minimal socialization to conspecifics from 5 to 20 weeks of age, which agrees  
290 with Fox and Stelzner (1967) findings. Our study indicates PC as a good way to offer  
291 social interactions between dogs.

292 Scott and Fuller (1965) defined the length of the socialization period as between 3 and 12  
293 weeks from the results of a study on complete isolation in laboratory animals. Previous  
294 studies have indicated that a dog's experience during the socialization period has a strong  
295 influence on future behavioral development (Freedman et al., 1961; Scott and Fuller,  
296 1965; Serpell and Jagoe, 1995; Appleby et al., 2002). However, as other studies claimed,  
297 contact with people after the socialization period was still effective (Kutsumi et al., 2012).  
298 In this study puppy and juvenile animals (older than three months) were included and  
299 preventive effects were shown for both groups, so PC could be useful for juvenile dogs  
300 and puppies and interestingly the contact with other dogs could also be effective after the  
301 socialization period. It would be important not only to offer classes to puppies but to  
302 include juvenile classes for education centers and veterinary hospitals and clinics.

303 Neutering may affect a variety of behaviors, but results of neutering studies have been  
304 ~~somewhat varied and~~ conflicting (Landsberg et al., 2013). Entire males could have an  
305 increased probability of being aggressive than neutered dogs; conversely, aggressiveness  
306 was observed more often in spayed females (Borchelt, 1983; Wright and Nesselrote,  
307 1987; Wright 1991). Guy et al. (2001) indicated that both neutered males and spayed  
308 females showed a positive association with a higher probability of aggression. However,  
309 Blackshaw (1991) found that entire males and females were more aggressive than  
310 neutered males and spayed females. Sexually intact dogs were less likely to have  
311 separation anxiety as compared with neutered dogs (Flannigan and Dodman, 2001;  
312 Takeuchi et al., 2001). ~~Another previous study showed that~~ dogs gonadectomized at ≤

313 6 months of age had significantly increased odds of developing fear of storms, separation  
314 anxiety, fear of noises, fear of gunfire, timidity, excitability, submissive urination,  
315 aggression, hyperactivity, and fear biting (Zink et al., 2014). ~~Nevertheless, in the present~~  
316 ~~paper~~In this study, castration only showed a preventive effect for aggression towards dogs  
317 of the same household.

318

319 Earlier research also revealed that males have higher risk for behavioral problems than  
320 females (Wright and Nesselrote, 1987; Landsberg, 1991; Hsu and Serpell, 2003). Males  
321 were more likely to score above the median on owner-direct aggression and may mark,  
322 mount, masturbate and display aggression toward other male dogs (Patronek et al., 1996;  
323 Landsberg et al., 2013; González et al., 2011). However, sex was not found to be related  
324 to any factor risks in this study.

325 Nevertheless, unlike other studies, no positive effect of PC on responses to stranger dogs  
326 (Kutsumi et al., 2012; Casey et al., 2014) or people (Blackwell et al., 2008) was found in  
327 the present paper. As other authors suggest, it is possible that most pet dogs are raised in  
328 enriching environments that provide adequate socialization for unfamiliar people and  
329 dogs without the need for special classes (Howell et al., 2015).

330 Behavioral problems are risk factors for relinquishment of dogs to an animal shelter  
331 (Patronek et al., 1996). Interestingly, because differences between dogs purchased or  
332 adopted from an Animal Shelter were found, PC could be an important tool to prevent  
333 behavioral problems in shelter puppies.

## 334 ~~5.~~ **Conclusion**

335 According to the data obtained from dog owners, PC may help prevent canine behavioral  
336 problems as it reduced familiar-dog aggression, non-social fear and touch sensitivity  
337 related problems as well as improved trainability (as reflected in the C-BARQ).  
338 Regardless of the benefits obtained from puppy classes, differences in methodology  
339 throughout classes and variations in procedures to assess behavior patterns might hinder  
340 the extrapolation of the results detailed in the present paper to other studies in the same  
341 field.

342

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345

#### 346 **Conflict of interest**

347 The authors declare no conflicts of interest

348

#### 349 **Ethical statement**

350 Dogs were treated according to European and Spanish legislation on animal protection  
351 (Directive 86/609/EEC, Real Decreto 1201/2005)

352

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476 **Table 1**

477 Behavioral traits included in the C-BARQ questionnaire, including their definitions.

Behavioral traits	Definition
Stranger-directed aggression	Dog shows threatening or aggressive responses to strangers approaching or invading the dog's or the owner's personal space, territory, or home range
Owner-directed aggression	Dog shows threatening or aggressive responses to the owner or other members of the household when challenged, manhandled, stared at, stepped over, or when approached while in possession of food or objects.
Dog-directed aggression	Dog shows threatening or aggressive responses when approached directly by unfamiliar dogs
Dog-directed fear	Dog shows fearful or wary responses when approached directly by unfamiliar dogs
Familiar dog aggression	Dog shows aggressive or threatening responses to other familiar dogs in the same household.
Trainability	Dog shows a willingness to attend to the owner and obey simple commands. Dog is not easily distracted, tends to be a fast learner, responds positively to correction, and will fetch or retrieve objects
Chasing	Dog chases cats, birds, and/or other small animals, given the opportunity
Stranger-directed fear	Dog shows fearful or wary responses when approached directly by strangers.
Nonsocial fear	Dog shows fearful or wary responses to sudden or loud noises, traffic, and unfamiliar objects and situations
Separation-related problems	Dog vocalizes and/or is destructive when separated from the owner, often accompanied or preceded by behavioral and autonomic signs of anxiety
Attachment/attention seeking	Dog maintains close proximity to the owner or other members of the household, solicits affection or attention, and displays agitation when the owner gives attention to third parties
Excitability	Dog displays strong reaction to potentially exciting or arousing events, such as going for walks or car trips, doorbells; has difficulty calming down after such events
Energy	Dog is energetic, "always on the go", and/or playful
Touch sensitivity	Dog shows fearful or wary responses to potentially painful or uncomfortable procedures, including bathing, grooming, nail-clipping, and veterinary examinations.

478 Modified from Hsu and Serpell (2003) and Duffy and Serpell (2012)

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480 **Table 2**

481 Descriptive analysis of the studied dog population

Variable		Descriptives		
PC	Yes	32 (40%)	Before 3 months of age	15 (46.9%)
			After 3 months of age	17 (53.1%)
<del>Morphotype</del> Size	No	48 (60%)		
	Small	23 (28.8%)		
	Medium	37 (46.2%)		
Gender	Large	20 (25%)		
	Male	42 (52.5%)		
	Female	38 (47.5%)		
Mean age at acquisition (months)		3.48 (S.D. = 2.6)		
Place of acquisition	Shelter	40 (50%)		
	Other	40 (50%)		
<del>N</del> eutered	Yes	45 (43.8%)	Due to a behaviour problem	7 (15.5%)
			Other reason	38 (84.5%)
			Before 6 months of age	12 (26.7%)
			After 6 months of age	33 (73.3%)
Activity pattern	No	35 (56.3%)		
	No activity	65 (81.3%)		
	Agility/bike/march	11 (13.7%)		
Dogs previously owned	Other	4 (5%)		
	None	24 (30.0%)		
	One or more	56 (70.0%)		

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491 **Table 3**

492 Mean (with 95% confidence interval) and median scores obtained in the studied  
493 population for the different traits considered in C-BARQ

C-BARQ traits	Mean (95% confidence interval)	Median
Stranger-directed aggression	0.35 (0.24-0.46)	0.20
Owner-directed aggression	0.18 (0.09-0.27)	0.00
Dog-directed aggression	0.71 (0.52-0.89)	0.50
Familiar dog aggression	0.50 (0.32-0.67)	0.00
Separation related problems	0.60 (0.48-0.72)	0.50
Trainability	2.79 (2.67-2.90)	2.88
Chasing	1.32 (1.06-1.57)	1.29
Stranger-directed fear	0.48 (0.30-0.67)	0.00
Dog-directed fear	0.52 (0.36-0.67)	0.25
Nonsocial fear	0.73 (0.59-0.87)	0.67
Touch sensitivity	0.54 (0.40-0.68)	0.29
Attachment/attention seeking	2.11 (1.93-2.30)	2.17
Excitability	1.83 (1.66-2.02)	1.75
Energy	2.84 (2.58-3.09)	3.00

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**Table 4**

Results of an ordinal regression model for the effect of attending PC on behavioral traits (as measured by the C-BARQ questionnaire)

Variables	Familiar dog aggression		Trainability		Non-social fear		Touch sensitivity		Excitability	
	Coefficient (95% CI)	p-value	Coefficient (95% CI)	p-value	Coefficient (95% CI)	p-value	Coefficient (95% CI)	p-value	Coefficient (95% CI)	p-value
PC	2.6 (1.1-6.4)	0.040	3.0 (1.2-7.7)	0.022	2.8 (1.1-7.3)	0.025	3.1 (1.2-7.7)	0.017	3.1 (0.8-12.6)	0.112
Neutered	3.3 (1.3-8.1)	0.010	-	-	-	-	-	-	-	-
Age acquisition (months)	-	-	-	-	-	-	-	-	1.3 (0.9-1.7)	0.062
PC x PC $\leq$ 3 months	-	-	-	-	-	-	-	-	3.7 (0.9-12.9)	0.053

Dogs were treated according to European and Spanish legislation on animal protection  
(Directive 86/609/EEC, Real Decreto 1201/2005)