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1 **Behavior Traits Associated with Career Outcome in a Prison Puppy-Raising Program**

2

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30 Abstract

31 The Canine Behavioral Assessment and Research Questionnaire (C-BARQ©) (<http://www.cbarq.org>)
32 has been used to measure behaviors associated with release or graduation from several assistance dog
33 programs, however it has never been evaluated within a prison environment. This study investigated
34 whether a modified version of the C-BARQ© can be utilized in a prison puppy-raising program
35 (Puppies Behind Bars, PBB) to identify behaviors that are associated with dogs' career outcomes.
36 PBB dogs that successfully complete the program are placed as service dogs or explosives detection
37 dogs (EDD). Dogs are released from the program as a result of behavioral or medical problems. The
38 PBB program has more than one career outcome, facilitating an assessment of the C-BARQ© as a
39 tool to identify specific working dog roles based on differences in C-BARQ© subscale scores. We
40 examined the associations between subscale scores and career outcomes by comparing the scores of
41 dogs with successful outcomes (service or EDD) with those released for behavioral reasons. We
42 assessed the questionnaire's application to the PBB setting and its ability to distinguish between
43 outcomes. 314 paper copies of the C-BARQ© were completed by puppy raisers from seven
44 correctional facilities in the New York area when their assigned dog was between 6 and 16 months
45 old. Dogs that had successfully completed the PBB program or had been released due to behavioral
46 issues were included, whereas dogs still in training and those released for medical reasons were
47 excluded. A total of 271 completed C-BARQ© questionnaires were analyzed. Service dogs and EDDs
48 were compared with released dogs to determine whether C-BARQ© subscale scores were associated
49 with outcome. Multinomial log-linear models containing one subscale score and fixed factors (age
50 group, medical category, sex, neuter status within sex, the interaction between age group and medical
51 category) and outcome as the dependent variable, were fitted for each subscale. Service dogs had
52 lower stranger-directed aggression, owner-directed aggression, dog-directed aggression, dog-directed
53 fear, dog rivalry, chasing, stranger-directed fear, and separation-related problems than released dogs.
54 EDDs had lower trainability, dog-directed fear, dog rivalry, and attachment/attention-seeking
55 behavior than released dogs. These findings suggest that some of the C-BARQ© subscales might be

56 used in the future to predict outcomes for young dogs. Results show that the C-BARQ© can be
57 applied to the PBB program; however, the omission of seven questions is recommended.

58 Keywords: Canine, Behavior, C-BARQ, Puppy, Dogs, Prison

59

60 **1. Introduction**

61 Researchers have developed and employed a variety of methods to identify behaviors associated with
62 release or failure in training working dogs. These have included: behavioral and temperament tests,
63 such as placing puppies in novel environments (e.g. Pfaffenberger et al., 1976; Wilsson & Sundgren,
64 1997; Ruefenacht et al., 2002); questionnaires for trainers or owners (e.g. Diederich & Giffroy, 2006)
65 observations by practiced trainers under semi-naturalistic conditions (e.g. Maejima et al., 2007);
66 measurements of cognitive ability (e.g. MacLean & Hare, 2018) and body posture (De Meester et al.,
67 2008), and evaluations of physiological measures (Tomkins et al., 2011). A shortcoming of these
68 behavioral and physiological assessments is that there is often a lack of standardization between tests,
69 and most have not been validated (Taylor & Mills, 2006). Many also rely on the interpretations of a
70 single trainer or individual and have not been suitably tested for inter-rater reliability (Jones &
71 Gosling, 2005; Taylor & Mills, 2006). The Canine Behavioral Assessment and Research
72 Questionnaire (C-BARQ©) (Hsu & Serpell, 2003; Duffy & Serpell, 2012) is a validated tool
73 developed to assess canine behavioral traits. The current version of the C-BARQ© consists of 100
74 questions that explore dogs' responses to an extensive number of naturally occurring situations and
75 stimuli. Unlike other testing methods, the C-BARQ© offers a single, standardized method for which
76 both validity and reliability have been established (Hsu & Serpell, 2003). Research into the
77 application of the C-BARQ© as a predictor of success for a specified working role has focused
78 primarily on guide dogs (Duffy & Serpell, 2012) and assistance dogs (Bray et al., 2019). In both cases
79 the C-BARQ© was able to identify behaviors associated with success or release from their respective
80 training programs. Recently, studies have widened the use of the C-BARQ© to assess its ability to
81 distinguish individual characteristics in working dogs. For example, Hare et al. (2018) found that the
82 C-BARQ© could identify behavioral differences between search-and-rescue and pet dogs. The C-

83 BARQ© has further been applied in veterinary and re-homing settings to establish the characteristics
84 of an individual dog (e.g. Segurson et al., 2005; Duffy et al., 2014). While the C-BARQ© is utilized
85 by numerous organizations internationally, its use as a tool to effectively classify successful and
86 released dogs has only been established for certain populations (e.g. Duffy & Serpell, 2012, Bray et
87 al., 2019). The C-BARQ’s validity is likely dependent on the environment that both the raiser and dog
88 are in, and the type of role for which the dog is being trained. For example, in studies by both Duffy
89 & Serpell (2012) and Bray et al. (2019) the dogs were fostered from eight weeks until they entered
90 training and were raised in a home environment. This is the setting that the C-BARQ© was developed
91 for, as it includes questions specific to household environments. The ability of the C-BARQ© to
92 differentiate between dogs in other settings, such as a prison puppy raising program, has not
93 previously been tested.

94

95 Puppies Behind Bars (PBB) is an Assistance Dogs International accredited program that places eight-
96 week-old puppies with prison inmates enrolled in a training program. Puppies are raised and trained
97 by their assigned individual for approximately six to 24 months. The variability in duration of training
98 is related to the differences in training procedures between service dogs (assistance dog for a veteran
99 or first responder) or explosives detection dogs (EDD). Puppies are informally evaluated at eight
100 weeks of age based on current behavior and history of behavior with their litters. EDDs and service
101 dogs require different sets of traits. Puppies are trained for service work if they are more confident,
102 easy-going, human-connected, and mild, while EDDs are more vocal, have higher prey drive, or are
103 more timid. Weekly observations are made during classes and monthly reports describe confidence,
104 ease of training, human dependence, energy level, and environmental stability. Each dog’s career can
105 be changed based on these observations if the behavioral changes last longer than several weeks to a
106 few months. EDDs usually graduate at about 12 months of age after learning 23 commands, while
107 service dogs usually graduate between 20 and 24 months of age after learning over 80 commands. It is
108 also thought that the difference in training duration is because EDD behaviors, such as sniffing,
109 running, and jumping, are more “natural” for dogs than service dog activities such as turning on light

110 switches, opening doors, and staying in a tight heel (Carl Rothe, personal communication).
111 Throughout this process, approximately 25% of dogs that begin the program are ‘released’ due to
112 behavioral and/or medical issues and are then offered for adoption to the public. Of those released,
113 approximately 50% are rejected for behavioral reasons (Puppies Behind Bars, 2019). Given the
114 extensive funding and time required to train a puppy, the ability to ascertain behaviors that are non-
115 conducive to success could significantly reduce costs by identifying dogs likely to be released as early
116 as possible. In addition, identifying which behaviors align with certain success outcomes (service or
117 EDD) would add insight into behaviors that should be focused on during training, further ensuring
118 productive placements and possibly reducing the number of dogs transferred between EDD and
119 service training. Prior to implementing the C-BARQ© as a predictive tool, it is necessary to establish
120 whether it can be applied to a prison setting, as it was developed for use in a typical home
121 environment. Further, as the program has more than one success outcome (service or EDD), an
122 assessment of the C-BARQs ability to differentiate between these roles is required. Application of the
123 C-BARQ© to this setting and to these working dog roles have not previously been assessed.

124

125 The purpose of this study was therefore to establish the degree to which assessments, based on inmate
126 puppy-raiser responses to the C-BARQ©, can distinguish between prison-raised dogs that proceed to
127 successfully complete training and graduate as service or EDDs, and those that are released for
128 behavioral reasons. Given the unique situation that PBB provides, where more than one graduate
129 outcome is possible, this study can also assess whether specific behaviors are associated with a
130 particular working role. Identifying behaviors that may be associated with particular outcomes
131 (service or EDD) may help to draw focus on specific attributes during training and assist in
132 determining a career outcome for a particular dog.

133

134 **2. Materials and Methods**

135 *2.1 Participants*

136 The current study resulted from an on-going collaboration between Puppies Behind Bars (PBB) and
137 The University of Pennsylvania School of Veterinary Medicine (Philadelphia, PA). Surveys were
138 collected from seven prison locations in New York State. Dogs were provided to the PBB program by
139 independent breeders. Dogs enter the program at eight weeks of age and graduate between 12 and 24
140 months. All puppy raisers were asked by the PBB organization to complete a paper copy
141 questionnaire (C-BARQ©) every six months, starting when the dogs were six months of age through
142 to graduation or release. Five hundred C-BARQs from a total of 314 dogs were collected between
143 2012 and 2017. If a puppy raiser filled out multiple C-BARQs for the same dog, the most recent
144 questionnaire (taken at the oldest recorded age for that dog) was used for analysis because most dogs
145 only had one complete C-BARQ© at the time of data collection. There were not enough dogs with
146 multiple C-BARQs at different time points to use a repeated measures model. Dogs still in training
147 and dogs released for medical reasons were excluded (Category 3 health condition). All dogs released
148 for medical reasons were in the same medical category, so including them would not allow the
149 assessment of the impact of medical records category on the outcomes. To assess whether certain
150 behavioral traits could be associated with underlying health issues, medical conditions 0 – 2 were
151 included in the model. In total, 271 dogs were included in the analysis: 147 males (54%) and 124
152 (46%) females. The majority of dogs were Labrador Retrievers (256, 94%) with small numbers of
153 Golden Retrievers (8, 3%) and crosses of Golden and Labrador Retrievers (7, 3%). The dogs were a
154 mix of sexually intact and neutered (96, 65% of males) or spayed (86, 70% of females) at the time
155 that the survey was taken, and thus neuter status nested within sex was included as a possible
156 predictor in statistical models.

157

158 *2.2 Outcomes*

159 Dogs included in the analysis were either considered ‘successful’ (graduated from the program) or
160 ‘released’ (due to medical or behavioral problems). Outcome information was determined based on

161 medical records provided by the PBB program and information from the PBB website, and confirmed
162 through personal communication with the Senior Instructor of PBB. Graduates were further classified
163 based on their ultimate career placements (service or EDD) and released dogs were classified based
164 on their reason for leaving the program (medical or behavioral). Decisions made by the PBB program
165 to release dogs from training were made independently of C-BARQ© results. There were 150
166 successful detection dogs (55%), 79 successful service dogs (29%) and 42 dogs released for behavior
167 reasons (15%).

168

169 *2.3 C-BARQ© administration and delivery*

170

171 Puppy raisers completed the C-BARQ© based on the protocol defined in Duffy & Serpell (2012)
172 which generated quantitative scores (0-4) for 14 behavioral subscales (see Table 1). Questionnaires
173 were mailed to the University of Pennsylvania School of Veterinary Medicine to be logged.

174

175 *2.4 Database*

176 Upon receipt of a C-BARQ© or medical record for each dog, an ID number was assigned. The
177 following information from each C-BARQ©, if provided, was entered into a master spreadsheet: dog
178 information (ID number, microchip/registration number, dog name, date of birth, sex, breed,
179 spay/neuter status, weight, time spent training in months, number of dogs previously trained by the
180 inmate raiser, and current health issues), numerical responses to each of the 100 questions, and any
181 additional details given by the raisers in the spaces provided. It was not possible to include
182 information about raisers or their levels of experience in further analysis because of frequent missing
183 data and incomplete data when dogs were transferred between puppy raisers and prison facilities.

184

185 Any subscale calculated that included a value of “NA” (i.e. a contributing question had been left
186 unanswered by the respondent) was given a value of “NA.” Calculations were modified when items

187 were dropped by dividing subscale scores by the number of items used in each subscale. Subscale
188 scores for each dog were considered missing if < 75% of the items were answered.

189

190 *2.5 Age Categories*

191 Early versions of the C-BARQ© questionnaire (2012- 2013) did not specify the date on which the
192 survey was completed. Later versions of the C-BARQ© were updated to include this information,
193 however for 146 surveys received, dogs' ages and order of sequence of C-BARQs had to be estimated
194 based on a variety of factors (weight, time spent with specific raiser, receipt date of the survey).

195 Ultimately, dogs were separated into three age groups using certain criteria for those for which the
196 exact age was not known. Age Group 0 (n = 71, 26%) was assigned to dogs known to be less than six
197 months of age, or to dogs that were not yet spayed or neutered whose age was missing (as dogs in the
198 program are spayed or neutered at approximately six months of age). Age group 1 (n = 143, 53%) was
199 assigned to dogs known to be between six and fifteen months of age, or to dogs that had been spayed
200 or neutered and whose age was missing. Age Group 2 (n = 57, 21%) was used for those known or
201 suspected to be older than 16 months based on his or her reported age, time spent training, and/or age
202 of exit from the program.

203

204 *2.6 Medical Categories*

205 Official medical records provided by the PBB program were used to classify dogs into one of four
206 health categories (Table 2). Category 0 (n = 186, 68%) was used to describe dogs with no significant
207 medical issues. Category 1 (n = 66, 24%) described dogs with minor medical conditions that could be
208 treated successfully. Category 2 (n = 19, 7%) described dogs with moderate medical conditions that
209 could be treated but which might affect the dog's performance in later life. Dogs in Category 3 were
210 released from the program due to untreatable conditions and were excluded from the study. These
211 categories were intended to help account for moderate or recurring health conditions as a contributing
212 factor to behavioral release.

213

214 *2.7 Analysis*

215 Analysis focused on the data from each dog's most recently completed C-BARQ© and training
216 outcome. Data from 273 dogs were included after individuals with missing data were removed. An
217 additional two dogs in the database were omitted from the analysis due to the inability to determine
218 which C-BARQ© was most recent, leaving 271 dogs.

219

220 Fourteen C-BARQ© subscales were computed according to the protocol outlined in Duffy and
221 Serpell (2012); however, seven questions were omitted (Table 3). These were items that could not be
222 evaluated by puppy raisers in the prison system as they were irrelevant to the training style employed
223 (such as the question about corrections, which are not used by PBB trainers) or could not be observed
224 (such as aggressive reactions to strangers when in the car or in public) (Table 3). Trainability is the
225 only subscale where a high value is more desirable, for all other scales a low value is more favorable.

226

227 *2.8 Statistical Analysis*

228 Descriptive statistics for the C-BARQ© scores were calculated using the open-source R statistical
229 software (R Core Team, 2017; available at <http://www.r-project.org>). Cronbach's alpha was
230 calculated using the 'cronbach' function in the 'psy' R package (Falissard, 2012) as a measure of the
231 agreement between the individual items in each subscale.

232

233 To determine whether C-BARQ© subscale scores were associated with each of the three possible
234 outcomes, multinomial log-linear models containing one subscale score and fixed factors age group,
235 medical category, sex, neuter status within sex and the interaction of age group and medical category
236 as explanatory factors and dependent variable outcome were fitted for each subscale. Breed was not
237 used as a fixed factor because of the small number of dogs that were not Labrador Retrievers. The
238 reference categories for sex and neuter status were "male" and "neutered" respectively. Models were
239 fitted using the 'multinom' function in the 'nnet' R package (Venables & Ripley, 2002), which uses
240 neural networks to fit nonlinear models to categorical outcomes. Z-scores and Chi-square p-values

241 were calculated for the significant explanatory factors. Odds ratios and their p-values were calculated
242 using the ‘questionr’ package (Barnier et al., 2017).

243

244 **3. Results**

245 Descriptive statistics including means, standard deviations, and Cronbach’s Alpha for C-BARQ©
246 subscales are presented in Table 4. Figure 1 shows mean subscale scores by outcome (service dog,
247 EDD or released for behavioral reasons). Table 5 includes means and standard deviations by outcome.
248 Dogs that graduated as service dogs had lower reported owner-directed aggression (OR 1.7E-26, 95%
249 CI 1.7E-26, 1.7E-26), stranger-directed aggression (OR 0.02, 95% CI 0.01, 0.33), dog-directed
250 aggression (OR 0.13, 95% CI 0.04, 0.46), dog-directed fear (OR 0.22, 95% CI 0.08, 0.63), stranger-
251 directed fear (OR 0.11, 95% CI 0.03, 0.43), chasing (OR 0.47, 95% CI 0.24, 0.92), dog rivalry (OR
252 0.30, 95% CI 0.11, 0.82) and separation related behaviors (OR 0.11, 95% CI 0.01, 0.75) than dogs
253 that had been released from the program for behavioral reasons (all significant at $p < 0.05$; Table 6).
254 Dogs that graduated as EDDs had lower trainability (OR 0.27, 95% CI 0.10, 0.71), dog-directed fear
255 (OR 0.43, 95% CI 0.20, 0.93), dog rivalry (OR 0.43, 95% CI 0.19, 0.98), and attachment/attention-
256 seeking (OR 0.41, 95% CI 0.23, 0.73) than dogs released for behavioral reasons (all significant at $p <$
257 0.05 ; Table 6). Subscales that did not differ significantly between each outcome group and dogs
258 released for behavior reasons were touch sensitivity, excitability, and energy.

259

260 Other variables included in the models were age group, neuter status nested within sex, medical
261 category, and the interaction between age group and medical category. Age group was not
262 significantly associated with any outcome. Neutered females were more likely to be both service dogs
263 and EDDs in many of the models fitted. The relationship between being a neutered female and a
264 service dog was significant at the $p = 0.05$ level for models including trainability, owner-directed
265 aggression, dog-directed aggression, and rivalry with odds ratios between 7.44 and 9.03. The
266 relationship between being a neutered female and an EDD was significant for models including
267 trainability, stranger-directed aggression, owner-directed aggression, dog-directed aggression, and
268 touch sensitivity with odds ratios from 6.43 to 11.97. No relationship was found between medical

269 category 1 or 2 compared to category 0 with outcome. Interactions between age category and medical
270 category were also not significant.

271

272 **4. Discussion**

273 This study provides evidence that the C-BARQ© can be successfully applied to an inmate puppy
274 raising setting, and, further, that it can distinguish career outcomes in a prison program (PBB). We
275 identified seven individual questions (from six subscale categories) that were not applicable, and were
276 therefore omitted. While the extensive coverage of naturalistic scenarios is a strength of the survey, in
277 that it allows for a breadth of assessment across various situations, it cannot be directly applied to a
278 prison setting. The questions omitted had a high percentage of missing values and were confirmed by
279 the director of the program to be difficult or impossible to evaluate by inmate puppy-raisers. For
280 example, the question referring to the dog's reaction to the doorbell ringing could not be applied to
281 the PBB program, where these dogs were never exposed to such events. Other studies implementing
282 the C-BARQ© have been criticized for amending the questionnaire to such an extent that it can no
283 longer be considered valid (Batt et al., 2009 c.f. Duffy & Serpell, 2012). Here, we assessed the
284 meaningfulness of the subscale scores with Cronbach's alpha, a measure of the reliability or internal
285 consistency of a set of items (Cortina, 1993) such as a C-BARQ© subscale. Alpha varies between 0
286 and 1, with values between 0.8 and 0.9 indicating good agreement, while lower alphas indicate poorer
287 agreement and alphas above 0.90 may reflect scale redundancy (Mair, 2018). In this study, subscales
288 with alpha higher than 0.80 included stranger-directed aggression, dog-directed aggression, chasing,
289 stranger-directed fear, and excitability. Many subscales had moderate values from 0.70 to 0.80
290 (trainability, dog-directed fear, rivalry, non-social fear, attention-seeking and energy, while separation
291 issues and touch sensitivity had alphas below 0.70). Further validation of this modified version to a
292 prison setting would be recommended to establish this preliminary finding. In future, this modified
293 version of the C-BARQ© may help to inform studies applying the questionnaire to a prison
294 environment as a potential predictive screening tool.

295

296 Results show distinct patterns of behavioral subscales that were significant for either service dogs or
297 EDDs, indicating that the C-BARQ© can differentiate between behaviors associated with specific
298 working dog roles. We found that successful service dogs had lower owner directed aggression,
299 stranger-directed aggression, dog-directed aggression, dog-directed fear, stranger-directed fear,
300 rivalry, chasing and separation-related problems than dogs released because of behavioral reasons. It
301 should be considered that the majority of the behaviors with a significant association were fear or
302 aggression based. This is consistent with the PBB evaluation process in which desired traits for
303 service dogs include “confident” and “easy going.” EDDs showed lower dog-directed fear, rivalry,
304 trainability and attention-seeking than dogs released from the program. The lower attention-seeking in
305 EDDs may be related to the fact that dogs that are “human-connected” tend to be selected for service
306 dog training. Overall, more subscale scores are associated with service dogs’ success than with EDDs’
307 success. There may be more behavioral requirements for service dogs because of the larger number of
308 commands they learn or the high level of environmental stability, obedience, and impulse control
309 necessary for service dogs that accompany their handlers in public facilities and transportation. The
310 type of behavior required for service dogs to accompany their handlers in public may be a reason why
311 various types of fear (of strangers, dogs, and separation anxiety) and aggression (stranger-, owner-,
312 and dog-directed) are associated with failure to complete training. Dogs experiencing stress associated
313 with fear may be inhibited in learning service dog tasks. In dogs admitted to a shelter, high speed of
314 learning two operant tasks was associated with low levels of fearful behavior (Blackwell et al., 2010)
315 and associations of fear with impaired learning has been found in numerous species (Rooney et al.,
316 2016).

317 The findings presented here differ somewhat from those from studies of other working dog
318 populations. These variations could be related to differences between prison and home raising
319 environments or other differences between samples of dogs, raisers, or training methods. In a study of
320 guide and service dog puppies from five programs raised in homes, favorable scores on all subscales
321 measured at six and twelve months of age, except for dog-directed fear measured at six months of
322 age, were associated with successful training (Duffy & Serpell, 2012). The lack of association of
323 some subscales with training success in the present study may be due to different raising and training

324 practices or the wider range of breeds and the presence of guide dogs in the other study sample. For
325 Swedish military working dogs, higher trainability scores were associated with successful training and
326 higher stranger-directed fear, non-social fear, and dog-directed fear were associated with unsuccessful
327 training (Foyer et al., 2014). Although military working dogs are trained on some different tasks than
328 EDDs, both types of work appear to require dogs that score low on various types of fear. Among
329 service dog puppies in the Canine Companions for Independence (CCI) program, significant
330 predictors of training success included trainability, stranger-directed fear, and dog-directed aggression
331 (Bray et al., 2019), showing a narrower range of significant fear-related behaviors predicting success.
332 This could be due to different sample composition of Labrador Retrievers, Golden Retrievers, and
333 crosses of these breeds in the CCI population, different levels of fear in the dogs from the CCI and
334 PBB programs, or differences in the dogs' environment between prison and home or difference in
335 training methods between programs. Overall, trainability and fearlessness appear to be important traits
336 for a wide variety of working dog disciplines and raising situations.

337

338 Odds ratios represent the impact of a one-unit change in predictor variables (e.g. C-BARQ© subscale
339 scores) on the outcome. The odds ratio for owner-directed aggression for service dogs was close to
340 zero, suggesting a large difference between service dogs and dogs released for behavioral reasons. In
341 fact, service dogs had a mean of zero for the owner-directed aggression subscale score compared with
342 0.04 for dogs released for behavior reasons. Although owner-directed aggression is rare in this
343 population, it appears to be incompatible with success as a service dog. In contrast, the largest
344 statistically significant odds ratio was 0.47 for chasing in service dogs. The odds of service dog
345 success are 53% greater for each unit decrease in chasing. These percentages are greater for the other
346 significant C-BARQ© subscales. For this population, information on the C-BARQ© scores for these
347 significant traits could help with decisions about whether to retain dogs in training, and whether they
348 should be used in a breeding program.

349

350 Although all PBB groups scored high on trainability (Table 5) compared to search and rescue dogs
351 (mean 3.16), a group of non-search dogs (mean 2.64) (Hare 2018) and dogs in the Swedish military
352 (Foyer 2014); successful EDDs showed lower trainability than those PBB dogs that were released
353 from the program. This finding may suggest that trainability (the willingness to attend to the owner,
354 obey simple commands, learn quickly, fetch objects, and ignore distracting stimuli) is a less critical
355 discriminating trait for EDDs. Alternatively, it is possible that dogs have other, unaccounted for,
356 behavioral traits that impact trainability in varying situations. As released dogs show higher dog-
357 directed aggression, dog-directed fear and dog rivalry than both outcome groups, it suggests that these
358 behaviors are of primary importance to a dog's release from the program. C-BARQ© subscales that
359 were not associated with either outcome group were touch sensitivity, excitability, and energy. This
360 suggests that, for this population, these behaviors were not predictors of release from the PBB
361 program, however future assessments could confirm this finding.

362 We did not find any relationship between medical record category 1 or 2 compared to category 0 with
363 outcome, suggesting that the medical conditions in these categories did not contribute to dogs'
364 success or release for behavior reasons.

365

366 This study analyzed a single C-BARQ© per dog to assess the population, whereas previous studies,
367 such as Duffy and Serpell (2012), utilized multiple tests over time. Implementing serial C-BARQs© in
368 a prison setting could be beneficial in assessing the earliest age that behavioral differences can be
369 identified that will predict outcome. In future, it would be valuable to understand whether these traits
370 are present from the dog's arrival to the prison setting, or develop over time. A limitation is that the
371 earliest version of the C-BARQ© did not ask for the specific age of the dog. Therefore, we used
372 categories based on variables such as neuter status. The ages included were not consistent, as C-
373 BARQs© were submitted by puppy raisers between six and 16 months of age. Given that some ages
374 had to be estimated using the information provided, there would be benefit in future in obtaining specific
375 time-point data to ensure that potential effects of age were controlled for. Fitting exact age as a covariate
376 in our models would have resulted in more statistical power to detect age effects. Furthermore, it should

377 be considered that the older the dogs get the more likely they are to develop medical conditions that
378 may impact their career outcome.

379

380 Prison puppy raising programs are popular and diverse. Over 330 programs throughout the United
381 States. England, Canada, Australia, New Zealand, South Africa, Austria, Italy, Poland, Spain, and
382 Scotland also have programs. Practices vary between programs according to characteristics of the
383 prisons (e.g. high or low security), the population of puppy raisers, and the goals of training. In some
384 programs, dogs from shelters are trained to be adoptable family companions or service dogs. In other
385 programs such as PBB, dogs are trained for specific working roles. Programs vary in formality; some,
386 including PBB, have training manuals that are used at multiple prison locations (e.g. within US
387 states). Another aspect of these programs that varies is the amount of time the puppies spend outside
388 of the prison, living with trainers (PBB) or visiting volunteers for weekends so they can be exposed to
389 different environments and develop skills and environmental stability they will need as service dogs.
390 (Cooke, 2019). The PBB program requires an eight-month training program for the raisers before they
391 receive puppies and provides extensive, weekly oversight during puppies' development (Carl Rothe,
392 personal communication). PBB is a program specific to the New York State area. Providing a
393 representative sample for the PBB program was considered by including multiple prison locations that
394 are part of PBB, however other prison-based programs, both domestic and internationally, may have
395 different career outcomes and training methods than the current sample. Programs that do not share
396 characteristics that are likely to affect dogs' behavior and success should conduct research on their
397 specific populations to determine whether C-BARQ© scores are predictive of successful completion.

398 *4.1 Conclusion*

399

400 The present study finds that the C-BARQ© can differentiate between working dog roles in a prison
401 environment, however minor adaptations are required for its success. We provide primary findings as
402 to how systematic data collection could be applied in subsequent investigations as a prognostic tool to
403 improve the process of selecting and releasing dogs from a PBB program. We further identified

404 certain behavioral traits that are associated with graduating as either a service dog or EDD. This is of
405 interest given that the C-BARQ© has previously not been studied in prison puppy programs to our
406 knowledge, and it may add insight into specific behaviors that should be assessed when making
407 decisions on what outcome a dog is suited for. This study does not employ the C-BARQ© as a
408 predictive tool, however the results suggest that there may be scope for its development as such a
409 screening tool in the future. Application of this method on a wider scale could help to reduce costs
410 and ensure optimal placement partnerships, ultimately providing more successful assignments of
411 service and EDDs through the PBB program.

412

413 **Declaration of interest**

414

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417

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419

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426

427

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549 Tables

550 Table 1. Fourteen behaviors measured by subscales of the C-BARQ© and analyzed in this study.

551 Table 2. Criteria used to classify the health of dogs in the Puppies Behind Bars puppy raising
552 program.

553	
554	Table 3. Items removed from analysis of C-BARQ© questionnaires, their question numbers, and
555	associated subscales. These questions could not be answered by puppy raisers in the prison
556	environment.
557	
558	Table 4. Descriptive statistics for C-BARQ© subscales on 271 PBB program puppies, including
559	number of items per subscale, number of missing observations, mean, standard deviation, skewness,
560	kurtosis, and Cronbach's Alpha for each subscale. Subscale scores range between 0 and 4.
561	
562	
563	Table 5. Means and standard deviations of C-BARQ© subscale scores for 271 Puppies Behind Bars
564	program dogs by training outcome (released for behavior reasons, successful service dog, and
565	successful explosives detector dog (EDD)). Subscale scores range between 0 and 4.
566	
567	Table 6. Odds ratios (OR) and 95% confidence levels (CI) for C-BARQ© subscales with significance
568	levels. Outcomes are "released for behavior reasons" (reference level), "service dog," or "explosives
569	detection dog" (EDD).
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572	Figures
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574	Figure 1. Mean subscale values for 14 behavioral traits measured with the C-BARQ© among 271
575	Puppies Behind Bars dogs by outcome (released for behavioral reasons, successful service dog, and
576	successful explosives detection dog (EDD)). Standard deviations and further descriptive statistics are
577	in Table 4.