

Association of Puppies' Behavioral Reaction at Five Months of Age Assessed by Questionnaire with Their Later 'Distraction' at 15 Months of Age, an Important Behavioral Trait for Guide Dog Qualification

Natsuko KOBAYASHI¹⁾, Sayaka ARATA¹⁾, Ai HATTORI¹⁾, Yui KOHARA¹⁾, Yasushi KIYOKAWA¹⁾, Yukari TAKEUCHI^{1)*} and Yuji MORI¹⁾

¹⁾Laboratory of Veterinary Ethology, Department of Animal Resource Sciences, Graduate School of Agriculture and Life Sciences, The University of Tokyo, 1-1-1 Yayoi, Bunkyo-ku, Tokyo 113-8657, Japan

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ABSTRACT. Guide dogs help visually impaired persons both physically and psychologically. More than half of all candidate dogs do not qualify, mainly for behavioral reasons. Improved training efficacy is desirable, and earlier prediction of qualification-related traits would be beneficial. In a previous study, we identified 'Distraction', assessed during the training period, as an important behavioral trait for judging the qualification of guide dogs at the Japan Guide Dog Association. As a second step, we aimed to develop an index that can predict during the puppy period. In this study, candidate guide dogs, 5-month-old Labrador retrievers, were assessed by puppy raisers using a newly developed questionnaire that consisted of 20 items. The same dogs were assessed later, at 15 months, by trainers to determine 'Distraction'. In principal components analysis, nine items, including excitability toward strangers, initiative while out for a walk, and exploration, composed the first principal component (PC1). When we compared PC1 points with 'Distraction' points, the two categories were positively correlated ($n=110$, $r_s=0.31$, $P=0.0009$). Although the accuracy of the questionnaire should be increased, the results of the present study suggest that it may be possible to assess and predict 'Distraction', which is associated with disqualification for guide dogs, early in the puppy-raising period.

KEY WORDS: behavioral traits, Distraction, guide dogs for visually-impaired people, puppy-raising period, questionnaire.

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Guide dogs assist visually impaired persons in both physical and psychological ways. In general, more than half of all candidate dogs do not qualify, chiefly for behavioral reasons. For example, 77.3% of disqualified dogs in Australia [8], 65.5% in the U.S.A. [17] and 69.5% in Japan (data from the Japan Guide Dog Association [JGDA] between 2003 and 2005) failed to qualify because of behavioral issues. Therefore, development of methods for the early prediction of guide dog qualification is strongly desired to help promote efficiency in the rearing and training of dogs.

Recent investigations at The Seeing Eye, Inc. (Morristown, NJ, U.S.A.) proposed that qualification should be based on the complex combined effects of variable traits, such as 'suspicious of people' and 'lack of confidence' [17], while 'fearfulness' and 'dog distraction' were found to be important traits according to the Royal Guide Dogs for the Blind Association in Australia [8]. This discrepancy might have been caused by the difference of the behavioral tendency that is considered acceptable in each society or country. Therefore, it appears practical to first identify an influential trait for qualification and then predict the trait at

earlier ages within the same facility [9].

In a previous study, we identified 'Distraction' as an important behavioral trait for judging the qualification of guide dogs at the JGDA [1]. This trait was extracted as the first factor during factor analysis on our trainer assessment in which experienced trainers were asked to assess candidate dogs during the third month of the training period. Of the 22 items that appeared in the trainer assessment, six items (dog interest, sudden movements, excitability, dominance, self-interest, and steadiness) composed the 'Distraction' factor. A dog's 'Distraction' point was consistently and significantly lower in successful dogs than in failed dogs. It predicted qualification with an accuracy of 80.6%, which was much higher than the prediction using other factors. Therefore, we regarded 'Distraction' as a meaningful behavioral index for the early prediction of guide dog qualification at the JGDA.

Questionnaire surveys are helpful for assessing a dog's behavioral trait in everyday situations, because they are easy to complete and can include multiple aspects of behavior at one time [14]. The Canine Behavioral Assessment and Research Questionnaire (C-BARQ) is a well-known questionnaire, and it could detect future behavioral problem when it was answered by puppy raisers (PRs) [17]. Batt *et al.* [2] applied a substantially modified version of C-BARQ to 13-month-old dogs to predict final qualification at Guide Dogs New South Wales/Australian Capital Territory (NSW/ACT) in Australia. Although no association was found between the C-BARQ questions and guide dog qualification, the predictions of individual success by PRs were associ-

*CORRESPONDENCE TO: TAKEUCHI, Y., Laboratory of Veterinary Ethology, Department of Animal Resource Sciences, Graduate School of Agriculture and Life Sciences, The University of Tokyo, 1-1-1 Yayoi, Bunkyo-ku, Tokyo 113-8657, Japan.
e-mail: aytake@mail.ecc.u-tokyo.ac.jp

ated with the qualification outcome. Therefore, both reports indicate the value of PRs as estimators.

The purpose of the present study was to develop an index that can predict 'Distraction' during the puppy period. We administered a questionnaire survey with 20 items to PRs and analyzed the responses using principal components analysis (PCA). Then, we examined the correlation coefficients between the principal components (PCs) and 'Distraction' points. This survey may provide the first step toward developing an assessment to predict future 'Distraction', which is an influential trait for guide dog qualification at the JGDA.

MATERIALS AND METHODS

Animals: The canine subjects included 158 Labrador retrievers (41 litters born from 31 dams and 24 sires: 86 females and 72 males; 92 yellow and 66 black). All subjects were candidate guide dogs at the JGDA, 34 dogs were born at the homes of several volunteers, and the other 124 were born at the breeding facility of JGDA between April 2007 and January 2010. Dogs were brought up with dam and litter mates until they were eight weeks old. From eight weeks of age, the dogs were reared in private homes by volunteer PRs with the purpose of establishing the human-dog relationship through daily communication [12]. Male dogs were castrated at around six months of age, and female dogs were spayed at around one year of age. The dogs began training when they were about one year old. After six months to one

year of training, guide dog qualification was judged at the final exam, a field test where a candidate dog guided a trainer with an eye mask on, by several staff members and trainers based on health, guiding performance and behavioral problems (such as aggression). 'Distraction' points were not in practical use as a basis for releasing dogs from the training program. Dogs for breeding were brought up in the same way as other dogs except for the neutering and final exam.

PR questionnaires, described in greater detail below, were conducted when dogs were five-month-old, and trainer assessments were conducted after dogs were trained for three months (15 months of age).

PR questionnaires: Questionnaires were sent to 158 PR homes by the JGDA between September 2007 and June 2010, when candidate dogs were approximately five-month-old. The package also included a letter of introduction with an informed consent document, a stamped return envelope, and a cover page requesting general information such as the dog's name, sex, and the number of PR family members. We asked PRs who take care of them the most to answer. The timing was set so that the PRs had raised the puppies for about three months, which was considered a sufficient period of time for assessing a puppy's behavior based on daily observations in variable situations. The 20 question items are listed in Table 1. Most questions addressed the frequency of the dog's behaviors and were answered on a scale of 1 to 5, with 5 being the highest rating. The exceptions included question 6, which addresses the duration of the behavior, and questions 18–20, which address the intensity of the behavior.

Table 1. Twenty items on the PR's questionnaire (when puppies were approximately five months old)

Items	
Q1	Does your dog jump or bark with excitement when family members return home?
Q2	Does your dog jump or bark with excitement when unfamiliar persons visit your home?
Q3	Does your dog jump or bark with excitement toward unfamiliar persons while out for a walk?
Q4	Does your dog jump or bark with excitement toward other dogs while out for a walk?
Q5	Does your dog bark or run around with excitement when the doorbell or telephone rings?
Q6 ^{a)}	For how long does your dog's excitement usually continue?
Q7	Does your dog whine or bark if family members are out of sight?
Q8	Is your dog frightened by sudden or loud noises?
Q9	Is your dog frightened in the presence of a crowd?
Q10	Does your dog venture away from you without hesitation, even in an unfamiliar place?
Q11	Does your dog explore willingly in an unfamiliar place?
Q12	Does your dog approach novel things such as a vacuum cleaner, soap bubbles, or a person in a costume without hesitation?
Q13	Does your dog approach with tail wagging or sniff other dogs while out for a walk?
Q14	Does your dog pull hard or try to decide where to go while out for a walk?
Q15	Does your dog attempt to initiate play?
Q16	Is your dog delighted to play?
Q17	Does your dog show concentration and motivation for training when you work on skills such as 'sit' or 'shake hands'?
Q18 ^{b)}	Does your dog show different attitudes toward various family members, such as the one who feeds them, takes them out for a walk, or stays home for a shorter time?
Q19 ^{b)}	Does your dog change his/her attitude in response to friends of family members or strangers?
Q20 ^{b)}	Does your dog change his/her attitude in response to unfamiliar adults or unfamiliar children?

The responses identified the frequency of each behavior on a scale of 1 to 5, with 5 being the highest level. a): For this item, responses indicated the duration of the dog's behavior, with 5 being the shortest duration. b): For these items, responses indicated the intensity of the dog's behavior, with 5 being the least intense.

Trainer assessments: The trainer assessment was completed during the third month of the training period, when the dogs were around one year three months old. Experienced trainers assessed 22 items on a 5-point scale (1=low, 5=high) depending on each dog's behaviors during training and everyday life. 'Distraction' points were calculated using the raw scores of six items: 'Distraction' points = dog interest + sudden movements + excitability + dominance + self-interest – steadiness [1]. These six items are defined in detail as follows; dog interest: motivation toward other dogs, and how much it exceeds its concentration on the handler; sudden movements: sudden responses, which usually originate from interest or fear; excitability: degree of excitement and how long it takes to calm down; dominance: to show disobedience or to try to gain the favor of dogs and humans; self-interest: overall motivation toward surroundings and low concentration on the handler; steadiness: to retain stable behavior in spite of external stimuli in familiar situations.

Statistical analyses: All data analyses were performed using JMP 7.0.7 (SAS Institute, Cary, NC, U.S.A.) software. The two-tailed significance level was set at 0.05 for all statistical tests.

PCA of PR question items: PCA was carried out to generate an integrative description of the questionnaire survey. The relative importance of each PC was assessed by its eigenvalue. When we drew a scree plot in which eigenvalues were plotted in the order of the PCs, the plotted values initially fell in a steep curve but then flattened out in a line; we used the PCs that preceded the flat portion of the scree line [4].

Calculation of PC points and their association with 'Distraction' points: Items with absolute loading values over 0.4 were used to describe the PCs. PC points were calculated by adding or subtracting the raw scores of included items according to their positive or negative loadings. Then, associations between PC points from PR answers and 'Distraction' points from trainer assessments were examined using Spearman's rank correlation coefficients. Interpretation of the correlation coefficients followed Martin and Bateson [13].

The association between 'Distraction' points and success or failure outcomes was also calculated using a Mann-Whitney *U*-test to assess the reproducibility of the current study [1].

RESULTS

PCA of PR questionnaires: A total of 145 out of 158 (91.7%) questionnaires were returned. Twenty dogs were excluded because of missing values, and thus 125 dogs were used for analyses.

The PCA on the 20 questions resulted in the extraction of six PCs that had eigenvalues greater than 1.0. Based on the scree plot, PC1 was the only factor indicated as important (Table 2). Of the 20 questions, nine were included in PC1, which explained 18.1% of the total variance.

Association between PC1 and 'Distraction': PC1 points were calculated using the raw scores of nine question items as follows: PC1 points = Q3 + Q11 + Q2 + Q14 + Q4 + Q1 + Q10 + Q15 + Q12. We found no effects of sex, coat color or place of birth (volunteer's homes or the breeding facility) on PC1 points (sex: $U=1811.0$, $P=0.5283$, coat color:

Table 2. Principal component analysis of 20 question items (PR questionnaire at five months)

Items	PC1	PC2	PC3	PC4	PC5	PC6
Q3 Excitability toward strangers	0.661					
Q11 Exploration	0.654					
Q2 Excitability toward visitors	0.653					
Q14 Initiative while out for a walk	0.645					
Q4 Excitability toward other dogs	0.565					0.459
Q1 Excitability toward family	0.543					
Q10 Confidence in an unfamiliar place	0.542					
Q15 Willingness for play	0.537					
Q12 Interest in unfamiliar things	0.511					
Q18 Differentiation among family members		0.591	0.510			
Q17 Trainability		0.525			-0.573	
Q16 Playfulness		0.507		0.479		
Q19 Differentiation of familiar and unfamiliar persons		0.482				
Q20 Differentiation of adult or child		0.453				
Q8 Fear of noises			0.503	0.454		0.437
Q5 Excitability toward telephone			0.432			
Q13 Interest in other dogs			-0.415			0.697
Q7 Separation related behavior				0.642		
Q6 Average length of excitement						
Q9 Fear of crowd						
Eigenvalue	3.609	2.186	1.669	1.433	1.335	1.189
Contribution rate	18.1%	10.9%	8.3%	7.2%	6.7%	6.0%

PCs with eigenvalues greater than 1.0 are shown. No absolute values less than 0.4 are present in the table.

$U=1840.5$, $P=0.9133$, place of birth: $U=1207.0$, $P=0.4858$). Likewise, any effect was not found on 'Distraction' points (sex: $U=1283.5$, $P=0.1836$, coat color: $U=1440.5$, $P=0.8481$, place of birth: $U=742.0$, $P=0.0900$).

One hundred and fourteen out of 125 dogs with PR questionnaire had finished at least three months of training and undergone trainer assessments. Four dogs were excluded from this analysis for breeding purposes. As a result, 110 dogs were used and PC1 points showed significantly positive, although weak, correlation with 'Distraction' ($r_s=0.31$, $P=0.0009$).

The impact of 'Distraction' on success or failure outcomes was examined using all dogs that had already finished training and had been judged for qualification until August 2012. 'Distraction' points were significantly lower in the 28 successful dogs than in the 82 failed dogs ($U=508.5$, $P<0.0001$, the median point was 11 and 14 for the successful and failed dogs, respectively).

DISCUSSION

Five months old candidate guide dogs were assessed by PRs using a newly developed questionnaire (PR questionnaire) and later underwent trainer assessment at 15 months to determine 'Distraction' points that were identified as important indices for guide dog qualification [1]. We conducted PCA on 20 items from the PR questionnaire and found that nine of them were included in PC1. When we compared PC1 points with 'Distraction' points, we found a weak, but positive correlation.

There is only one survey that assessed candidate guide dogs using questionnaire before the age of 12 months [5]. At five guide and service dog associations in the U.S.A., C-BARQ was applied to PRs to assess candidate dogs of six and 12-month-old. When the PR's assessment of each period was compared with guide/service dog qualification by using generalized linear modeling, many factors were detected to have significant relation with the qualification at both periods. However, as the association between assessment at six months and that of 12 months has not been examined, the aim of the research is considered to be different from the present study which focuses on the prediction of adult behavioral trait. Generally, predicting adult behavior before dogs are 12-month-old is thought to be difficult [11]. This has been demonstrated by studies that conducted behavioral tests and compared behavior between dogs aged four and 12 months [10], as well as eight weeks and 3–6 years [19]. Behavioral tests are desirable for their objectivity, but they may be less representative than questionnaire surveys and thus have a risk to miss finding out a possible consistent behavior when the test content does not match the target behavioral trait [18]. Therefore, questionnaire surveys, such as the one conducted in the present study, can be effective as preliminary survey, because they can include several possible situations at one time and may indicate how a target adult behavior will appear during the puppy period.

PC1 that showed significant correlation with 'Distraction' included many items related to novelty seeking (Q10–12,

14) and excitability (Q1–4), and thus, it is thought that later 'Distraction' can appear as novelty seeking and excitability at five months old. Novelty seeking is one of the well-researched temperament in humans, and the influence of particular gene polymorphisms has been reported in humans [3, 7], horses [15] and mice [6]. In dogs, it is shown that socialization program for four weeks at around three months old brought higher response to commands, but no effect on response to novel stimuli [16]. These findings support our view that novelty seeking tends to be consistent over developmental stages in each individual rather irrespective of environmental variables. Duffy and Serpell [5] assessed 'excitability' factor that included excitability toward family or visitors at six and 12-month-old using C-BARQ. Although 'excitability' at both ages was significantly associated with qualification, its relation with adult behavioral tendency was not discussed. Therefore, the consistency of excitability as well as novelty seeking from puppy to adult should be studied in depth in the future.

Although the correlation in the present study was statistically significant, the questionnaire still needs improvement in order to increase its accuracy. First, attention should be paid to the items included in PC1: increase the number of question items which related to novelty seeking and excitability. Second, we need to describe more specifically the situations asked in the questions for PRs' ease of answering based on the response rate of each item and comments from PRs: the place (inside or outside the house), and the reaction of a person/dog that a puppy encounter. These improvements are expected to provide more precise assessment in the next survey.

We distributed a questionnaire survey to PRs when dogs were five months of age. PC1 from the questionnaire was positively associated with 'Distraction'. This suggests that future 'Distraction' might be predicted at an early stage in the rearing period. Future studies should be directed toward improving the accuracy of this questionnaire to provide practical strategies for evaluating 'Distraction'.

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