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Good Possibilities to Select Against Fearfulness in Rough Collie

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ABSTRACT: Fear-related problems are common among Swedish Rough Collies. Genetic analyses were performed on 4 composite behavioral traits based on 2953 Rough Collie results from a temperament test. Heritabilities ranged from 0.13-0.25. Validation of the test was done using a dog owner questionnaire, which generated information about everyday life behavior for 1738 Rough Collies. There were high and significant genetic correlations between traits measured in the test, and the everyday life behavior of the dogs as described by the owners. For instance, Curiosity/fearlessness in the test was negatively genetically correlated with Nonsocial fear in the questionnaire (-0.70, SE 0.10). We conclude that data from the analyzed test is possible to use for selection to decrease everyday life fearfulness in the Swedish Rough Collie population.
Keywords: breeding; behavior; dog

Introduction

Fear-related problems are common in the Swedish Rough Collie population (Svartberg, unpublished). Despite this, the Swedish Collie Club has so far experienced little success in convincing enough breeders to select efficiently against fearfulness; the problem does not seem to decrease. One reason might be that modern methods for genetic evaluation of potential breeding animals, such as BLUP, still today are rarely utilized by dog breeders (Arvelius and Klemetsdal (2013)).

Since 1997, 25-50% of the Rough Collies registered in the Swedish Kennel Club (SKC) each year are subjected to a temperament test, the Dog Mentality Assessment (DMA). The DMA is a test battery during which the intensity of 33 behavioral reactions are rated using predefined five-step scales. In a previous studie, five personality traits have been defined using factor analysis of the DMA variables (Svartberg and Forkman (2002)). These personality traits were shown to correlate (on a phenotypic level) with e.g. fearfulness in everyday life situations (Svartberg (2005)), however, not specifically for Collie. Strandberg et al. (2005) found additive genetic variation for these personality traits for Rottweilers and German Shepherd Dogs (h^2 0.10-0.25). It is therefore reasonable to hypothesize that DMA as an indicator can provide useful information about the breeding goal trait "everyday life behavior".

Our objective was to study if DMA data is possible to use for selection to decrease everyday life fearfulness in the Swedish Rough Collie population, by estimating heritabilities for the DMA traits and their genetic correlations to relevant breeding goal traits. We also wanted to compare different methods to calculate the DMA traits.

Materials and Methods

Data. DMA data were received from the Swedish Kennel Club (SKC) and contained records from 2953 identifiable dogs tested from January 1997 to November 2010. The sex ratio of the records for males to females was close to even. The average test age was 21 months (SD=10, min=12, max=120).

Data on the dogs' behavior in everyday life situations were collected by asking approximately 3600 owners of Rough Collies aged from 6 months to 10 years to fill out a web-based Swedish version of the Canine Behavioral Assessment and Research Questionnaire (C-BARQ) (Hsu and Serpell (2003)). Questionnaire data were collected during the period June-October 2010 and included records from 1738 identifiable dogs with a close to even sex ratio. 953 dogs had both questionnaire and DMA data. The average age when the questionnaire was answered was 68 months (SD=37, min=6, max=140).

Pedigree data were received from SKC and contained records from Rough Collies born from 1965 to 2011. After excluding all dogs except those with DMA or C-BARQ information and their ancestors, 8443 individuals remained.

Trait definitions. Following Hair et al. (1998), factor analysis of the DMA records for Rough Collie resulted in 5 factors (latent root criterion). After orthogonal varimax rotation, the factor loading pattern indicated that 22 of the 33 variables would be appropriate to use when computing 5 composite measures following the concept of summated scales (SS). A SS was calculated as an average of the standardized (mean=0, SD=1) values for the items judged to be good representatives for that factor. Between 3 and 7 items were included in each SS. Furthermore, the loadings from the rotated solution were used for computing factor scores (FS). Thus, composite measures were constructed both as SS and as FS. Our factor analysis gave a similar pattern of factor loadings as the study by Svartberg and Forkman (2002). Therefore, the composite measures were considered as personality traits and given the same names: Playfulness, Curiosity/fearlessness, Chase-proneness, Sociability and Aggressiveness.

C-BARQ consisted of 101 questions of which 78 were used for computing 15 behavior subscale scores

(BSS). Between 4 and 10 items were included in each BSS, which was calculated as an average of the items.

One of the five DMA SS (Aggressiveness) and seven of the fifteen C-BARQ BSS showed Cronbach's alpha values <0.70, indicating poor internal consistency (Hair et al. (1998)), and were therefore excluded from further analyses.

The SAS software (SAS (2008)) was used for data editing, factor analysis and calculating Cronbach's alpha values.

Estimation of genetic parameters for DMA and C-BARQ traits. Genetic parameters for the DMA traits Playfulness, Curiosity/Fearlessness, Chase-proneness and Sociability were estimated in two multivariate analyses - one for traits calculated as SS (N=2667-2953) and one for FS (N=2664) - using a linear animal model including fixed effects of sex, year and month of test, and random effects of litter, judge, test occasion, genetic effect of the individual and residual. Age at test was included as linear and quadratic regressions.

Genetic parameters for the eight C-BARQ BSS (N=1149-1732) were estimated in univariate analyses using a linear animal model, including a fixed effect of sex, and random genetic effect of the individual and residual. Age when the questionnaire was completed was included as linear and quadratic regressions.

Genetic correlations between C-BARQ BSS and the two versions of the four DMA traits were estimated in bivariate analyses applying the models described above.

The DMU software (Madsen and Jensen (2010)) was used for all genetic analyses.

Results and Discussion

Genetic parameters for DMA and C-BARQ scores. All 4 SS and 4 FS DMA traits, as well as the 8 C-BARQ BSS, showed significant heritabilities (h^2 0.17-0.25, 0.13-0.22 and 0.06-0.36) (Table 1). For all pairwise comparisons of heritabilities, the SS method did better or equal compared to the FS method. On the one hand, inclusion of all 33 original DMA variables to calculate all 4 FS could have been expected to reduce error variance with higher heritabilities as a result (when calculating SS, only 3-7 variables were used to calculate each score). On the other hand, inclusion of all variables might have had the effect that variables with comparably low heritabilities had a negative influence on the heritabilities of the FS.

It is interesting to note that the C-BARQ heritabilities are of similar order of magnitude as the DMA heritabilities. One could have expected that trained judges and standardized implementation of DMA would generate more reliable ratings of the dogs' behavior, compared with a dog owner questionnaire. One explanation could be that the owner having the opportunity of observing a dog's behavior during a good part of its life, in contrast to the DMA where the judge observes the dog only for around 45 minutes, compensates for lack of training and standardization.

Table 1. Significant heritability estimates for Dog Mentality Assessment (DMA) personality traits computed as summated scales (SS) and factor scores (FS), and for Canine Behavioral Assessment and Research Questionnaire (C-BARQ) behavior subscale scores (BSS)

Trait	SS	FS	BSS
DMA			
Playfulness	0.25	0.19	
Curiosity/fearlessness	0.20	0.18	
Chase-proneness	0.17	0.13	
Sociability	0.22	0.22	
C-BARQ			
Chasing			0.14
Dog-directed aggression			0.09
Energy			0.06
Dog Rivalry			0.16
Nonsocial fear			0.36
Stranger-directed aggress.			0.24
Stranger-directed fear			0.25
Separation-related problems			0.14

Table 2. Significant genetic correlations between Dog Mentality Assessment (DMA) personality traits computed as summated scales (SS) and factor scores (FS), and Canine Behavioral Assessment and Research Questionnaire behavior subscale scores (C-BARQ BSS)

		C-BARQ BSS	
DMA trait		Nonsocial fear	Stranger-directed fear
Playfulness			
	SS	-0.52	-0.40
	FS	-0.46	-0.33
Curiosity/fearlessness			
	SS	-0.70	-0.44
	FS	-0.70	-0.41
Chase-proneness			
	SS	-0.43	-0.30
	FS	-0.30	-0.28
Sociability			
	SS	-0.46	-0.80
	FS	-0.39	-0.83

Validity. There were significant correlations between both versions of the DMA traits (SS and FS) and everyday life behavior of the dogs as described by the owners in the questionnaire, and neither method to calculate underlying DMA traits succeeded systematically better than the other in this respect (not shown). However, priority for the Swedish Rough Collie population is to select against everyday life fearfulness. Therefore, the two most interesting C-BARQ BSS are Nonsocial fear and Stranger-directed fear. The genetic correlation to the former was high for the

DMA trait Curiosity/fearlessness (-0.70 for both SS and FS), and to the latter for the DMA trait Sociability (-0.80 (SS) and -0.83 (FS)) (Table 2).

When comparing the SS and the FS method in terms of the genetic correlations presented in Table 2, the SS method generated stronger correlations in all cases with only two exceptions (for Curiosity/fearlessness vs. Nonsocial fear the correlations were equal for the two methods, for Sociability vs. Stranger-directed fear the FS method resulted in a higher correlation).

Conclusion

We conclude that data from the Dog Mentality Assessment (DMA) is possible to use for selection to decrease everyday life fearfulness in the Swedish Rough Collie population. In terms of heritabilities and validity (genetic correlation between DMA result and everyday life fearfulness as described by dog owners), the summated scales method to compute DMA composite measures seem to perform better than the factor scores method.

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