

Genetics of behavior traits in dogs

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Possibilities for selection for behavior traits in dogs

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Behavioral tests as basis for selection

- **Objective:** an efficient selection of dogs with the desired behavioral traits for genetic progress of temperament and functionality
- Successful selection requires methods to measure genetic differences in behavioral traits
- How should dogs be tested to get the best information for selection?



Two types of behavior tests

- Test of functionality based on the practical situation, e.g. field trials for hunting
- Standardized behavior characterizations,
 - Based on defined behavior traits assumed to be related to functionality
 - Test situations constructed based on these traits

Test of functionality in practice

- Advantage: clear connection with the practical situation,
 - “index trait = breeding goal trait”
- Drawbacks:
 - practical situation may be too complex and consist of several “genetic” traits
 - Grading often from bad to good
- Example
 - Hunting test in pointers and setters



Some examples of tests

- Tests of functionality/field trials
 - Hunting test for British gun dogs in Sweden
- Behavior characterizations
 - Border collie herding trait characterization
 - Test of hunting behavior in flatcoated retrievers
 - (Dog mentality assessment)

Hunting test for British gun dogs in Sweden

Lousie Holm, MSc-thesis

Traits measured

- Speed
- Style
- Hunting eagerness
- Independence (of other dog)
- Seeking width
- Ability to work in the field
- Cooperation (with human)
- Bird finding
- Precision in raising bird
- Raising bird
- Standing when other dog stands
- Retrieving
- Reporting

Traits measured

- Speed
- Style
- Hunting eagerness
- Independence (of other dog)
- Seeking width
- Ability to work in the field
- Cooperation (with human)
- Bird finding (60% missing observations)
- Precision in raising bird (60% missing)
- Raising bird (66% missing)
- Standing when other dog stands (95% missing)
- Retrieving (83% missing)
- Reporting (99.9% missing)



Traits measured

- Speed
- Style
- Hunting eagerness
- Independence (of other dog)
- Seeking width
- Ability to work in the field
- Cooperation (with human)

(only 2-7% missing observations)



Traits measured

- Speed
- Style
- Hunting eagerness

Not acceptable

Acceptable

Quite good

Good

Very good

Excellent



Traits measured

- Independence (of other dog)

Totally dependent

Very dependent

Somewhat dependent

Checking up on the other

Almost independent

Totally independent

Traits measured

- Seeking width

Too narrow

Somewhat too narrow

Good

Excellent

Somewhat too wide

Too wide



Traits measured

- Ability to work in the field

Without a plan

Irregular

Somewhat too tight

Excellent

Somewhat too open

Too open

Traits measured

- Cooperation (with human)

Fixated on human

Somewhat dependent on human

Good

Excellent

With own will

Uncooperative



Heritability estimates for English setter and Pointer

	English setter	Pointer
1 Speed	0.13	0.04
2 Style	0.11	0.04
3 Eagerness	0.12	0.07
4 Independence	0.01	0.03
5 Width	0.07	0.09
6 Ability	0.04	0.02
7 Cooperation	0.04	0.07

About 800 dogs per breed



Repeatability estimates for English setter and Pointer

	English setter	Pointer
1 Speed	0.24	0.27
2 Style	0.22	0.22
3 Eagerness	0.21	0.27
4 Independence	0.05	0.11
5 Width	0.24	0.30
6 Ability	0.16	0.13
7 Cooperation	0.15	0.16

Genetic correlations for English setter (above) and Pointer (below diag)

	1	2	3	4	5	6	7
1 Speed	-	0.99	0.98	0.99	0.78	0.99	0.74
2 Style	0.97	-	0.97	0.99	0.81	1.0	0.72
3 Eagern	0.99	0.77	-	1.0	0.95	0.99	0.96
4 Indep	0.99	0.99	0.99	-	1.0	0.99	0.96
5 Width	0.92	0.62	0.79	0.99	-	0.97	0.99
6 Ability	0.69	0.54	0.83	0.99	0.99	-	0.92
7 Coop	0.99	0.99	0.79	0.77	0.99	0.99	-

Most traits are very strongly correlated



Hunting test for British gun dogs in Sweden: **Conclusions**

- Too low heritabilities for the traits to be used for mass selection
- Even with own, parental and sibling information included via BLUP, rather low accuracy, but better
- Repeatability higher, can to some extent be used to predict expected behavior within dog

Herding trait characterization in Border Collie in Sweden

Per Arvelius et al, submitted

Herding trait characterization

- Carried out in connection with sheep dog training, usually introductory courses for sheep dogs – close to a real situation
- Done by course instructor, local breed club consultant and dog owner
- Two consecutive protocols were used with 17 and 19 traits, respectively

Heritability estimates in the two versions

- Heritabilities generally higher in the first version of the test

	Version 1	Version 2
Average	0.30	0.16
High (> 0.4)	5	1
Medium (0.2-0.4)	10	7
Low (<0.2)	2	11*
		*3 ns

Heritabilities in the 2 versions for some comparable traits

	Ver 1	Ver 2
Balance	0.40	0.23
Natural working distance	0.39	0.29
Effective working distance	0.50	0.18
Natural ability	0.48	0.21
Eye	0.47	0.37
Outrun	0.33	0.34
Lift	0.25	0.12
Grip	0.31	0.13

Example of changed definition

Effective working distance

The distance where the animals become affected by the dog and start to move away.

- 0: 0-1 m
- 1: 1-2 m
- 2: 2-3 m
- 3: 3-5 m
- 4: 5-10 m
- 5: >10 m

$$h^2=0.50$$

- 0: Fails to move the animals regardless of distance.
- 1: needs to go very close
- 2: needs to go rather close
- 3: needs a medium long distance
- 4: needs a long distance
- 5: Can move any animals, also from a very long distance.

$$h^2=0.18$$



Most likely reasons for lower heritabilities in version 2

- Version 1 based on increasing intensity
- Less objective measures, values (good, bad, too far away, ...) used in version 2
 - New trait “Courage”:
 - 0: acts cowardly
 - 1: somewhat afraid of the animals
 - 2: too cautious
 - 3: normally cautious
 - 4: very unafraid
 - 5: death wish (lacks selfpreservation)

Most likely reasons for lower heritabilities in version 2

- Version 1 based on increasing intensity
- Less objective measures, values (good, bad, too far away, ...) used in version 2
- Some traits having almost same scale in both versions still had lower h^2 in ver 2
 - Lower interest in the test, fewer dogs tested, less qualified judges, more selected dogs, ...?

Herding trait characterization in Border Collie: **Conclusions**

- High heritabilities enough for mass selection, especially in version 1
- High heritabilities for behavior traits
- Beware of including value judgments into the scales

Progeny-test of hunting behavior in Flatcoated Retriever

Sofia Malm et al.

Lindberg et al, Appl Anim Beh Sci 88:289

Progeny-test of hunting behavior in Flatcoated Retriever

- ❑ Carried out by the Swedish Flatcoated Retriever Club
- ❑ Started in 1992
- ❑ Designed to be used as a progeny-testing tool
- ❑ Dogs should be between 12 and 24 months
- ❑ Whole litter tested at the same time
- ❑ Several standardised hunting situations
- ❑ Scales intend to show increasing intensity of reaction in the various tests, not good or bad

Description of the test

Subtest	Scores
1. Reaction to shot	1-5
2. Single marking test	1-6
3. Searching and retrieving	
a) Reaction when throwing the game	1-7
b) Interest in search	1-7
c) Retrieving	1-7
d) Delivery	1-5
e) Grip	1-5
f) Speed	1-3
g) Efficiency in searching	1-5
4. Interest in water retrieving	1-4
5. Cooperation	1-6
6. Waiting passively in a group	1-5

Example of description of variables

- Reaction when throwing the game
 - 1: shows discomfort to the situation
 - ...
 - 7: great excitement, clear whine
- Interest in search
 - 1: no interest
 - ...
 - 7: great interest during whole test

Heritability of separate traits

Subtest	h^2
1. Reaction to shot	0.37
2. Single marking test	0.13
3. Searching and retrieving	
a) Reaction when throwing the game	0.41
b) Interest in search	0.26
c) Retrieving	0.34
d) Delivery	0.15
e) Grip	0.19
4. Interest in water retrieving	0.23
5. Cooperation	0.12
6. Waiting passively in a group	0.74

Ca 1100 dogs



Results: Factor analysis

Subtest	Factor1	Factor2	Factor3
	<i>Excitement</i>	<i>Willingness to retrieve</i>	<i>Independence</i>
1. Reaction to shot	0.54	0.10	0.07
2. Single marking test	0.46	0.30	-0.11
3a. Reaction when throwing the game	0.61	0.04	0.03
3b. Interest in search	0.13	0.67	0.18
3c. Retrieving	-0.04	0.57	-0.08
3d. Delivery	0.07	0.32	-0.53
3e. Grip	-0.04	0.06	0.41
4. Interest in water retrieving	0.03	0.00	0.15
5. Cooperation	0.37	0.26	0.44
6. Waiting passively in a group	0.49	-0.18	0.01

Estimation of genetic parameters for broader personality traits

Personality trait	Excitement	Willingness to retrieve	Independence
Excitement	0.49		
Willingness to retrieve	0.15	0.28	
Independence	-0.08	0.02	0.16

Hunting behavior in Flatcoated Retriever:

Conclusions

- Relatively high heritabilities, even mass selection could be successful
- More practical to use 3 broader traits than all subtraits
 - High heritability and uncorrelated
- Need to decide on direction for selection!
 - Both Excitement and Independence have intermediate optima

Overall conclusions

- Possibilities for improvement from selection varies between populations and tests
 - Good for some situations, not for others
- Easier to get higher heritability if objective and intensity-based scales are used
- Avoid value judgments as much as possible
- Generally this means using standardized behavior characterizations
 - But ideally one should have genetic correlation estimates with breeding goal

