Improving Behavior With Estimated Breeding Values

Breeders Workshop, Vancouver Canada

May 1-3, 2023

Jane Russenberger,

International Working Dog Registry

Our Thanks To

Guiding Eyes for the Blind

Leading the way
Allowing use of their data and results

IWDR

Users of IWDR for
Learning to use these
Tools and collaborating in IWDR

What data are required

Best age to measure
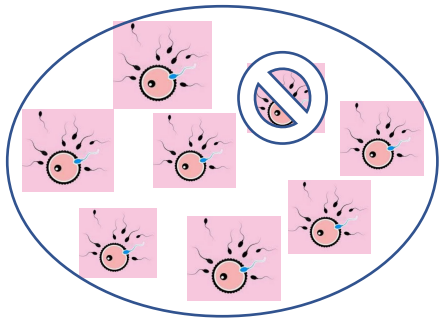
Estimates of heritability

Challenges

Response to selection

Multiple Measures- Same Scoring System

Guiding Eyes for the Blind

Graduated Working Dog (highlighted)

Training 16-25 mo (highlighted)

Early Development

Age 3-8 weeks (highlighted)

2 months old
GDBart Pup Test
+ observations from early socializations
N>3000

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Trainer's observation
In kennel, field work, social situations

Half-way in training
End of training
Also if withdrawn
N>7,300

On all or most dogs-
(even those rejected)

Puppy Raising
2-15 months (highlighted)

4,8,13 Mo W&T
Observe puppy walker –semi-standard assessment
Group puppy class observations
Raiser surveys
N>9,000

Pre-train assessment

Ave age -16 months (highlighted)

Start of training
GDBart Adult Test
 N>3400

What Causes Observed Variation?

Genetic makeup fixed at conception

Sex and color won't change due to the environment

Variation in aspects of behavior very impacted by environment
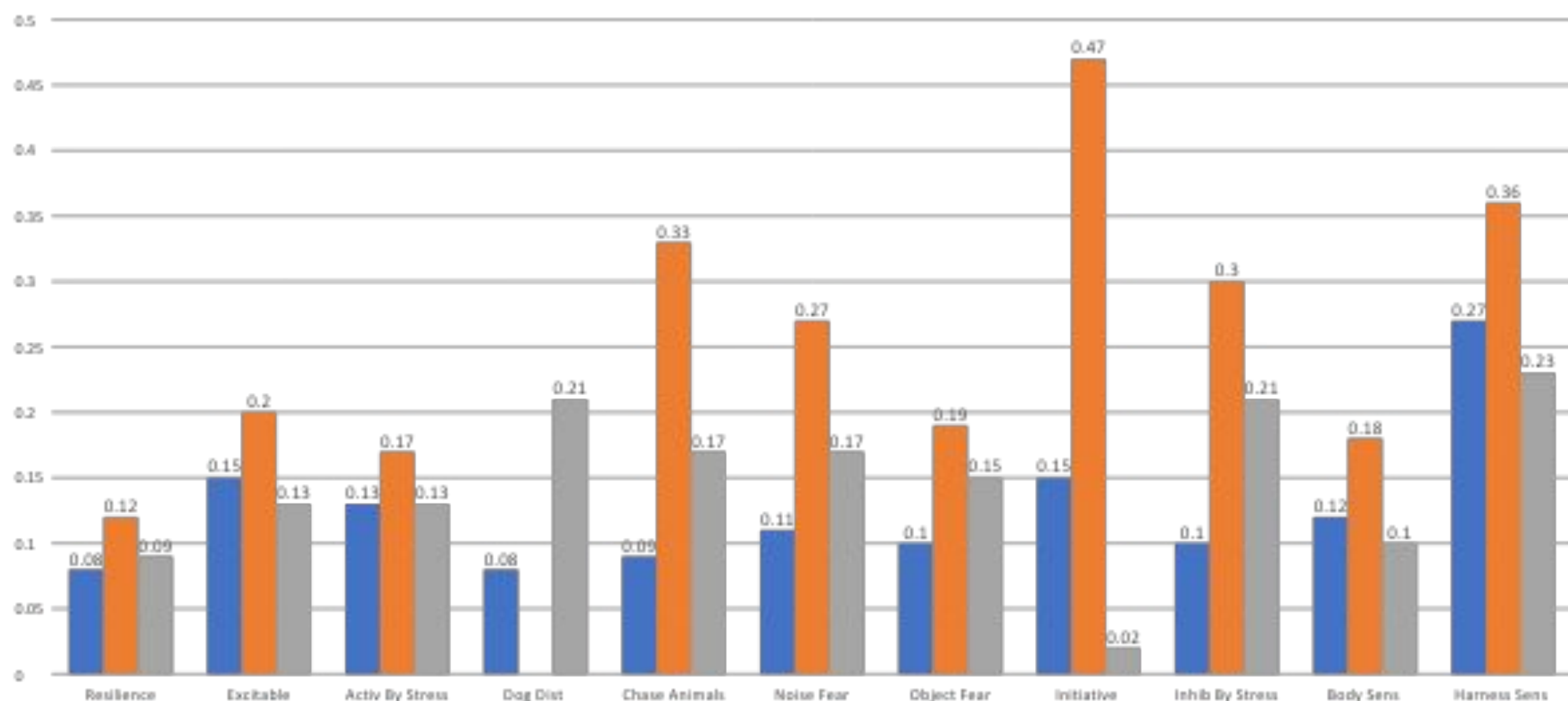
Genetic potential **+** Environmental influence
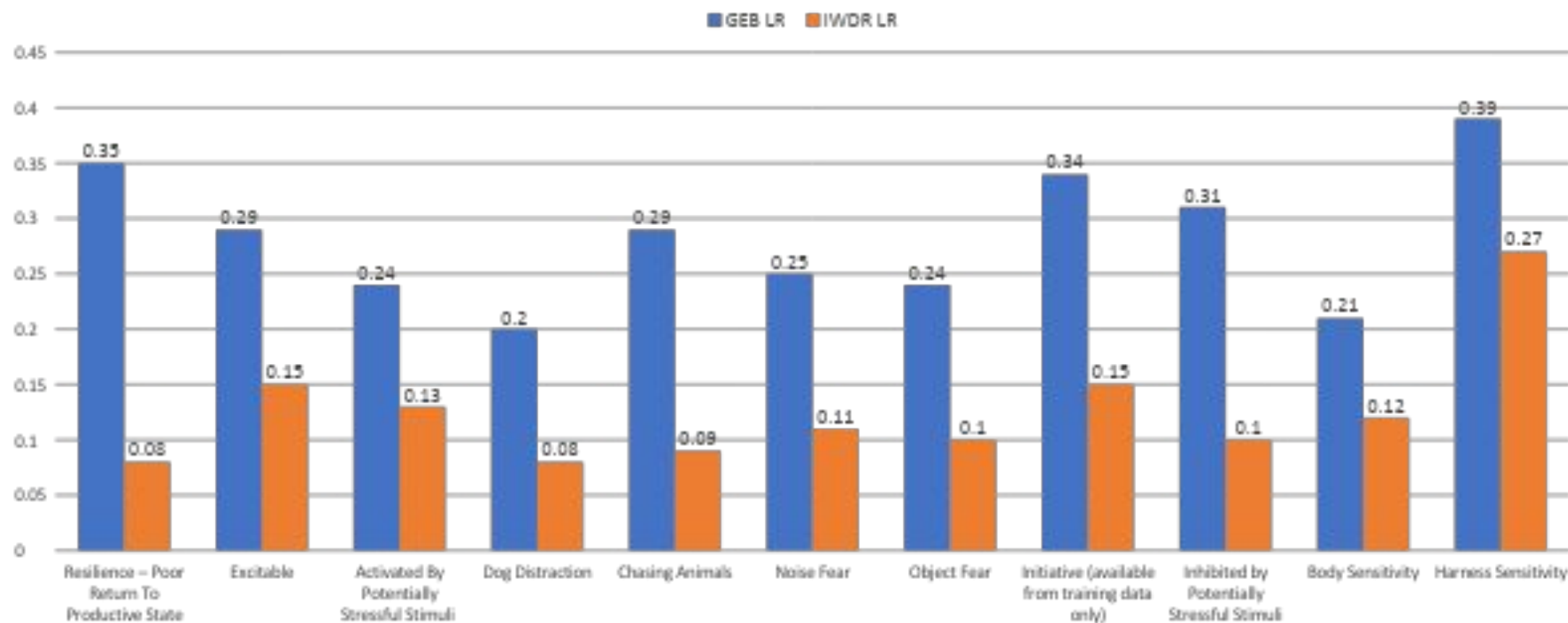
Estimates of Heritability - Three Breeds
Using All BCL Data- Puppy Test, W&T, GDBart IFT, Training Observations
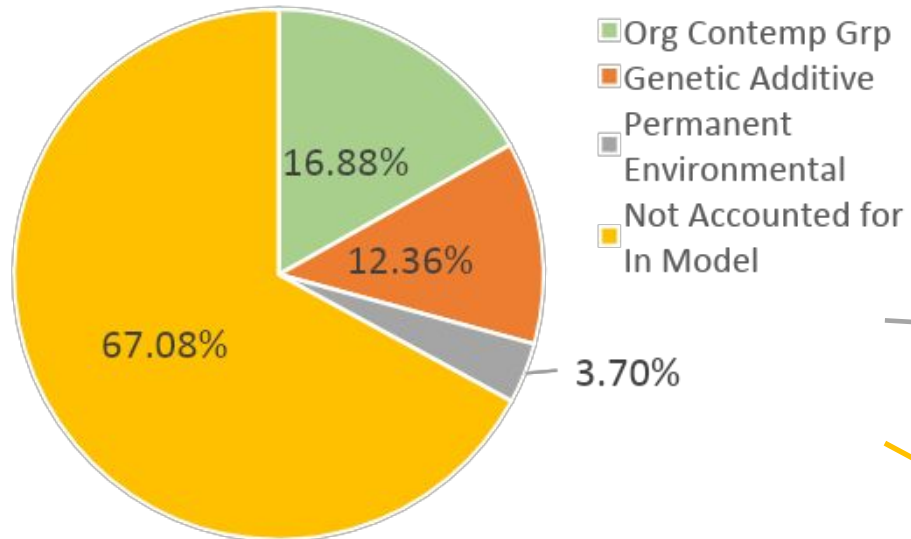
■ IWDRLR ■ IWDR GR ■ IWDR GS

Trait	IWDRLR	IWDR GR	IWDR GS
Resilience	0.08	0.12	0.09
Excitable	0.15	0.2	0.13
Activ By Stress	0.13	0.17	0.13
Dog Dist	0.08		0.21
Chase Animals	0.09	0.33	0.17
Noise Fear	0.11	0.27	0.17
Object Fear	0.1	0.19	0.15
Initiative	0.15	0.47	0.02
Inhib By Stress	0.1	0.3	0.21
Body Sens	0.12	0.18	0.1
Harness Sens	0.27	0.36	0.23

Estimates of Heritability GEB vs IWDR LR

Using All BCL Data- Puppy Test, W&T, GDBart IFT, Training Observations

■ GEB LR   ■ IWDR LR

Category	GEB LR	IWDR LR
Resilience – Poor Return To Productive State	0.35	0.08
Excitable	0.29	0.15
Activated By Potentially Stressful Stimuli	0.24	0.13
Dog Distraction	0.2	0.08
Chasing Animals	0.29	0.09
Noise Fear	0.25	0.11
Object Fear	0.24	0.1
Initiative (available from training data only)	0.34	0.15
Inhibited by Potentially Stressful Stimuli	0.31	0.1
Body Sensitivity	0.21	0.12
Harness Sensitivity	0.39	0.27

What Influences Heritability?

	Org Contemp Grp	Additive Genetic	Permanent Environment	Unexplained	Total
Variance	0.13349	0.097725	0.029278	0.53056	0.79093
% Var/Total	16.88%	12.36%	3.70%	67.08%	100.00%

LR IWDR Noise Sens H2- 0.12   SE- 0.01
NData- 14258 NPed- 22807

Legend:
- Org Contemp Grp
- Genetic Additive
- Permanent Environmental
- Not Accounted for In Model

Pie chart values: 16.88%, 12.36%, 67.08%, 3.70%

Dogs evaluated in the same 3 mo period at an organization
- Testing method per protocol, consistently done
- Scoring accuracy
- Data only on breeders (best phenotypes)

- Distribution of genes across dogs measured in the population
- Additive gene effects passed from parents to offspring
- Family within a breed
- Missing ancestors that tie pedigrees together

- Learned Conditioned Emotional Response
  - Sibling interactions (e.g. bullying)
  - Fear of dam
- Socialization quality & quantity at target ages
- Raiser/trainer skills

- Unaccounted for in the genetic model

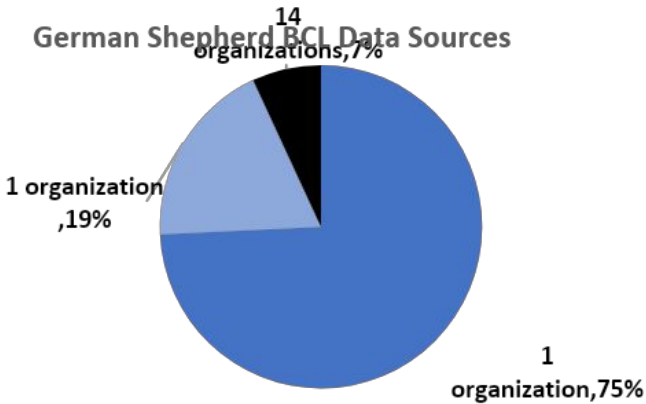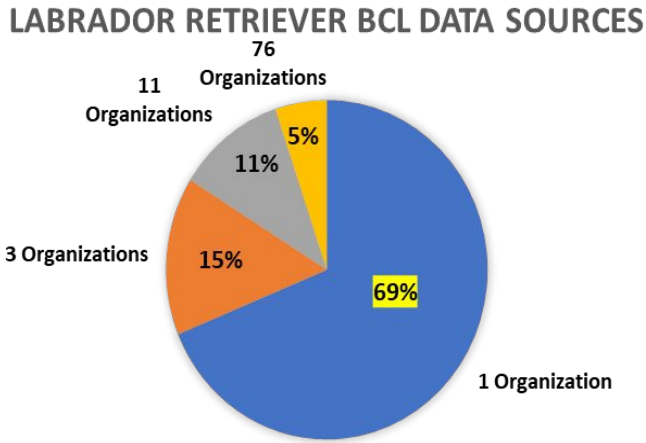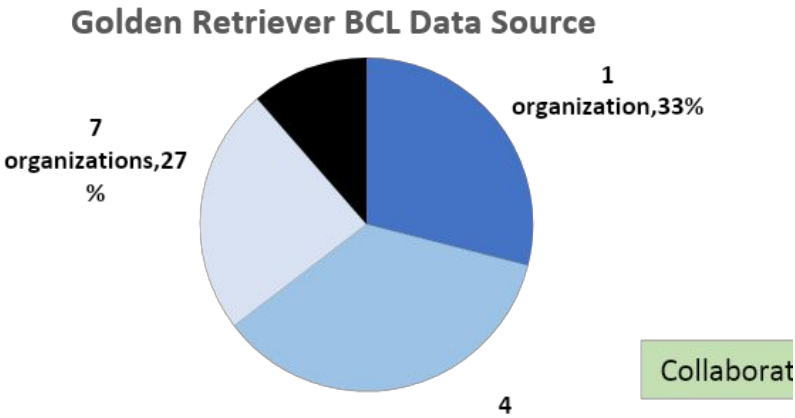% Total Variance Explained by Organization Providing Data
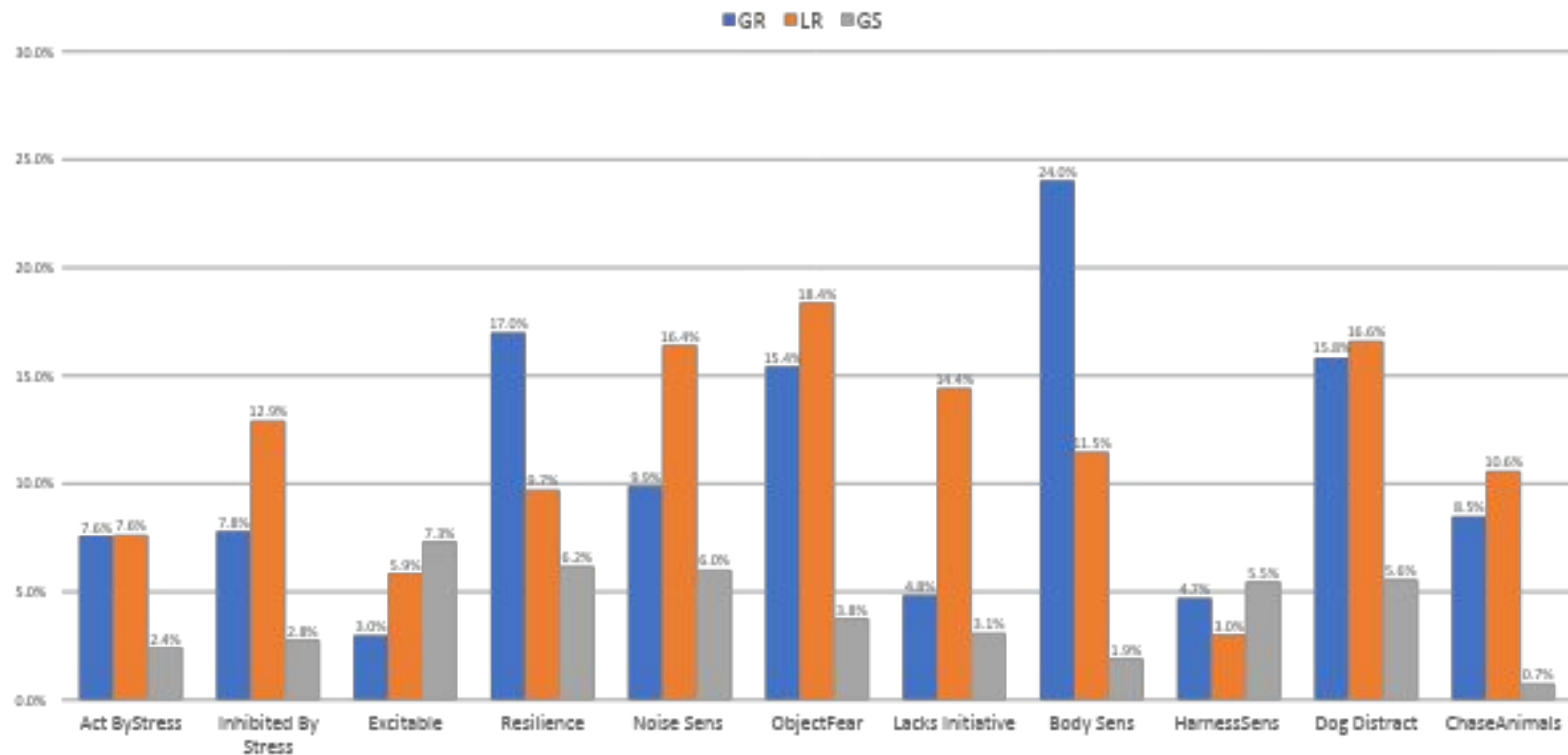
■ GR ■ LR ■ GS

Contemporary Grp Within Org	GR	LR	GS
Activated with Stress	7.4%	8.0%	2.5%
Excitable	2.8%	5.7%	7.0%
Resilience (return productive state)	19.8%	9.8%	5.7%
ObjectFear	17.0%	18.6%	4.2%
Noise Sensitivity	11.6%	16.3%	6.3%
Lacks Initiative	1.0%	13.6%	2.1%
Inhibited with Stress	9.2%	13.3%	3.1%
HarnessSensitivity	4.0%	3.1%	5.6%
Dog Distraction	18.6%	16.1%	5.9%
ChaseAnimals	10.1%	11.1%	0.7%
Body Sensitivity	25.2%	11.5%	1.8%

74% data from 5 orgs

31% data from 96 orgs
Variation Greater In

- BCL Scoring Skills
- Relatedness of Dogs
- Completeness of data

94% data from 2 orgs
Skilled BCL Scorers

Golden Retriever BCL Data Source

1 organization, 33%

7 organizations, 27%

4

Collaborat

LABRADOR RETRIEVER BCL DATA SOURCES

76 Organizations

11 Organizations

5%

11%

3 Organizations

15%

69%

1 Organization

German Shepherd BCL Data Sources

14 organizations, 7%

1 organization, 19%

1 organization, 75%

Variance Explained Labradors

H2, SE, NPed, NData

Update N-Ped after 3/19

~9000-12000 with data
~10000-13000 with pedigree file
SE behavior .09-0.13
SE health 0.02-0.04
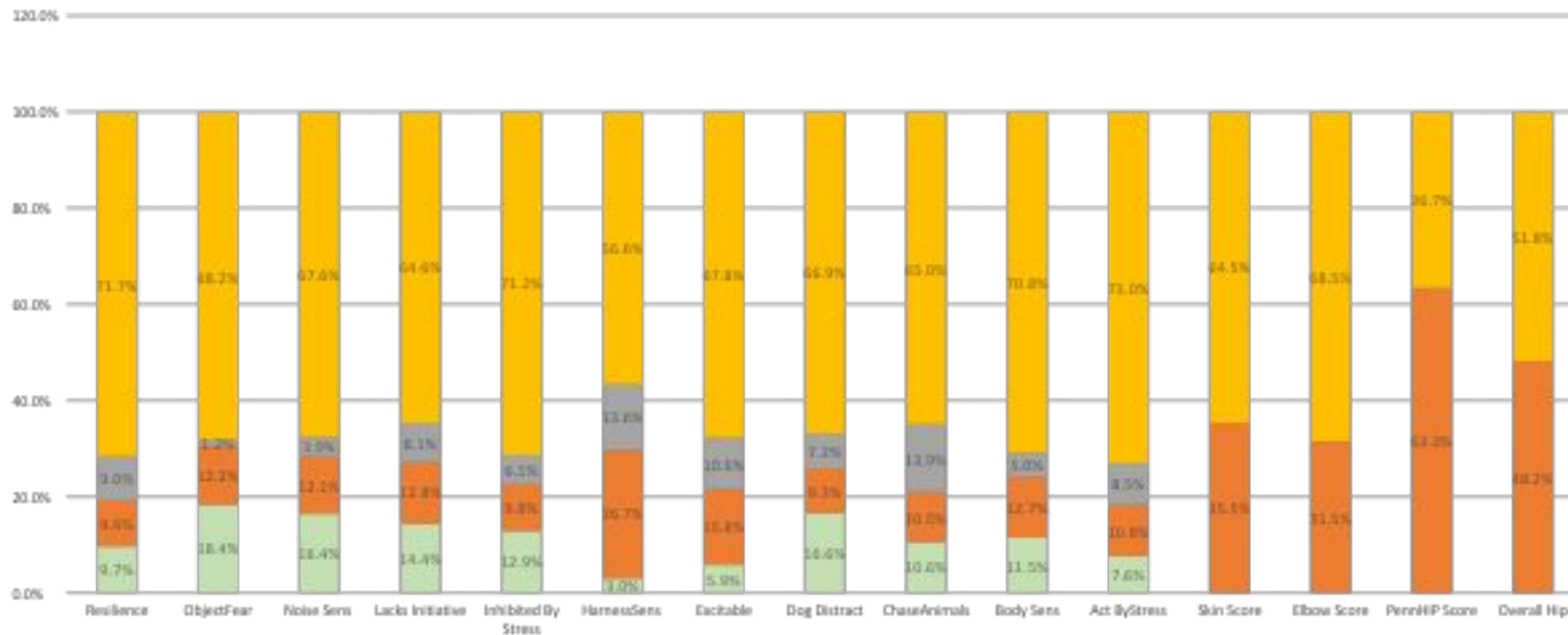
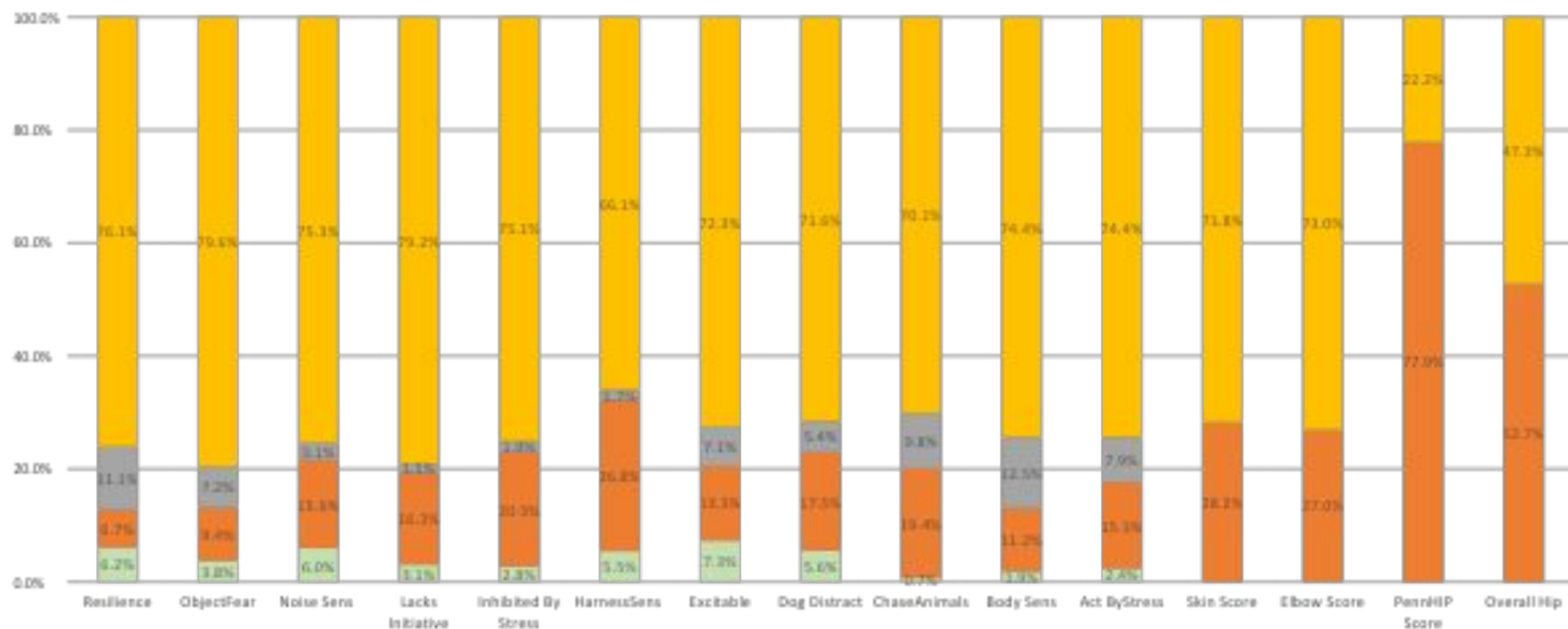Variance German Shepherds

H2, SE, NPed, NData

~600-1000 with data
~1300-1600 with pedigree file
Standard errors low (0.12 behavior)
Standard errors higher (0.34-0.64 health)

Update N-Ped after 3/19

Legend: □ Org ■ Genetic ■ Permanent Envir ■ Unexplained

Variance Golden Retrievers
H2, SE, NPed, NData

□ Org ■ Genetic ■ Permanent Envir □ Unexplained

~200 with behavior and 800 with health data
~ 1600 in pedigree file
SE 0.04-0.12 behavior
SE 0.07-0.13 health
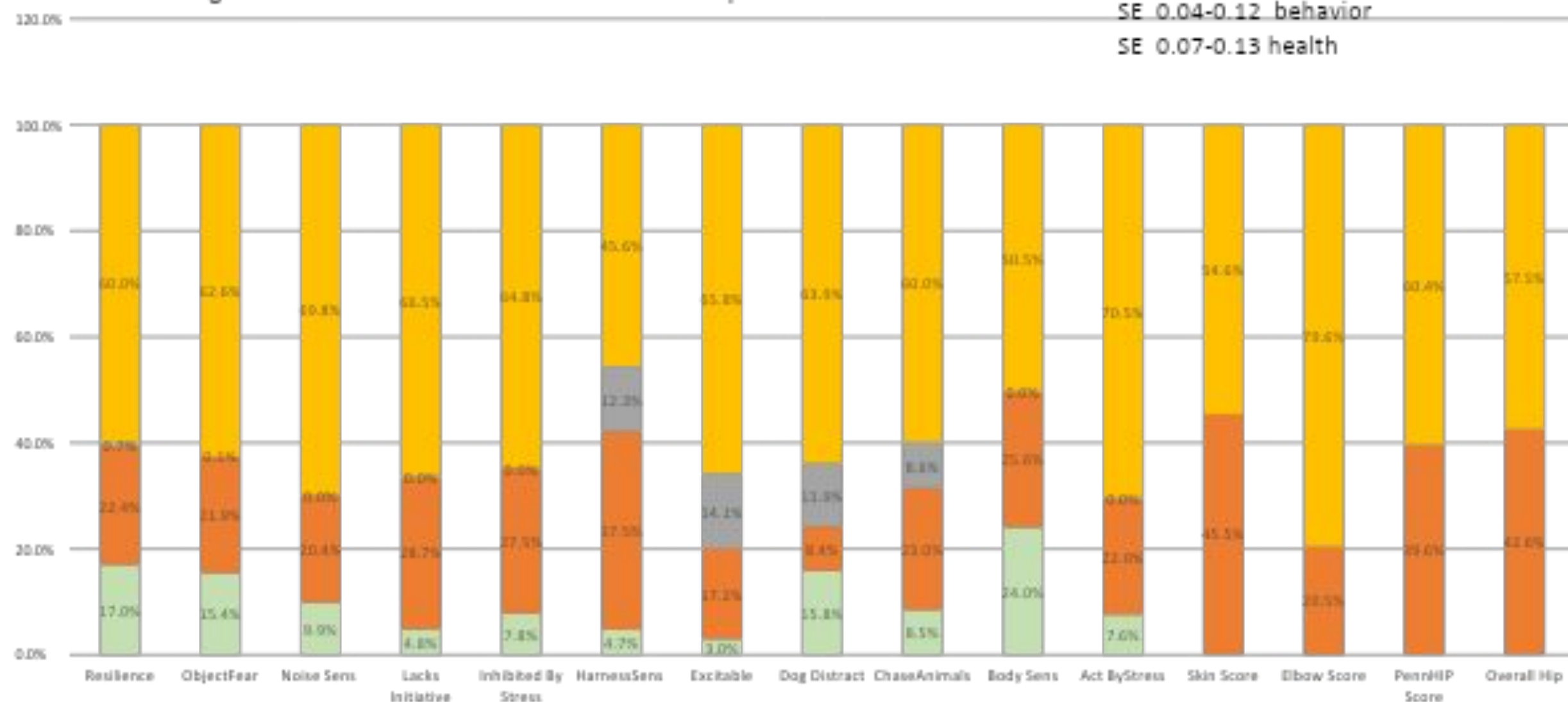
Choosing Where to Focus Genetic Selection Pressure
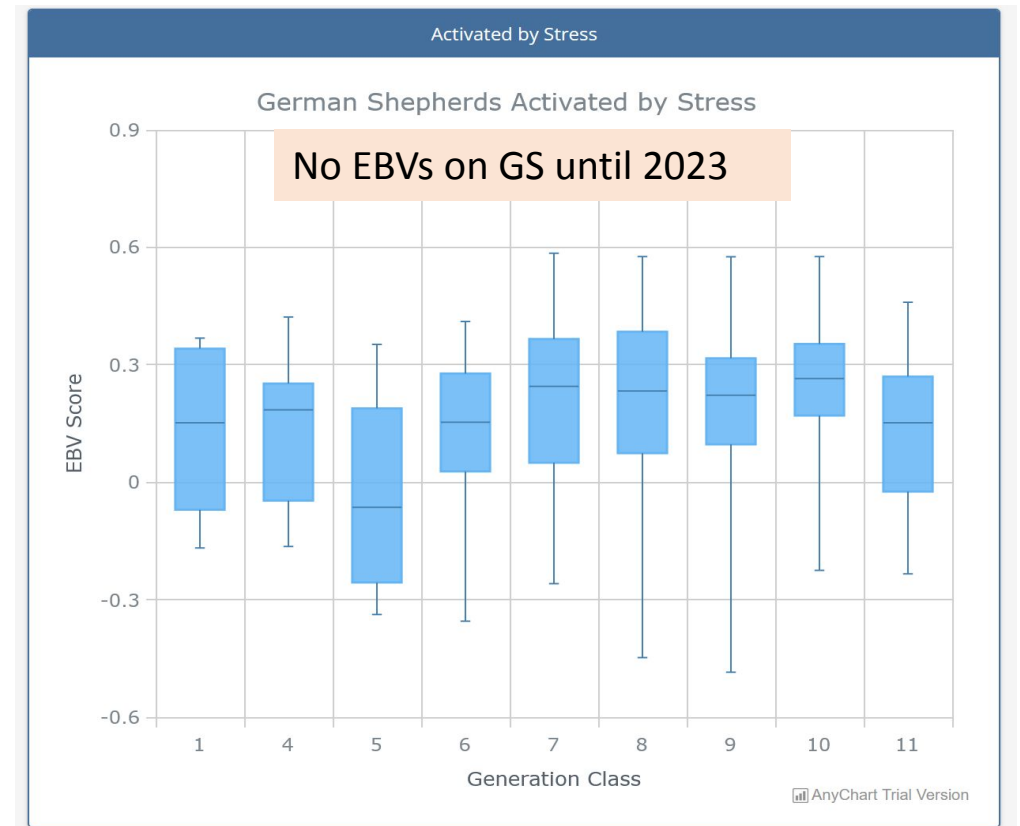

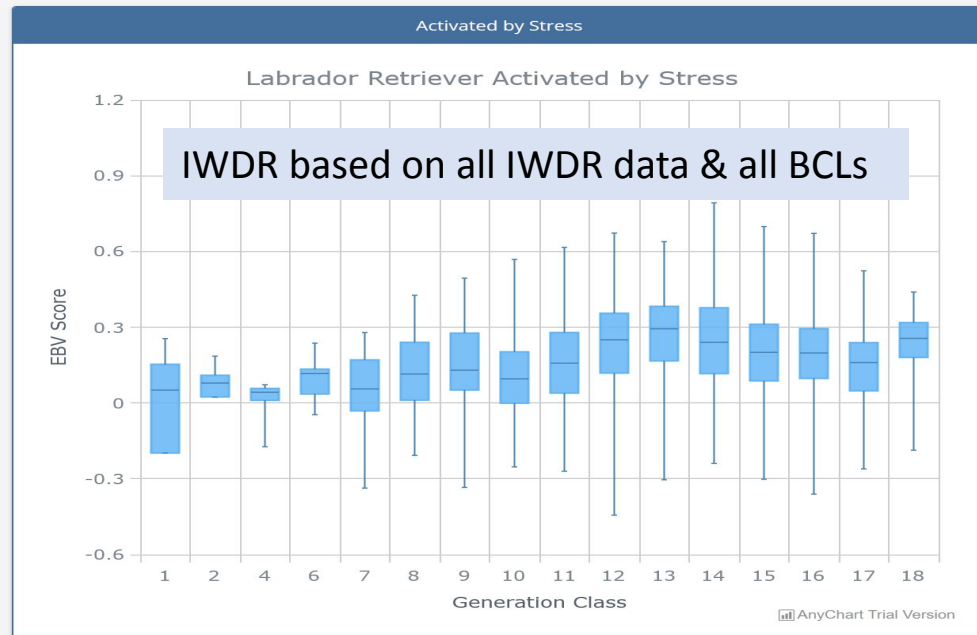Top 6 Reasons For Release

■ 2013 ■ 2014 ■ 2015 ■ 2016 ■ 2017 ■ 2018

Need MZ to provide
Updated data from Monthly Inv
Requested 3/11- organize by trait
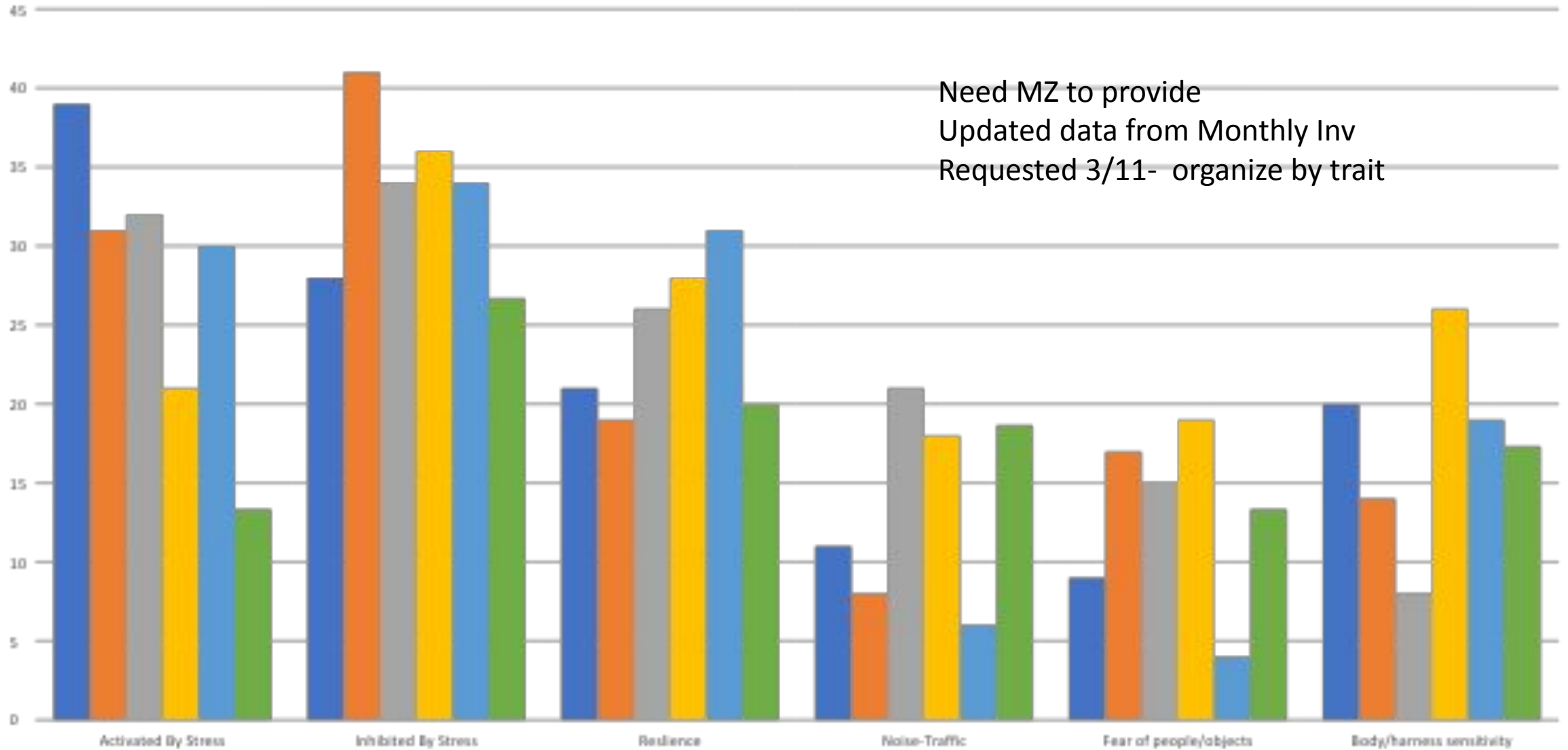
Activated by Stress

EBVs since xxxx LRs
Moderate selection pressure

Activated with Stress (PT) EBVs

GEB LRs -different model- BCLs from Puppy Test

January 09, 2023

Labrador Retrievers

Activated by Stress

Labrador Retriever Activated by Stress

IWDR based on all IWDR data & all BCLs

Activated by Stress

German Shepherds Activated by Stress

No EBVs on GS until 2023

Inhibited with Stress (PT) EBVs

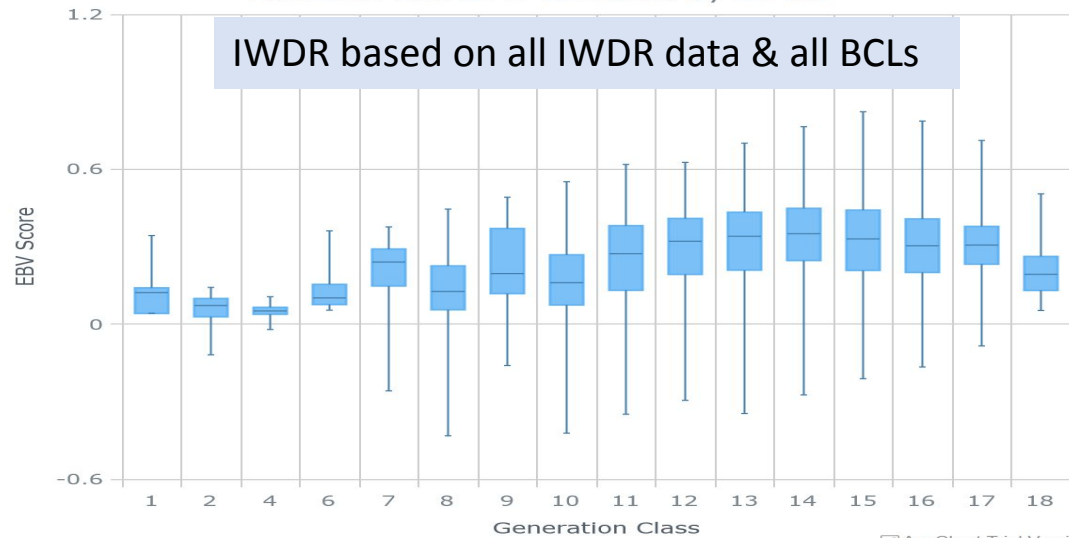GEB LRs different model- BCLs from Puppy Test
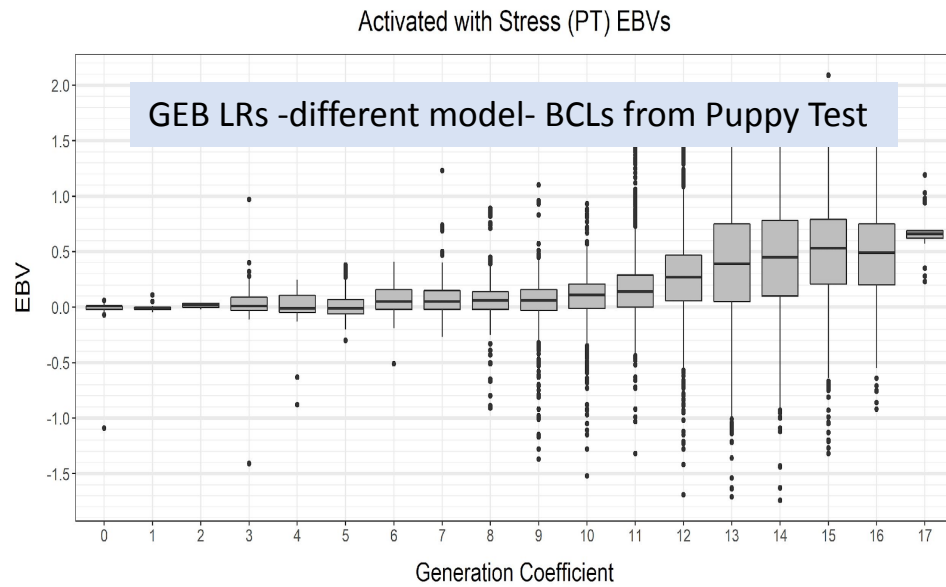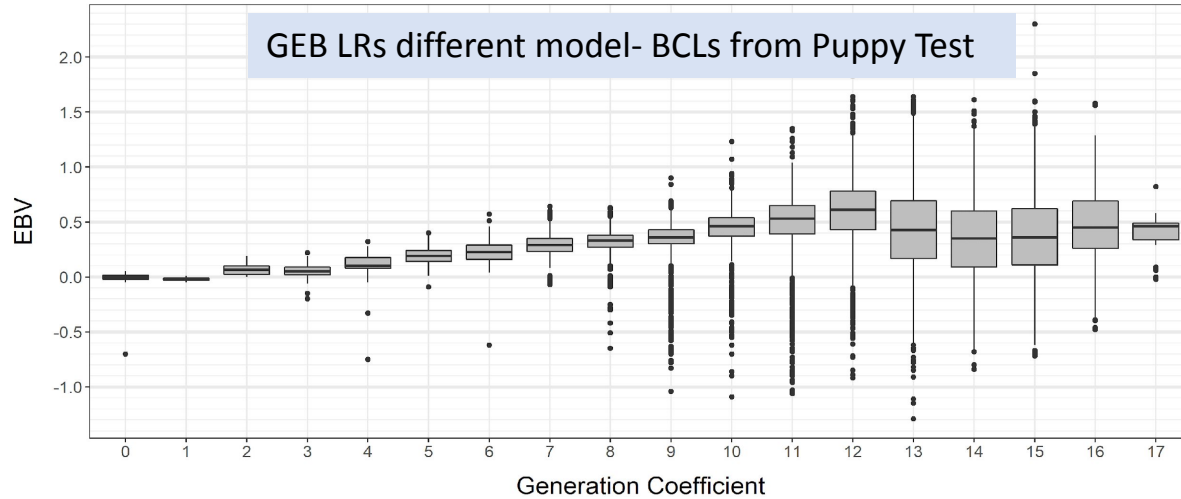
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Inhibited by Stress

EBVs since XXX in LRs

Small amount of selection pressure

Inhibited by Stress

Labrador Retriever Inhibited by Stress
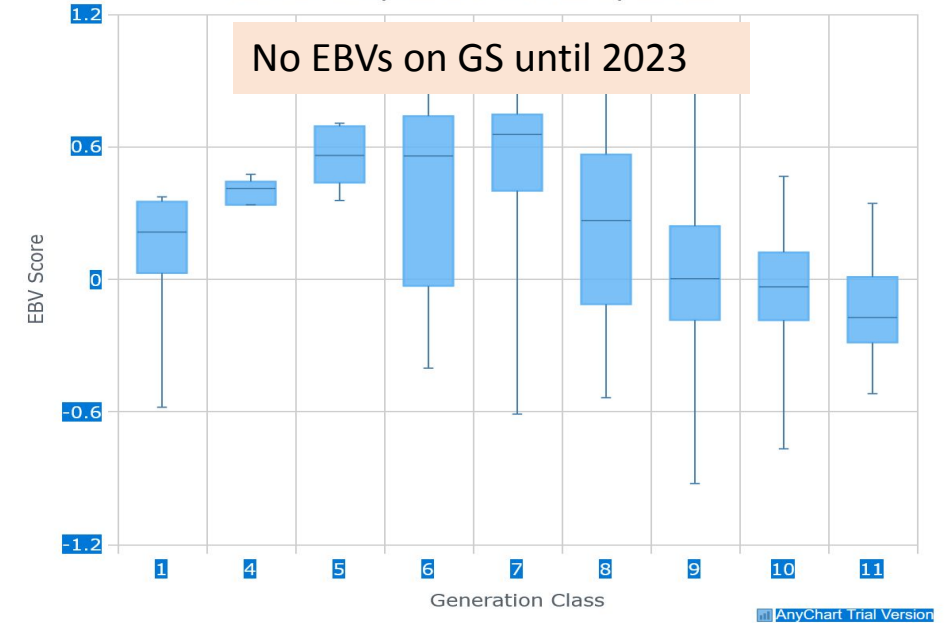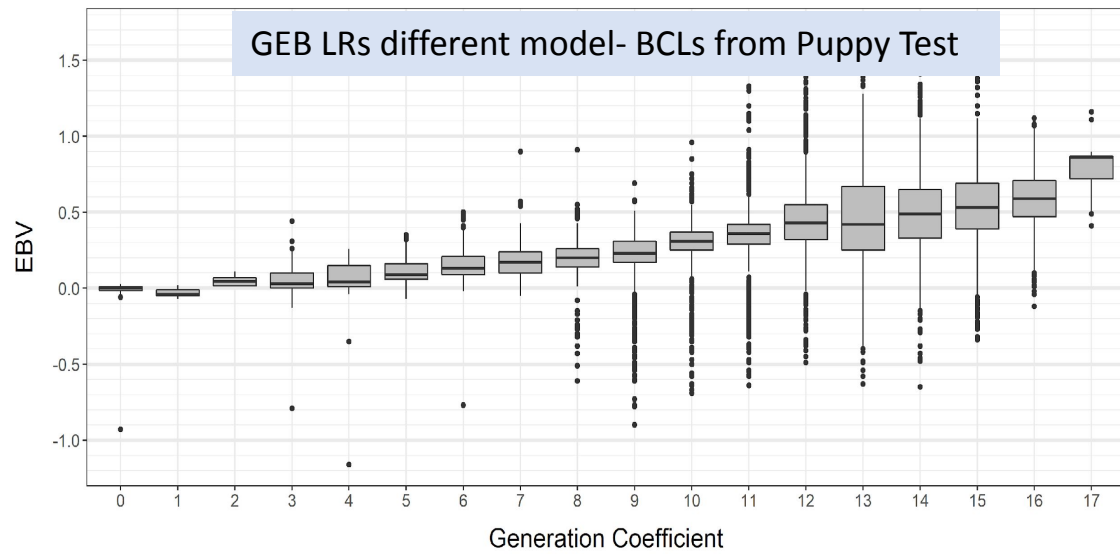
IWDR based on all IWDR data & all BCLs

Inhibited by Stress
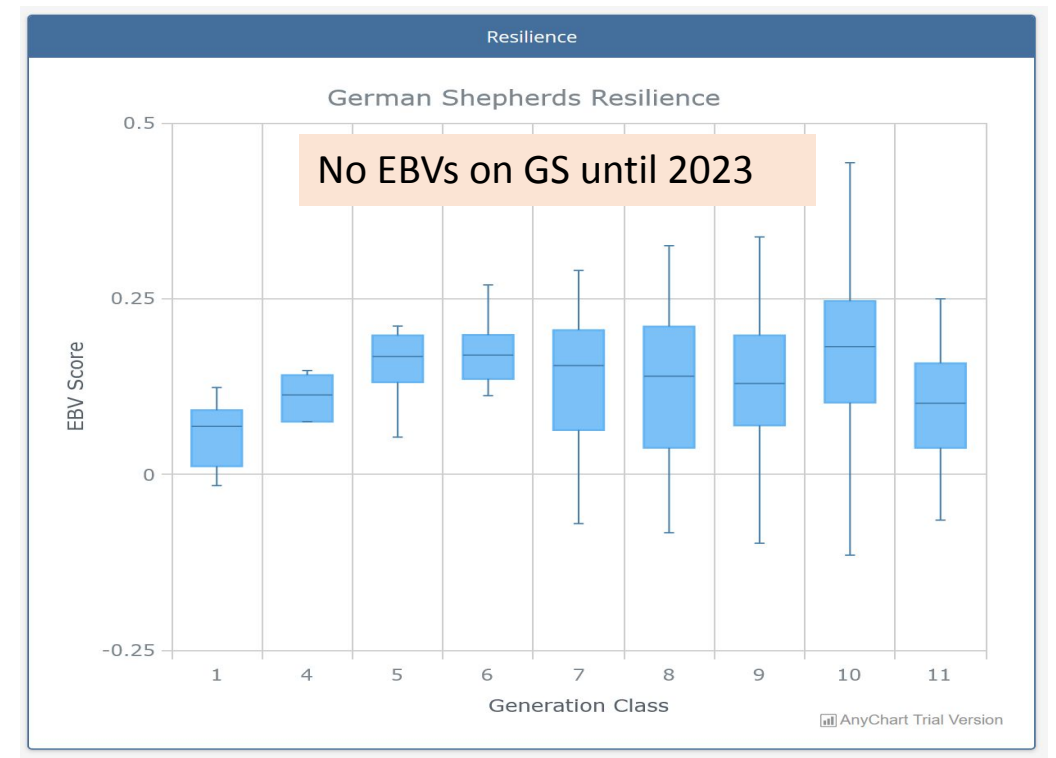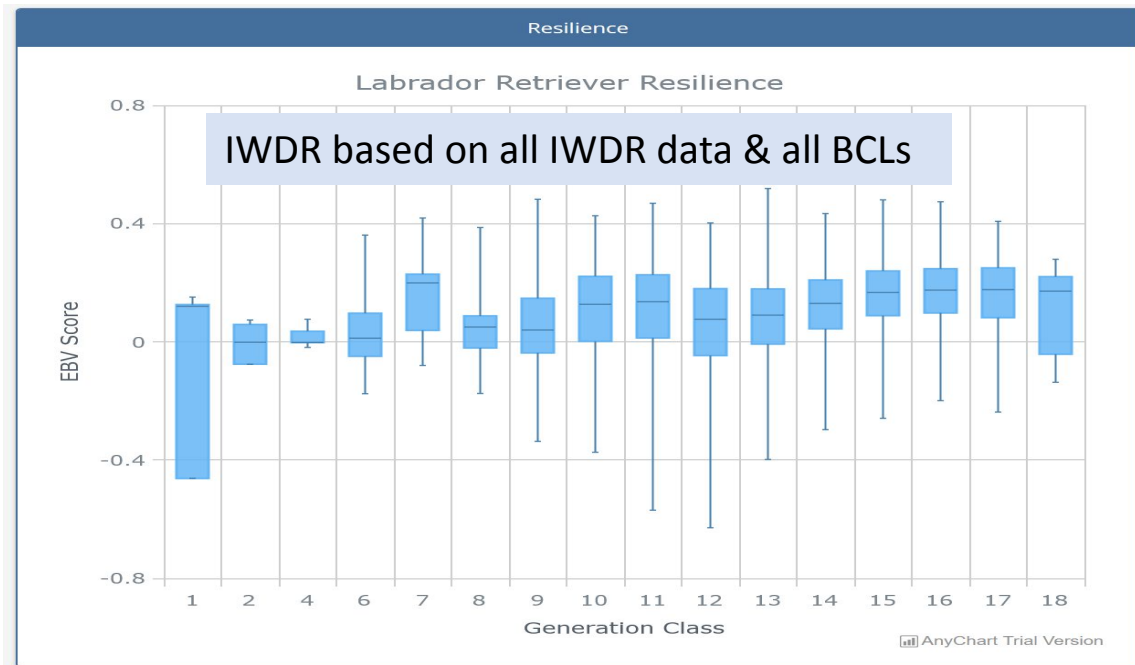
German Shepherds Inhibited by Stress

No EBVs on GS until 2023

Reslience
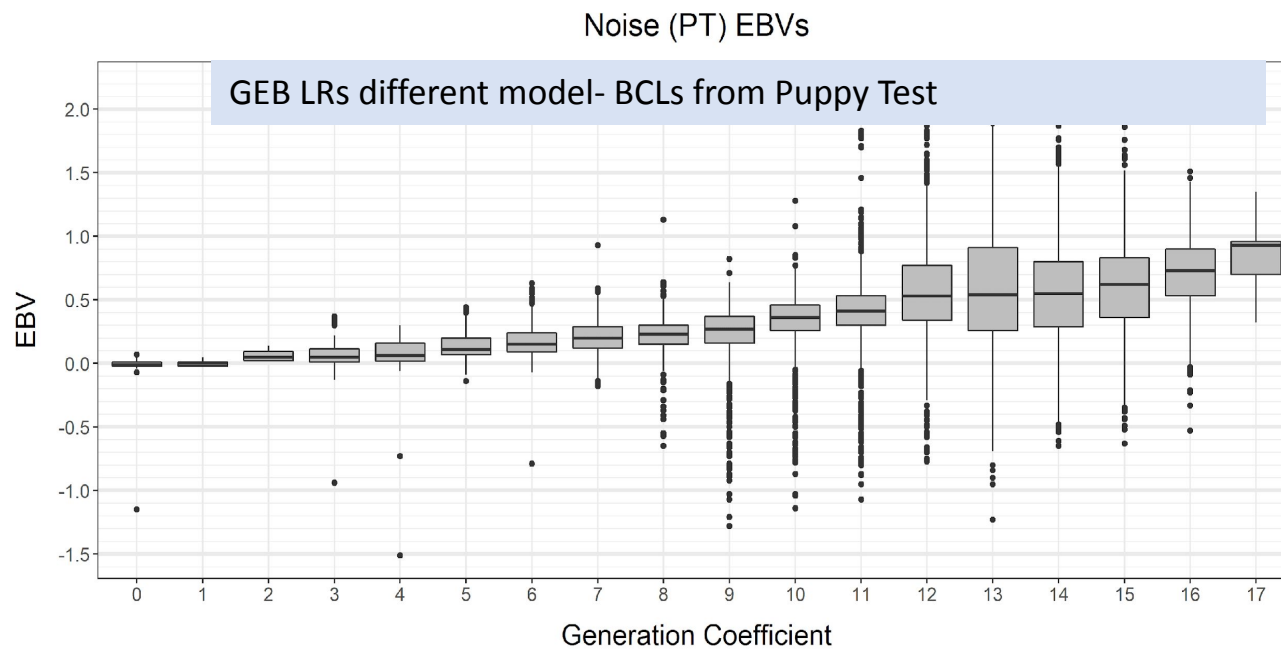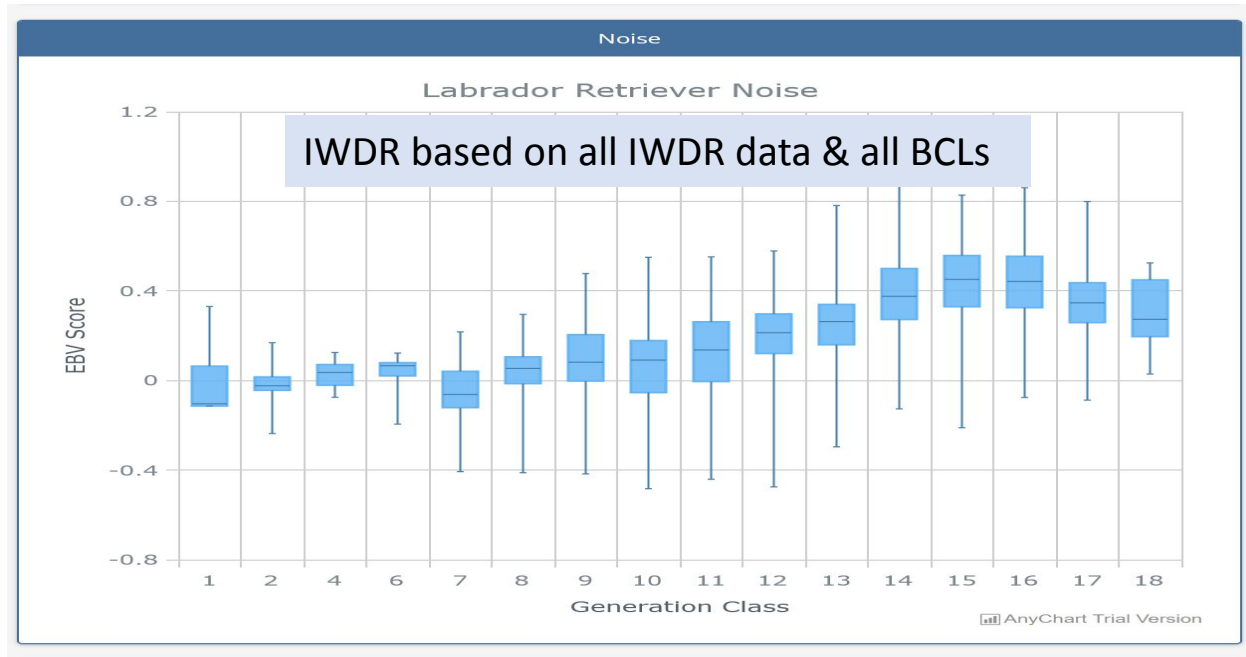
EBVs only calculated in IWDR

Selection

Self Modulation (PT) EBVs

GEB LRs different model- BCLs from Puppy Test

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Resilience

Labrador Retriever Resilience

IWDR based on all IWDR data & all BCLs

Resilience

German Shepherds Resilience

No EBVs on GS until 2023

Noise (PT) EBVs

GEB LRs different model- BCLs from Puppy Test

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Labrador Retriever Noise

IWDR based on all IWDR data & all BCLs

Noise Fear

EBVs since XXX in LRs

Small amount of selection pressure

German Shepherds Noise

No EBVs on GS until 2023

Object Fear (4mo) EBVs

GEB LRs different model- BCLs from 4 Mo W&T
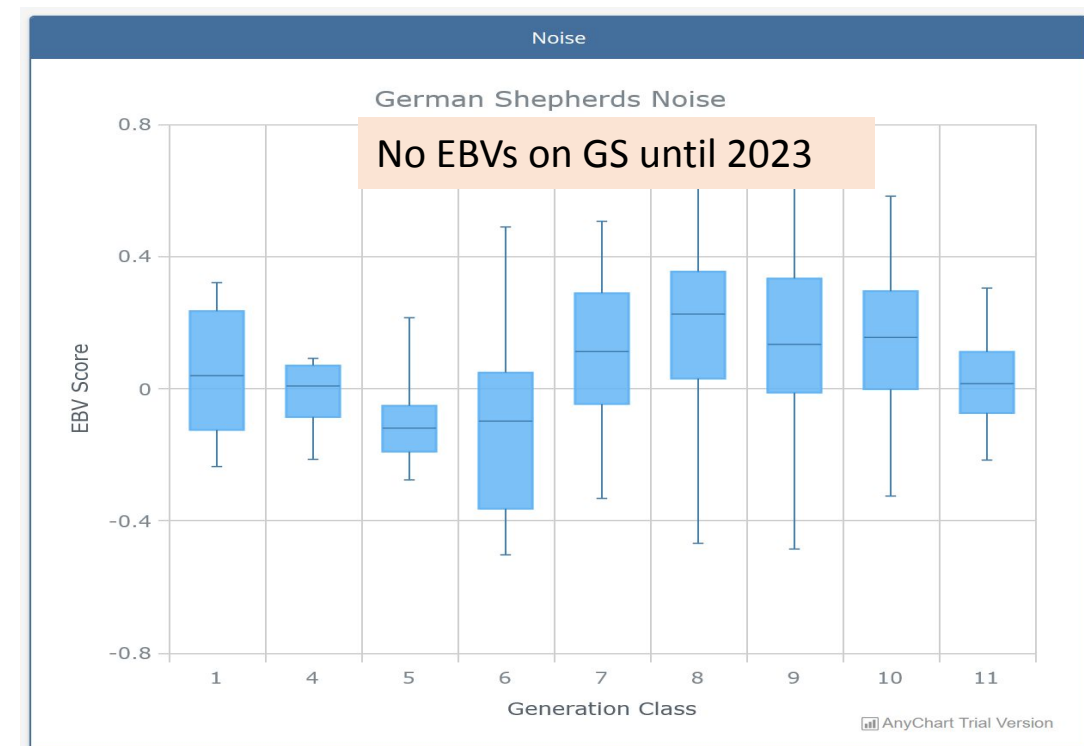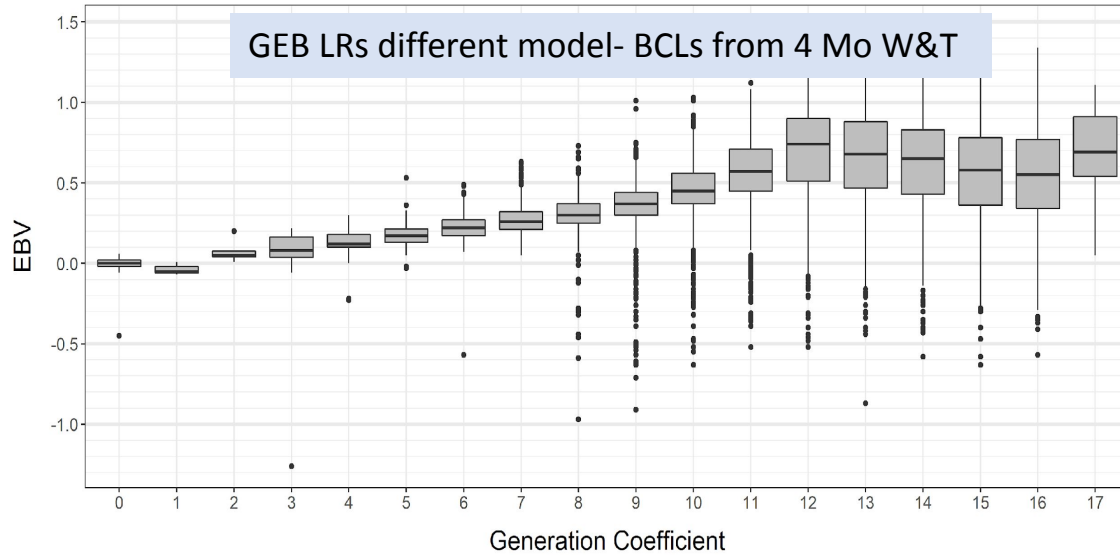
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Object Fear

EBVs since xxxx in LRs

Low selection pressure to improve

Object Fear

Labrador Retriever Object Fear

IWDR based on all IWDR data & all BCLs

Object Fear

German Shepherds Object Fear

No EBVs GS Until 2023

Body Sensitivity EBVs

GEB LRs different model- BCLs from 10 mo W&T, GDBart and Training
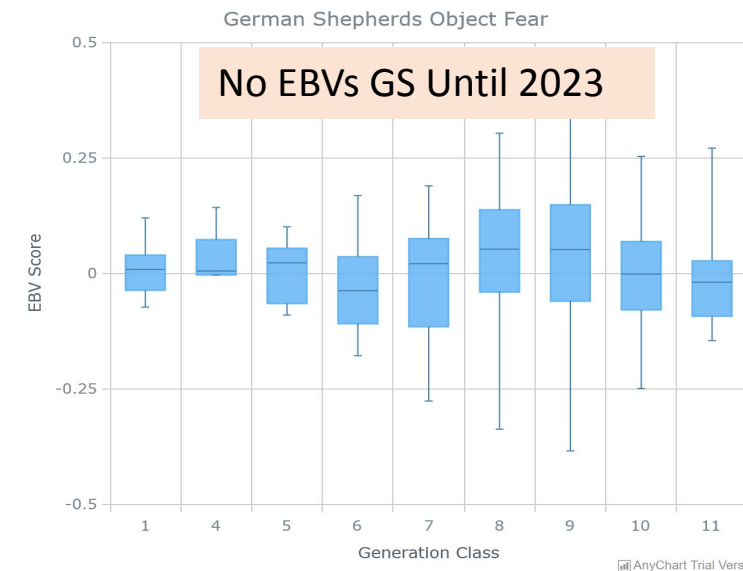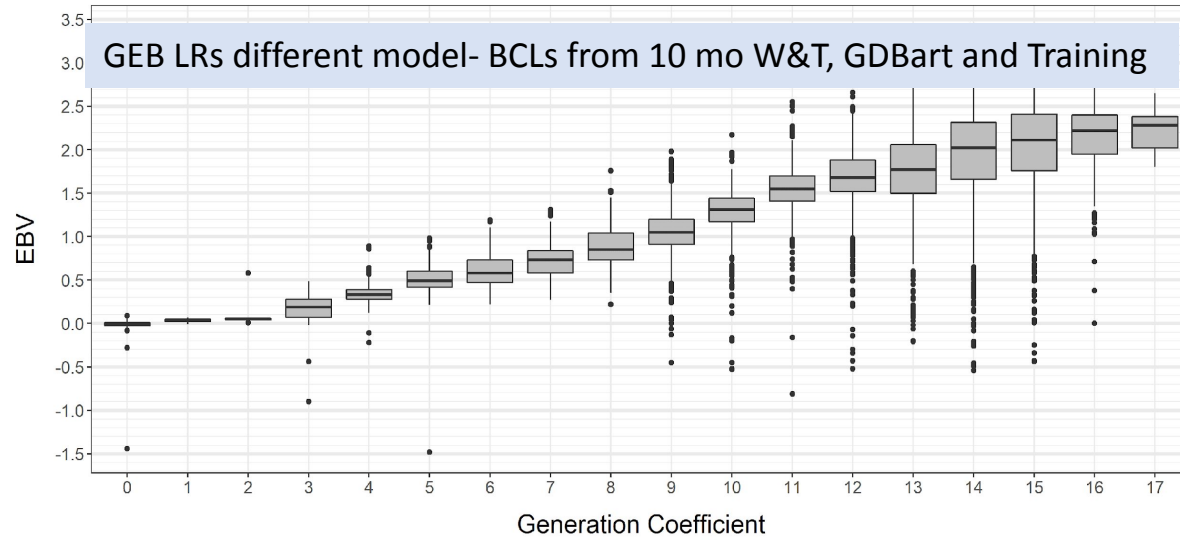
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Body Sensitivity

Labrador Retriever Body Sensitivity

IWDR based on all IWDR data & all BCLs

Body Sensitivity

EBVs since 2012 in LRs

Moderate selection pressure to improve
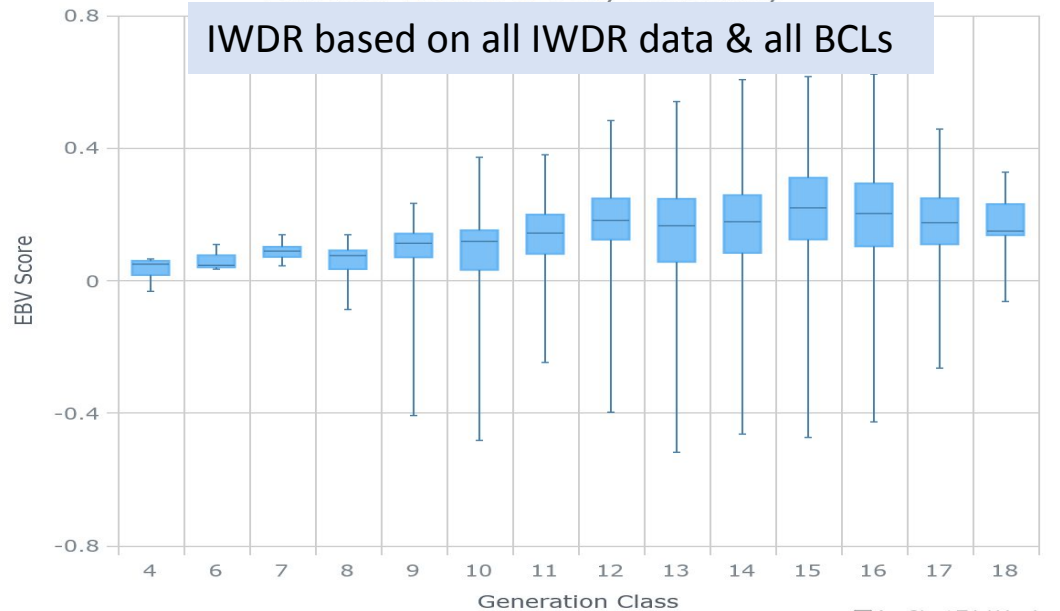
Body Sensitivity

German Shepherds Body Sensitivity

No EBVs GS Until 2023

Excitable

Labrador Retriever Excitability

IWDR based on all IWDR data & all BCLs
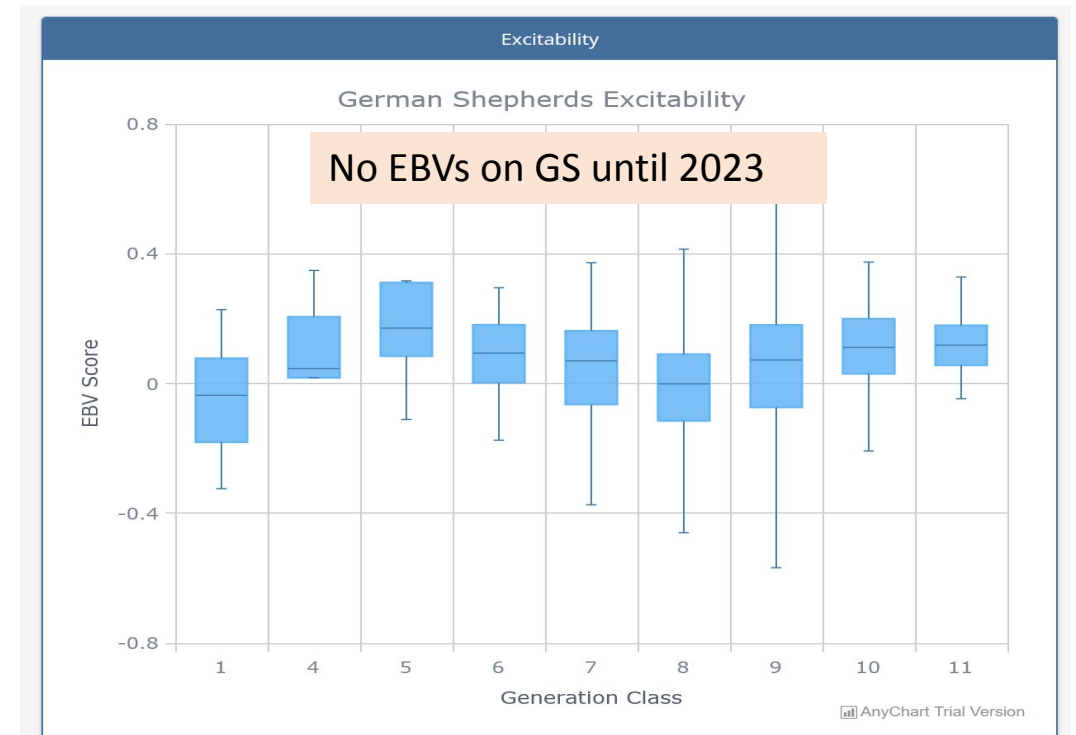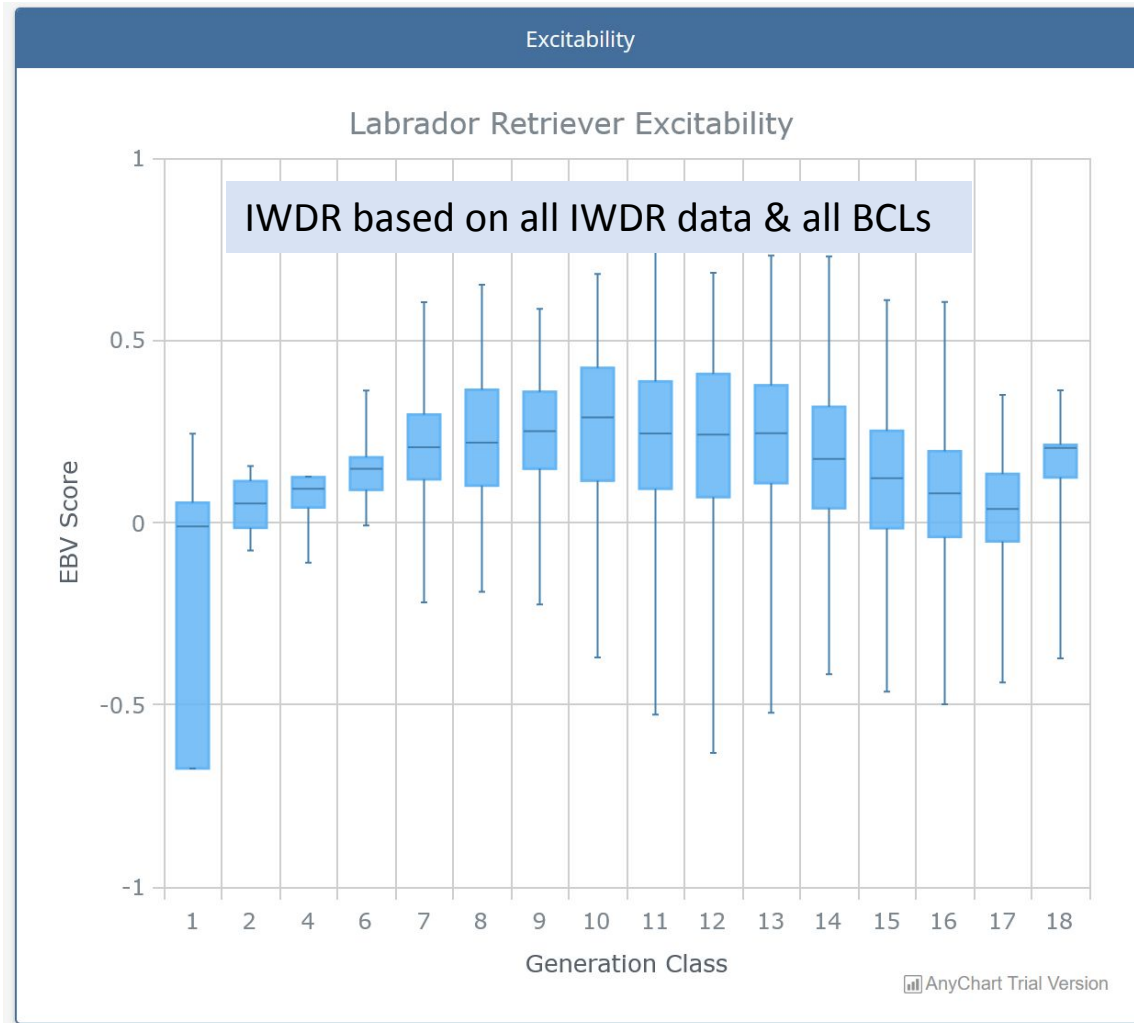
EBVs only calculated in IWDR

No selection pressure to improve

In Labrador Retrievers and German Shepherds

German Shepherds Excitability

No EBVs on GS until 2023

Questions?

BCL Items Loading to Arousal Factor

BCL Items	Phenotypic PCA Fratkin 2021	Genetic PCA Tsuruta 2021	Estimates of Heritability Tsuruta 2021
Chase	0.726	0.79	0.29
Movement excites	0.713	0.87	0.21
Excitable	0.655	0.95	0.29
Dog Distraction	0.61	0.90	0.20
Activated by stress	0.582	0.90	0.24
Lacks Focus	0.552	0.87	0.23
Fidgety	0.54	0.95	0.19
High energy	0.527	0.90	0.28
Poor return to productive state	0.482	0.90	0.35
Scavenges	0.477	0.78	0.17
Olfactory distraction	0.475	0.74	0.19
Sep anxiety	0.018	0.81	0.17
Barks Persistently	0.141	0.77	0.25
Inconsistent		0.64	0.17
Poor House Manners		0.63	0.32
OverallScore		0.60	0.19

Estimates of heritability use the puppy test, Walk and Talk, IFT and Training BCLs

BCL Items Loading to Environmental Soundness Factor

BCL Item	Phenotypic PCA Fratkin 2021	Genetic PCA Tsuruta 2021	Estimates of Heritability Tsuruta 2021
Noise Fear	0.696	0.85	0.25
Anxious New Situations	0.628	0.74	0.22
Traffic Fear	0.617	0.53	0.22
Object Fear	0.528	0.72	0.24
Dog Fear	0.476	0.24	0.23
Underfooting Fear	0.418	0.82	0.20
Stair Fear	0.33	0.73	0.28
Blowing Fan Fear	0.696	0.85	0.17

Estimates of heritability use the puppy test, Walk and Talk, IFT and Training BCLs

Adaptability

BCL Item	Phenotypic PCA Fratkin 2021	Genetic PCA Tsuruta 2021	Estimates of Heritability Tsuruta 2021
Separation anxiety	0.738	-0.11	0.17*
Barks Persistenty	0.666	-0.13	0.25
Kennels Poorly	0.553	0.84	0.58
HandlerAttachment	0.509	-0.07	0.30
Poor Social Manners	0.429	0.10	0.27

Estimates of heritability use the puppy test, Walk and Talk, IFT and Training BCLs

* NOTE-Separation anxiety Estimate of heritability without puppy test data = 0.28

Relationship- Initiative

BCL Item	Phenotypic PCA Fratkin 2021	Genetic PCA Tsuruta 2021	Estimates of Heritability Tsuruta 2021
Lacks Initiative	0.772	0.70	0.34
Unwilling	0.675	0.74	0.22
Inhibited By Stressful Situations	0.644	0.40	0.32
Dog & handler work as a team	0.459	0.40	0.29

Estimates of heritability use the puppy test, Walk and Talk, IFT and Training BCLs

Body Sensitivity

BCL Item	Phenotypic PCA Fratkin 2021	Genetic PCA Tsuruta 2021	Estimates of Heritability Tsuruta 2021
Body Sensitivity	0.811	0.67	0.21
Harness Sensitivity	0.725	0.59	0.39 /0.50*
Retreats When Reached For by Familiar Person	0.681	0.41	0.16
Body Handling Problems	0.542	0.56	0.22

Estimates of heritability use the puppy test, Walk and Talk, IFT and Training BCLs

* Estimate of Heritability Harness Sensitivity without puppy test data = 0.50

Which Traits Explain Differences Among Dogs?

Principle Components Analysis Simplifies the 52 BCL items into underlying factors	**Phenotypic Correlations Training BCLs Fratkin 2018** Variance Explained 42.8%	**Genetic Correlations All BCLs but puppy test Tsruta 2021** Variance Explained = 35.7%
1 Emotional Composure	**18.82** ⎤ **28.25**	**14.84** ⎤ **23.34**
2 Environmental Soundness	**9.43** ⎦ 66%	**8.05** ⎦ 65%
3 Adaptability	5.77	2.92
4 Relationship (Willingness, Team, Inhibited)	4.95	2.30
5 Body Sensitivity	3.80	2.00
6 Stranger Fear or Aggression	*	1.97
7 Dog Fear or Aggression	*	1.77
8 Resource Guarding Toward People or Dogs	*	1.74

* BCL Items eliminated from dataset which was BCLs from training. There is a very low incidence of BCL items loading in Factors 6-7 for dogs in training. The genetic PCA uses all BCL data- repeated measures analysis