Genetic parameters for eventing and their relationships to performance test traits

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WBFSH World Ranking List – Studbooks- Eventing

includes validated FEI results from 01/10/2014 to 31/07/2015

| Rank	Studbook	Points	Best Horse	
1	Irish Sport Horse	1135	(4)	Master Frisky
2	Oldenburger	914	(1)	Horseware Hale Bob
3	Hannoverian	895	(5)	FRH Butts Avedon
4	Holsteiner	860	(7)	Leonidas II
5	Selle Français	789	(19)	Samourai Du Thot
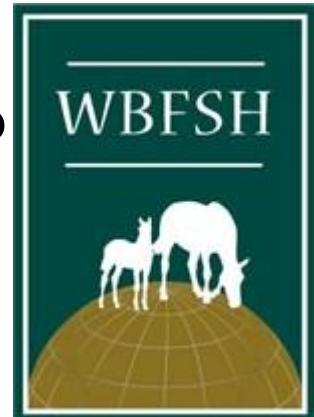
Current situation

- German eventing riders and horses highly successful

- But no targeted selection and breeding strategy for eventing in Germany

→ Estimation of heritabilities, genetic correlations and breeding values

→ Which traits are useful as early predictors of eventing ability?

www.eqwo.net

Timeline for selection steps

First
progeny
+
70-d PT

First starts at
high level
classes

Stallion
lincening

Age in
years

0

5

10

30-d PT

First starts in
young horse
eventing
classes

First EBVs
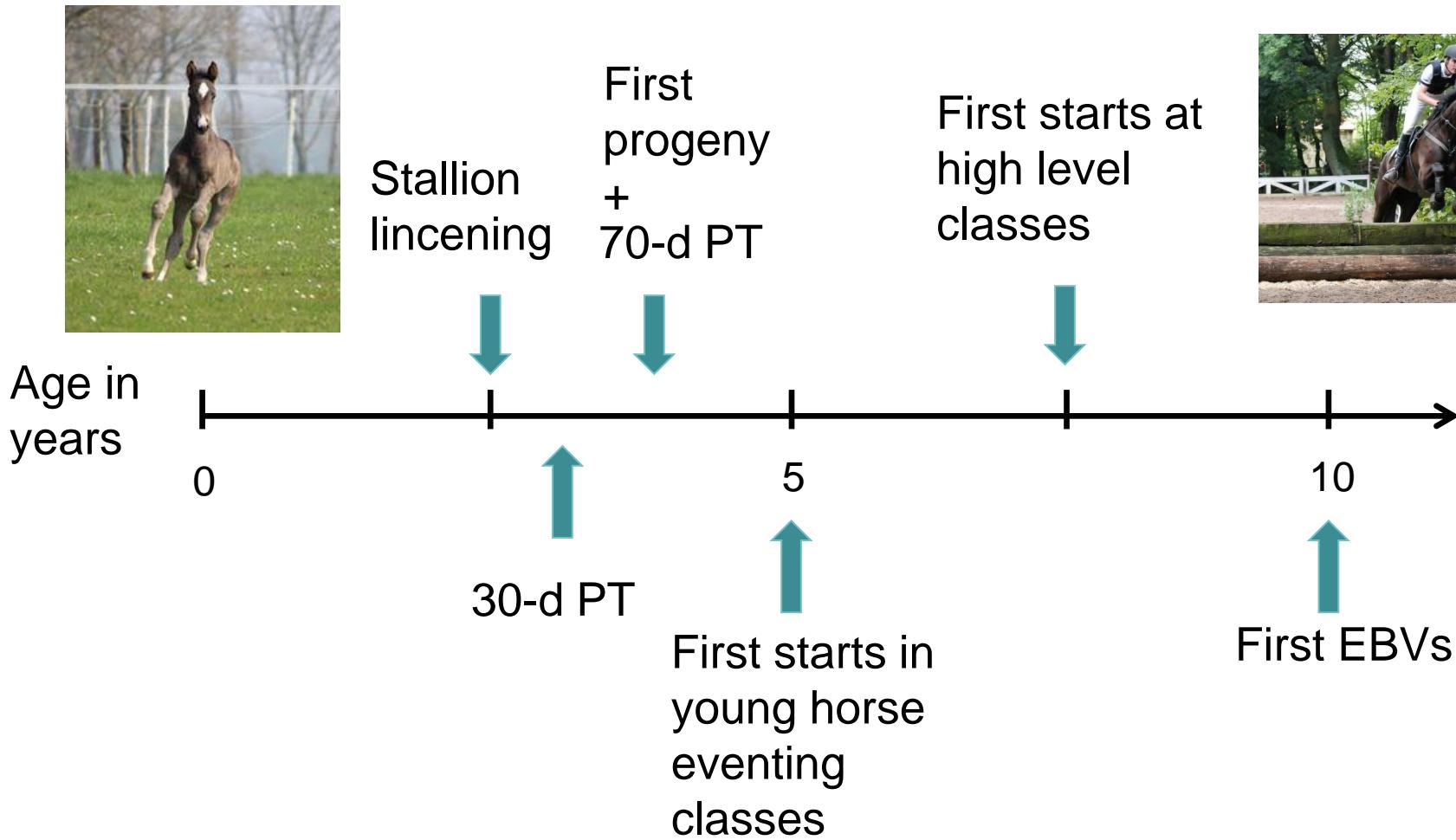
Data: Sport

- 6.42m. German equestrian competition results from 2005-2013

- 66.78% Jumping, 31.88% Dressage 1.34% Eventing

|	**Eventing national**	**Eventing international**
Starts	56459 (83.4%)	11206 (16.6%)
Horses	13910	2599

- For parameter estimation only dressage and jumping results from 2010 - 2013

- Trait: transformed rank (Hassenstein *et al.,* 1999):$TR = 11 - \sqrt{rank}$

- Pedigree file for 3.22m. horses

Data: Performance tests

- Stallion performance test results from 30-d (n=861) and 70-d (n=736) tests between 2001-2004

- Scores from 0 to 10 in 16 (30-d) or 19 traits (70-d); e.g., interior, basic gaits, jumping or rideability

Distribution of Scores for trait: trot
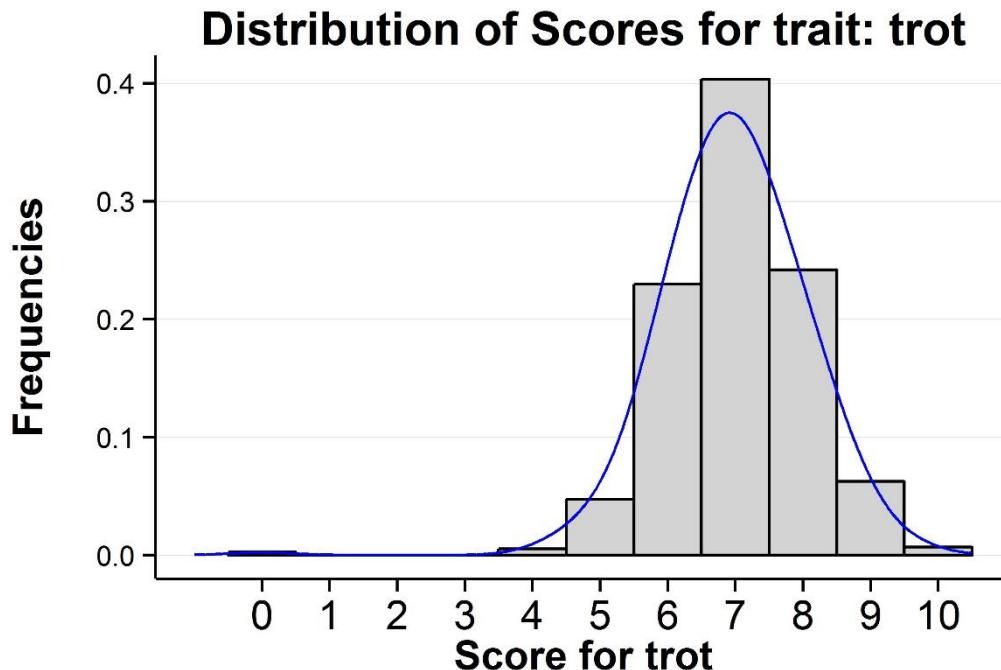
www.moz.de

$$Y_{ijklmno} = \mu + V_i + G_j + Age_k + K_l + R_m + pe_n + a_o + e_{ijklmno}$$

$Y_{ijklmno}$ = transformed rank of the animal

μ = population average

V_i = fixed effect of the i-th competition

G_j = fixed effect of the j-th sex

Age_k = linear regression of the k-th age in month

K_l = fixed effect of the l-th class

R_m = random effect of m-th rider

pe_n = random permanent environment effect of the n-th animal

a_o = random additive-genetic effect of the o-th animal

$e_{ijklmno}$ = random residual error

Program: DMU 6.5.1 (Madsen and Jensen, 2002)

$$Y_{ijk} = \mu + V_i + Age_j + a_k + e_{ijk}$$

Y_{ij} = score of the stallion

μ = population average

V_i = fixed effect combinding station, round and year of performance test

Age_j = linear regression of the j-th age in month

a_k = random additiv-genetic effect of th k-th stallion

e_{ijk} = random residual error

Program: DMU 6.5.1 (Madsen and Jensen, 2002)

Parameter calculation

- Bivariate models for trait combinations of interest

- Gibbs Sampling, 100'000 iterations, "Burn-in-period" of 10'000 iterations

- Breeding values are standardized to 100 ± 20 (mean ± SD)

- Proportion of thoroughbred in pedigree was calculated based on 4 generations

www.olympia.ard.de

Heritabilities and correlations

Posterior means of heritabilities (diagonal) as well as genetic correlations (above diagonal);

Standard deviations from posterior means: 0.01 to 0.02 for heritabilities and 0.03 bis 0.15 for genetic correlations

| Traits	Eventing national	Eventing international	Dressage	Jumping
Eventing national	**0.05**	0.46	0.78	0.19
Eventing international		**0.05**	0.41	0.35
Dressage			**0.10**	-0.09
Jumping				**0.09**

Heritabilities of performance test traits (70-d)

Genetic correlations between perfomance test traits (70-d) and national or international eventing
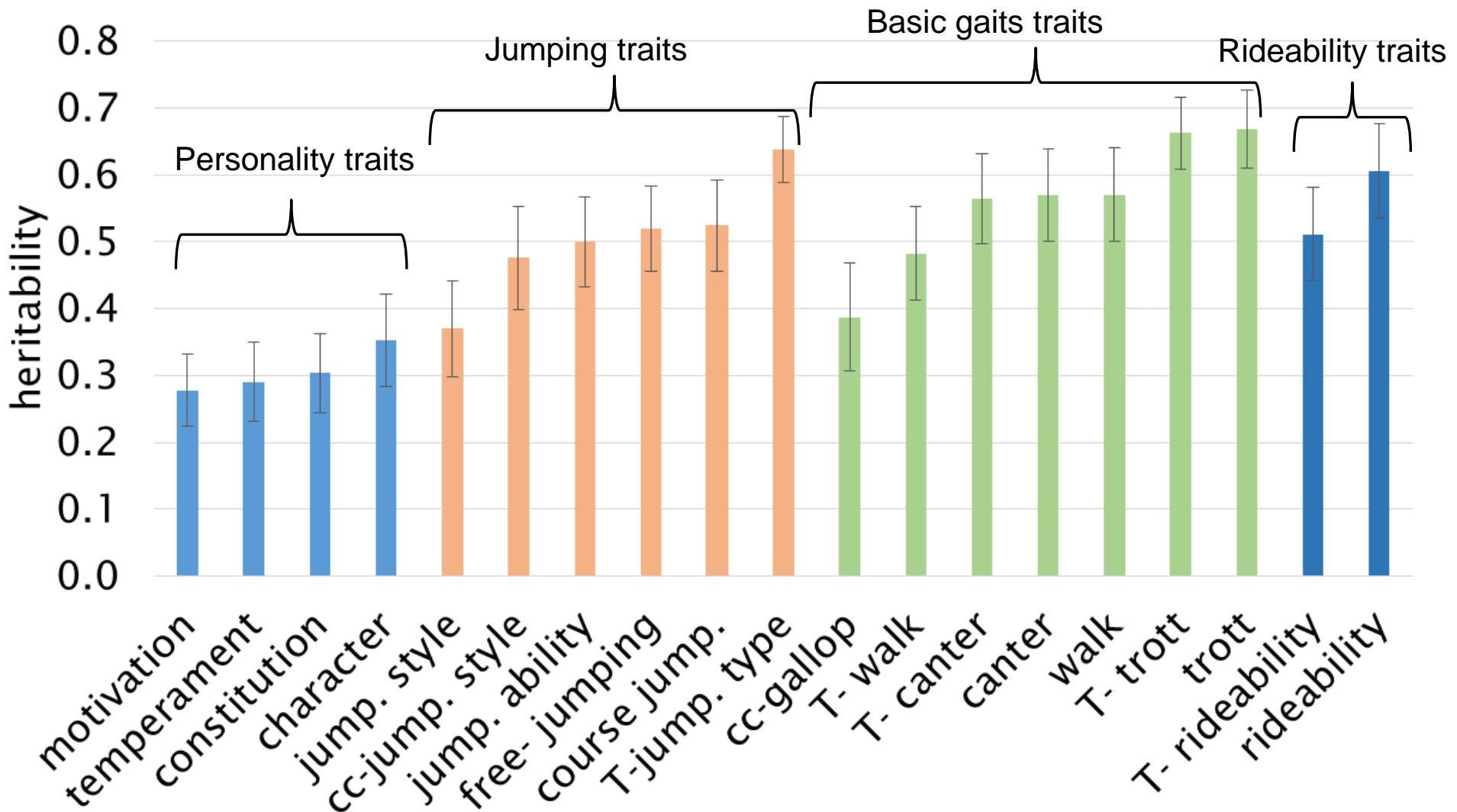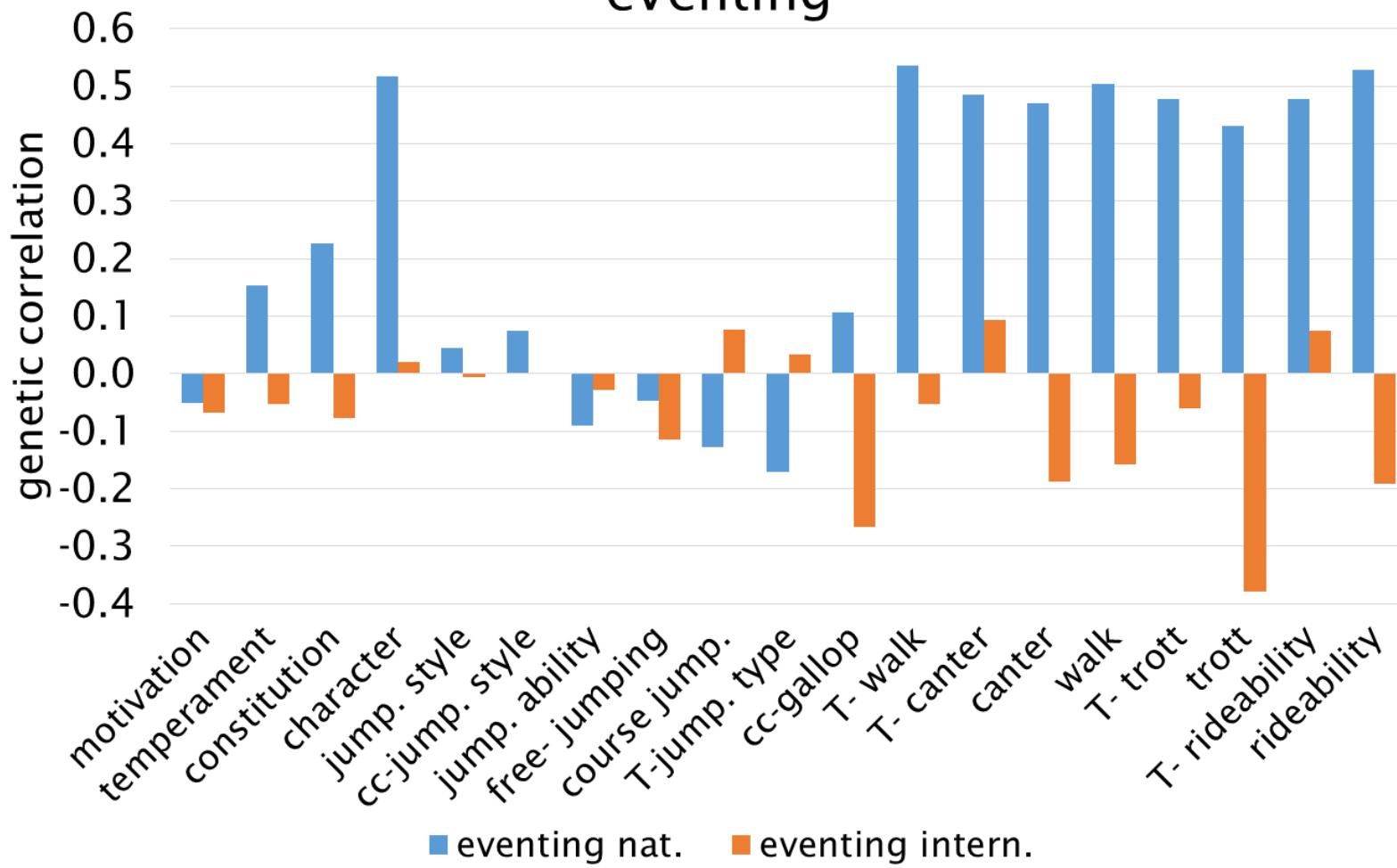
Genetic correlations between performance test traits (30-d) and national or international eventing
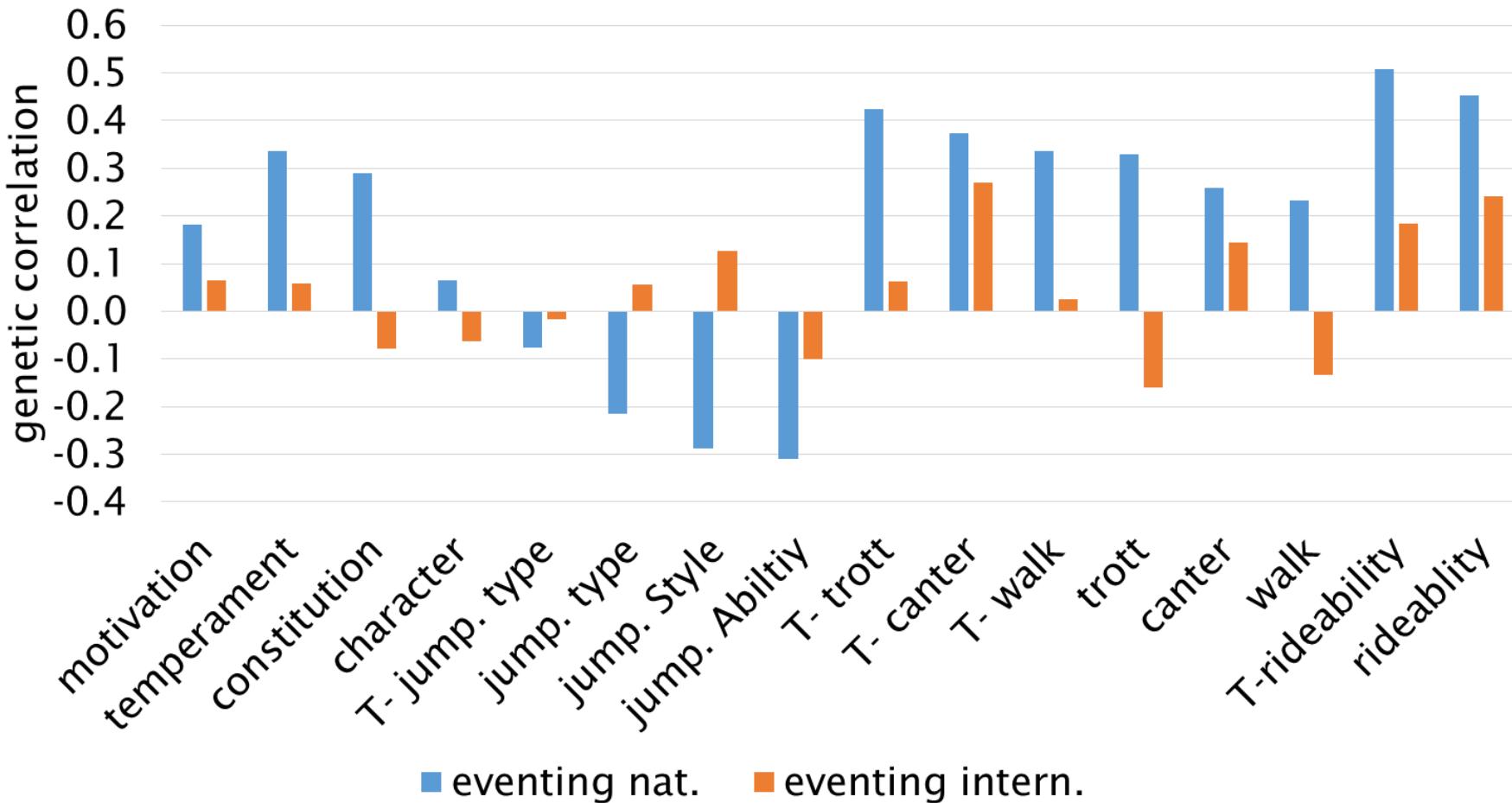
Proportion of thoroughbred in pedigree by classes of breeding values for eventing

Mean %
thoroughbred

Breeding value classes

eventing nat.   eventing intern.
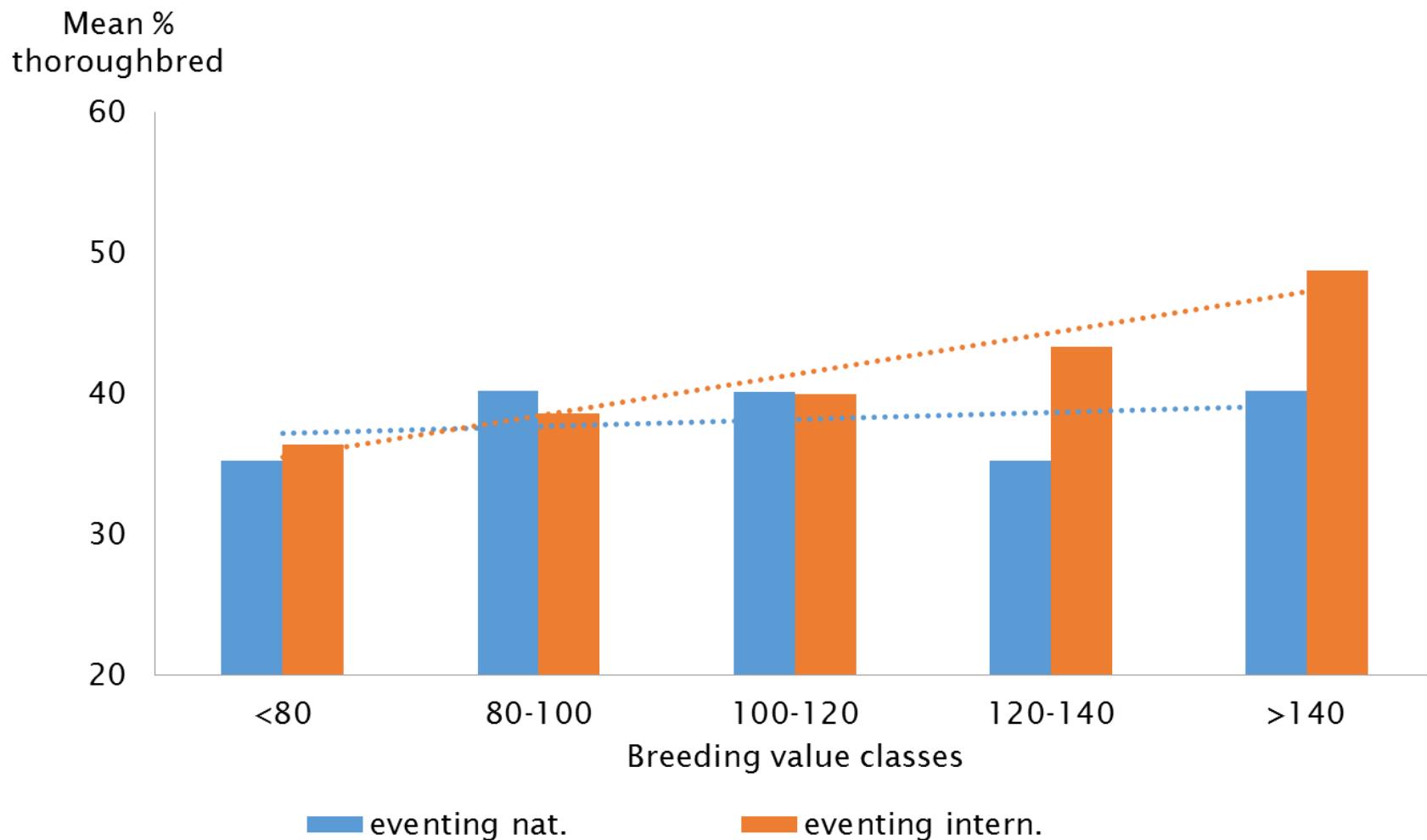
Proportion of thoroughbred within classes of breeding values for performance test traits

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Mean %
thoroughbred

Breeding value classes

character ▮ trot ▮ cc-jump. style
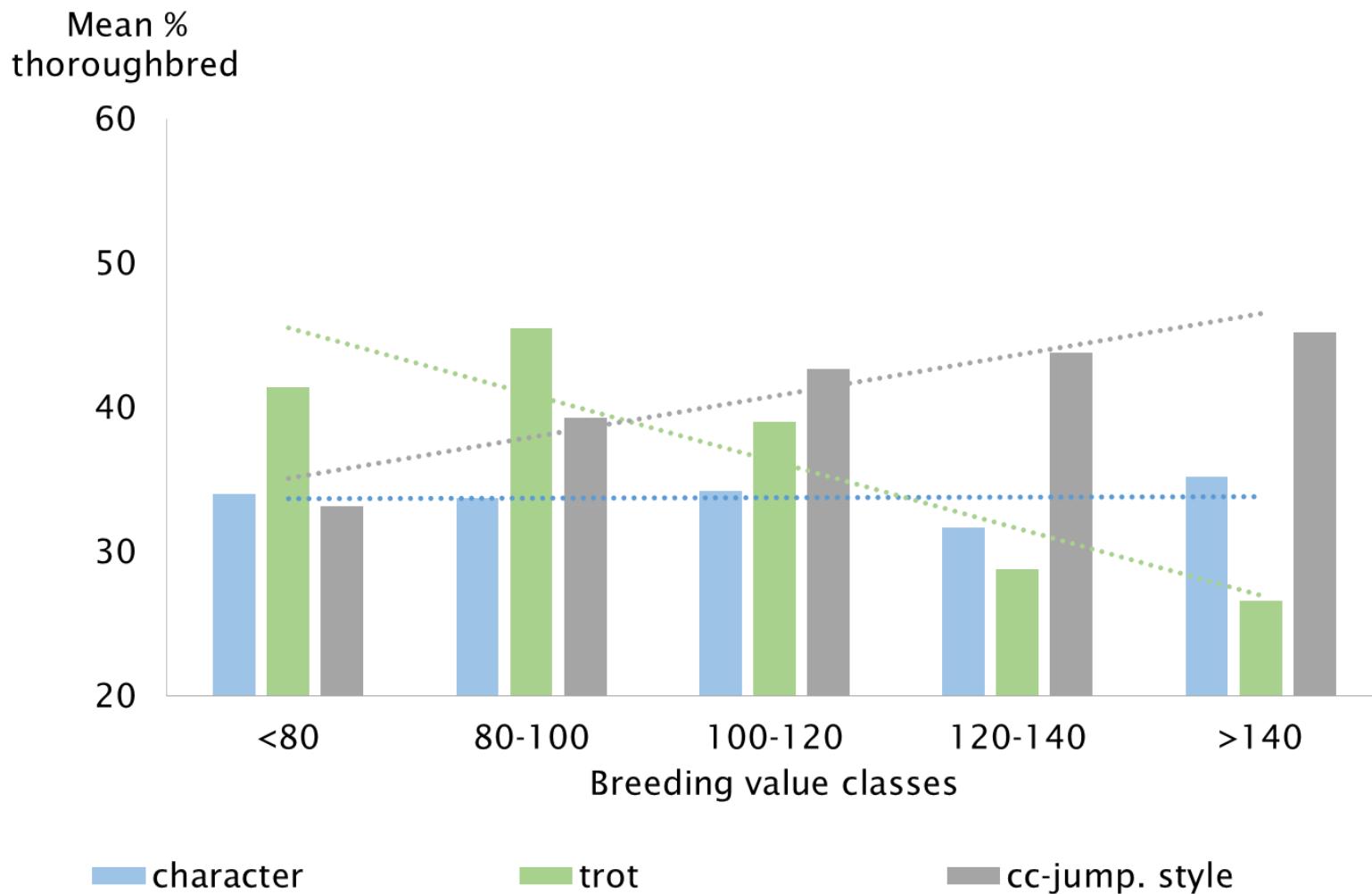
Conclusions

- National and international eventing competitions are two distinct traits, rg=0.46

- Only moderate correlations between conventional traits and - especially international - eventing competitions make direct selection necessary

- Also cross-country part of 70-d PT is not a suitable predictor for eventing

- No strong early predictors for international eventing in PT traits

- High proportion of thoroughbred particularly important for international eventing

Thank you for your attention!

www.osthessen-pferd.com/olympische-sommerspiele

Scoring

Dressage: marks from 0 to 10, in total a percentage quotation

→ Converted to penalties, 75% correspond to ca. -30 points

Cross-country: 20 penalties for the first refusal, 40 for the second, elimination for the third refusal or a fall

Time faults: zero point four(0.4) penalty per commenced second exceeding the optimum time, exceeding the time limit →elimination

Jumping: 4 penalties per knockdown, 4 penalties for the first refusal, second refusal or fall → elimination, Time faults for exceeding the time

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Heritabilities of performance test traits (70-d)

Trait	eventing national	eventing international
Character	0.35 (0.069)	0.37 (0.060)
Temperament	0.29 (0.059)	0.30 (0.047)
Motivation	0.28 (0.054)	0.29 (0.045)
Constitution	0.30 (0.059)	0.31 (0.046)
T-Trott	0.66 (0.054)	0.67 (0.056)
T-Canter	0.56 (0.068)	0.57 (0.064)
T-Walk	0.48 (0.070)	0.48 (0.063)
T-Rideability	0.51 (0.070)	0.52 (0.066)
T-Jumping predispostion	0.64 (0.050)	0.64 (0.055)
Trott	0.67 (0.059)	0.66 (0.067)
Canter	0.57 (0.069)	0.54 (0.073)
Walk	0.57 (0.070)	0.53 (0.073)
Free jumping	0.52 (0.064)	0.48 (0.072)
Jumping style	0.37 (0.072)	0.43 (0.084)
Jumping ability	0.50 (0.067)	0.50 (0.072)
CC-Gallop	0.39 (0.081)	0.33 (0.079)
CC-jumping style	0.48 (0.077)	0.40 (0.077)
Rideability	0.61 (0.071)	0.59 (0.076)
Course Jumping	0.52 (0.068)	0.49 (0.068)

Genetic correlations of performance test traits (30-d)

Trait	eventing national	eventing international
Character	0.07 (0.105)	-0.06 (0.124)
Temperament	0.34 (0.148)	0.06 (0.112)
Motivation	0.18 (0.137)	0.07 (0.116)
Constitution	0.29 (0,148)	-0.08 (0.128)
T-Trott	0.42 (0,121)	0.06 (0.111)
T-Canter	0.37 (0.138)	0.27 (0.171)
T-Walk	0.34 (0.147)	0.02 (0.112)
T-Rideability	0.51 (0.118)	0.18 (0.150)
T-Jumping predispostion	-0.08 (0.085)	-0.02 (0.111)
Trott	0.33 (0.132)	-0.16 (0.174)
Canter	0.26 (0.148)	0.15 (0.150)
Walk	0.23 (0.140)	-0.13 (0.171)
Jumping type	-0.21 (0.135)	0.06 (0.161)
Jumping style	-0.29 (0,154)	0.13 (0.157)
Jumping ability	-0.31 (0,164)	-0.10 (0.131)
Rideability	0.45 (0,124)	0.24 (0.163)

Genetic correlations of performance test traits (70-d)

Trait	eventing national	eventing international
Character	0.52 (0.136)	0.02 (0.145)
Temperament	0.15 (0.117)	-0.05 (0.151)
Motivation	-0.05 (0.103)	-0.07 (0.147)
Constitution	0.23 (0.133)	-0.08 (0.141)
T-Trott	0.48 (0.109)	-0.06 (0.145)
T-Canter	0.48 (0.114)	0.09 (0.131)
T-Walk	0.54 (0.107)	-0.05 (0.155)
T-Rideability	0.48 (0.117)	0.07 (0.138)
T-Jumping predispostion	-0.17 (0.128)	0.03 (0.123)
Trott	0.43 (0.150)	-0.38 (0.237)
Canter	0.47 (0.139)	-0.19 (0.193)
Walk	0.50 (0.134)	-0.16 (0.204)
Free jumping	-0.05 (0.114)	-0.11 (0.149)
Jumping style	0.04 (0.112)	-0.01 (0.128)
Jumping ability	-0.09 (0.103)	-0.03 (0.097)
CC-Gallop	0.11 (0.146)	-0.27 (0.233)
CC-jumping style	0.07 (0.135)	0.00 (0.147)
Rideability	0.53 (0.128)	-0.19 (0.194)
Course Jumping	-0.13 (0.127)	0.08 (0.156)