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Estimation of genetic parameters for two different performance tests of young stallions in Germany

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1. Introduction

According to the animal breeding law stallions have to pass a performance test in order to get their covering permission. Since 2001 all young stallions have to do a 30-day performance test at station. In order to get their preliminary covering permission the stallions have to be marked with a score of at least 7. Afterwards competition results or a performance test at station, which lasts 70 days are necessary to get the final covering permission.

The aim of the study was to estimated heritabilities as well as genetic correlations for the traits of the 30-day and the 70-day performance test. And in addition, to estimate genetic correlations between the same traits across tests.

2. Material and Methods

Data for the 30-day performance test originated from 10 stations throughout Germany with an overall of 1048 tested stallions recorded from 2001 to 2004. Besides that, the analysis included the results of the 70-day performance test recorded in the same time period on 7 stations with an overall of 773 performances. Out of the 1821 stallions recorded in both tests 212 had results in both tests.

The genetic parameters were estimated using the software REML VCE 4.2.5 (Groeneveld, 1998). For the estimation of the variance components and the genetic correlations between traits within test the following model was used:

$$y_{ijk} = \mu + P_{ik} + a_{jk} + e_{ijk},$$

with:

y_{ijk} = observation of the jth animal in the kth trait

μ = mean

a_{jk} = fixed effect of the ith test (place * year * alley way)

e_{ijk} = residual

In addition to the multivariate estimation of the heritabilities and genetic correlations of the traits within test, the genetic correlations of the respective traits between tests were analysed bivariate using the same model as shown above.

3. Results and Discussion

Table 1 and 2 give an overview of the means, standard deviations, variation coefficients and minimum and maximum values of the traits of the 30-day performance test and the 70-day performance test, respectively.

Table 1: Means ($\overline{x}$), standard deviations (σ), variation coefficients (VK) in percent, minimum and maximum values for the traits of the 30-day performance test (n = 1048)

Trait	$\overline{x}$	σ	VC	Min	Max
Walk	7.3	0.82	12	4.0	10.0
Trot	7.1	0.85	13	3.5	10.0
Canter	7.6	0.70	10	5.0	10.0
Rideability	7.7	0.77	11	4.5	10.0
Jumping ability	7.7	0.90	13	4.0	10.0
Character	8.7	0.76	8	5.0	10.0
Temperament	8.5	0.68	8	6.5	10.0
Willingness to perform	8.4	0.71	8	4.0	10.0
Constitution	8.4	0.71	8	6.0	10.0

Table 2: Means ($\overline{x}$), standard deviations (σ), variation coefficients (VK) in percent, minimum and maximum values for the traits of the 30-day performance test (n = 773)

Trait	$\overline{x}$	σ	VC	Min	Max
Walk	7.3	0.87	12	3.0	9.5
Trot	7.0	0.88	12	3.5	9.8
Canter	7.5	0.72	10	4.0	10.0
Rideability	7.5	0.87	12	3.5	10.0
Jumping ability	7.6	0.88	12	3.5	10.0
Course jumping	7.6	1.11	15	4.0	10.0
Character	8.6	0.73	8	5.0	10.0
Temperament	8.3	0.65	8	6.0	10.0
Willingness to perform	8.3	0.67	8	6.0	10.0
Constitution	8.3	0.63	8	6.0	10.0

In both tests the means of the different traits are on a high level whereas the standard deviations are very low. This is due to the insufficient utilisation of the score scale, which is most obvious for the interior traits.

Heritabilities and genetic correlations of the traits of the 30-day performance test are shown in Table 3. The estimated heritabilities are on a high level. The estimated heritabilities for the gaits are in good agreement with the estimated heritabilities of the 70-day test (Table 4), whereas the estimates for rideability and jumping ability show distinct differences.

Estimated heritabilities for the traits of the 70-day performance test are high compared to the literature. Friemel (2002) estimated heritabilities for the traits of the 70-day test which were in the range of 0.37-0.46.

Table 3: Heritabilities (on the diagonal) and genetic correlations (on top of the diagonal) for the traits of the 30-day performance test

Trait	Walk	Trot	Canter	Ride	JA
Walk	**0.43** (0.04)	0.41 (0.08)	0.33 (0.10)	0.48 (0.09)	-0.41 (0.10)
Trot		**0.62** (0.05)	0.73 (0.04)	0.78 (0.05)	-0.19 (0.05)
Canter			**0.50** (0.06)	0.75 (0.05)	0.14 (0.05)
Rideability (Ride)				**0.40** (0.05)	-0.27 (0.05)
Jumping ability (JA)					**0.71** (0.04)

Table 4: Heritabilities (on the diagonal) and genetic correlations (on top of the diagonal) for the traits of the 70-day performance test

Trait	Walk	Trot	Canter	Ride	FJ	CJ
Walk	**0.47** (0.06)	0.60 (0.06)	0.46 (0.06)	0.78 (0.04)	-0.15 (0.12)	-0.10 (0.11)
Trot		**0.63** (0.08)	0.83 (0.03)	0.87 (0.03)	-0.11 (0.12)	-0.15 (0.10)
Canter			**0.45** (0.05)	0.88 (0.03)	0.12 (0.07)	0.16 (0.07)
Rideability (Ride)				**0.60** (0.06)	0.08 (0.09)	0.09 (0.09)
Free jumping (FJ)					**0.57** (0.06)	0.99 (0.01)
Course Jumping (CJ)						**0.42** (0.04)

The genetic correlations within 30-day-test were moderate to high (0.33-0.78) except for those between free jumping and all other traits, which were low or negative (-0.27-0.14) (Table 3). The genetic correlations of the 30-day test are, although a bit smaller, in good agreement with the one's of the 70-day test, except for the genetic correlation between rideability and jumping ability. For this correlation a negative genetic correlation was estimated based on the data of the 30-day test (-0.27), whereas a slightly positive genetic correlation (0.08) was estimated based on the data of the 70-day test.
The estimated genetic correlations between the gaits and rideability were high (0.78-0.88). This was in good agreement with results of Lührs-Behnke et al. (2002). These authors estimated genetic correlations between the gaits and rideability in the range of (??-??). The genetic correlation between free jumping and course jumping was 0.99, which is even higher than the estimated correlation of Brockmann (1998). The author estimated a genetic correlation between free jumping and course jumping of 0.95. Brockmann (1998) as well as Lührs-Behnke (2002) estimated positive genetic correlations between course jumping and all other traits. This tendency could not be affirmed in the present study. The results of the present show negative genetic correlations between course jumping and walk as well as course jumping and trot.
The genetic correlations as well as the spearman correlations between the same traits across tests are shown in Table 5. Especially for the gaits the genetic correlations are very high, indicating that the traits in both tests are very similar. In contrast to this the correlation between jumping ability in the 30-day test and course jumping in the 70-day test is moderate (0.63).

In comparison to the genetic correlations the spearman correlations are lower, which is probably due to the insufficient utilisation of the score scale, so that a small differences in the score leads to high rank differences.

Table 5: Genetic correlations as well as Spearman correlations for the same traits across tests

Trait	Genetic correlations	Spearman correlations
Walk	0.99 (0.002)	0.61 (< .0001)
Trot	0.89 (0.062)	0.65 (< .0001)
Canter	0.93 (0.053)	0.65 (< .0001)
Rideability (Ride)	0.85 (0.079)	0.57 (< .0001)
Jumping ability (JA)	0.87 (0.064)	0.57 (< .0001)
JA30 –Course jumping70	0.63 (0.19)	0.28 (< .0001)

4. Summary and Conclusion

The estimated heritabilities for the traits of the 30-day and the 70-day performance test were high compared to the literature. Whereas the genetic correlations within test were in good agreement with literature results. The genetic correlations between the same traits across test were high, although the spearman correlations as well as the phenotypic correlations were lower. This shows that the traits in both tests are not the same, but still the high genetic correlations implicate that the 30-day performance tests gives a good instrument for the preselection of the stallions.

5. Acknowledgement

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6. References

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