Ann. Anim. Sci., Vol. 16, No. 3 (2016) 863–870 *DOI: 10.1515/aoas-2015-0092*

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EFFECT OF THE AGE ON THE EVALUATION OF HORSE CONFORMATION AND MOVEMENT*

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Abstract

The evaluation of horse conformation is a changeable characteristic and knowledge of its character is essential in horse breeding. The effect of the age was investigated based on the analysis of a subjective evaluation of eight conformation and movement traits according to the 70 points scale of registered 857 Polish Trakehner. The analysis of variance included fixed effects of sex (mares and stallions), age (up to 1 year, yearlings, 2-year-old, 3-year-old and older) and the kind of breeder (private/national) and the random effect of the sire. The effect of the sire was statistically significant for all traits. The effect of the sex was significant only for the movement traits – the walk and canter in stallions reached higher notes. The effect of the kind of breeder was also statistically significant but only for the movement traits. The considered effect of the age was the most surprising result as it was statistically significant for all traits, but the only differences between age classes were found between very young horses (up to 1 year) and all other groups. The phenotypic correlations between traits suggest that traits such as overall impression, type, trunk and limbs (feet and legs) are overvalued in the youngest group of horses.

Key words: conformation and movement traits, horse, age effect

The conformation traits are the first horse characteristics that are often evaluated early in life (Koenen et al., 2004). Conformation traits are correlated genetically with gaits characteristic that can help breeders in early selection of functional traits (Sánchez et al., 2013). Detailed movement characteristic provided in a linear manner is correlated with routinely assessed conformation and performance tests (Becker et al., 2013). The connection between conformation of the horse and rider comfort was also proved (Matsuura et al., 2008). The comparative biology research

*This study was funded from statutory activity no. 11.610.007-300 and on the horse breeding evaluation (S.V.1).

used conformation traits to recognise the subtle conformational differences between close related breeds or describe quite different types of horses (Komosa et al., 2013). The horse development took up to six years in the warmblood horse breeds (Bennet, 1992), so the horse evaluation may change with the age of the horse. Development of foal conformation was observed on the skeleton development, however only a small number of animals was available for this kind of investigations (Anderson and McIlwraith, 2004). The period of bone development or the period of the highest bone growth was established. The study on different breeds and their diverse conformation support the separation of conformational traits for overall body and limbs (Brooks et al., 2010), based on a principal component analysis. Better knowledge regarding horse evaluation of conformation allows for better selection and increase of horse welfare, as longevity is genetically correlated on the level of 0.3 with evaluation of conformation (Jönsson et al., 2014).

Based on the literature there is a gap in research of the possible age effect on horse conformation; that is especially important because correct evaluation allows making the first proper breeding decision. The assessment of phenotypic evaluation is a basic characteristic of the horse and knowledge regarding the influences of different effects is essential. The aim of the study was to evaluate the effect of the age on horse conformation and movement as well as to establish the phenotypic correlations between conformations and movement traits at different ages. The data on conformation of Trakehner horses is especially useful as all age classes are evaluated according to the same scale and the mentioned scale is of international use in breeding and sports (Teegan et al., 2009).

Material and methods

The database covered 857 horses registered in Poland in the years 2000–2007. All data came from the breeding documentation of the Polish Trakehner Association. Investigated population consisted of 596 mares and 261 stallions. In the whole group of horses 270 were evaluated up to the age of 1 year, 114 were at the age of one year, 68 two years old and 405 three years old and older. Horses were bred by 176 stallions and 473 mares. As recorded by the association, the investigated group of horses represented 77 sire lines and 121 mare lines (also connected between each other). About 60% of the sires had progeny in more than one age group. The following numbers of the sires were used in the corresponding age groups: 69, 44, 23, 135. The dataset used for the analysis came from a single evaluation of the horse. The evaluation of horse conformation was conducted according to the German scale of 70 points with an accuracy of 0.5 point. The judges committee consisted of three judges and one single note for every separate trait was given during their evaluation. Horses were judged by almost the same commission every year and at every place. According to the breeding programme one judge came usually from the German association. They were trained and licensed by their associations. Information about judges was not recorded in the official database. Horses were evaluated at the meeting points in

the stables of leading breeders. Inclusion of the year of evaluation and place into the statistical model were not effective. The effect of year is closely related with the age group and sire effects as well as the place of evaluation with the breeder.

The following traits were evaluated: type, trunk, limbs (feet and legs), walk, trot, canter and overall impression on the scale of 0–10. Most traits were evaluated within the narrow range of notes, specific for sport horse breeding (Koenen et al., 2004). The analysis of variance was performed using the random effect of the sire and fixed effects of the sex, age group and kind of breeder (private, stud).

$$y_{ijklm} = \mu + s_i + S_j + A_k + B_j + e_{ijklm}$$

where:

y_{ijklm} – judges' score,

μ – mean,

s_i – random effect of the sire (i=1. …. 176),

S_j – fixed effect of the sex (j = stallions, mares),

A_k – fixed effect of the age group (k= <1 year, 1-year-old, 2-year-old, 3-year-old and older),

B_j – fixed effect of the kind of breeder (j= national, stud),

e_{ijklm} – error.

The GLM procedure of the SAS program was used with the t-test for LSMs. The phenotypic correlations (Pearson coefficient) between separate traits of evaluations in the age classes were calculated also. All presented correlations were obtained for all age groups by dividing the existing dataset into separate files according to the studied age. Calculations of correlations between ages were not possible because the number of horses evaluated more than once was not high enough.

Results

The range of received notes is 4–9 points for the trunk and limbs, 5–9 points for the overall impression trait, 5–9.5 points for the walk, trot and canter trait, and 5–10 points for the type. The obtained results showed the mean from 6.73 to 7.24 with standard deviations from 0.07 to 0.78. The effect of the sire was statistically significant for all investigated traits. The sex of horses influenced two movement traits – walk and canter (Table 1). As expected, the notes for more pre-selected group of stallions are higher by 0.10 for walk and by 0.28 for canter. The other traits were not significantly higher. Surprisingly, the total sum of points for evaluation was 49.2 for mares and 49.8 for stallions. The investigated effect of the age was statistically significant for all traits and the highest value of evaluation was always observed for very young horses – foals up to 1 year. The other age groups did not differ between each other. The highest differences between notes of age groups were observed for the canter (0.71 point with 2-year-old horses), type (0.53 point with yearlings) and overall impression (0.48 point with 2-year-old horses). The highest age differences

for the sum of points were observed between the youngest and the oldest evaluation groups. The effect of the kind of breeder, investigated according to the division into private and national stud horses, was statistically significant for the movement traits. The difference was about 0.3 point for the walk and trot, and 0.2 point for canter was observed in the group of state horses. The analysis of correlations between traits showed some irregularities between assessments of different traits through the age groups (Table 2). The type, walk and limbs seem to be such traits as they correlated very irregularly with each other through the age groups. The correlations obtained between limbs, walk, trot and sum of points in the study are decreasing with the age.

Table 1. Means of conformation evaluation of horses according to sex, age and kind of breeder

Effect/Trait LSM (SE)		Type	Trunk	Limbs	Walk	Trot	Canter	Overall	Sum
Sex	mares (n=596)	7.29 (0.06)	7.06 (0.05)	6.68 (0.05)	6.89 A (0.05)	7.27 (0.00)	6.94 A (0.05)	7.04 (0.05)	49.00 (0.28)
	stallions (n=261)	7.22 (0.07)	7.13 (0.06)	6.70 (0.06)	7.09 B (0.06)	7.27 (0.00)	7.22 B (0.06)	7.11 (0.06)	49.00 (0.33)
Age	up to 1 year (n=270)	7.62 A (0.07)	7.35 A (0.07)	6.93 A (0.06)	7.19 A (0.07)	7.42 A (0.00)	7.54 A (0.07)	7.42 A (0.06)	51.60 A (0.36)
	yearlings (n=114)	7.09 B (0.09)	7.04 B (0.08)	6.68 B (0.08)	7.02 B (0.08)	7.24 B (0.00)	6.96 B (0.09)	6.96 B (0.08)	49.10 B (0.46)
	2-year-old (n=68)	7.15 B (0.11)	7.03 B (0.10)	6.59 B (0.09)	6.85 B (0.09)	7.20 B (0.00)	6.83 B (0.10)	6.94 B (0.09)	48.70 B (0.51)
	3-year-old and older (n=405)	7.13 B (0.05)	6.95 B (0.04)	6.56 B (0.04)	6.90 B (0.04)	7.17 B (0.00)	6.97 B (0.05)	6.99 B (0.04)	48.60 B (0.25)
Kind of breeder	private (n=569)	7.25 (0.05)	7.00 (0.05)	6.65 (0.04)	6.99 (0.05)	7.14 A (0.00)	6.89 a (0.05)	7.00 a (0.04)	49.14 (0.26)
	stud (n=288)	7.24 (0.08)	7.00 (0.08)	6.65 (0.04)	6.99 (0.08)	7.41 B (0.00)	7.17 b (0.08)	7.16 b (0.07)	49.90 (0.41)

The different letters show significant differences between groups. Statistically significant differences in columns within effect marked with small letters P≤0.05, capital letters P≤0.01.

Table 2. Correlations between conformations traits of horses evaluated by Polish Trakehner Association (correlations above the diagonal, statistical significance (p value) below the diagonal)

Trait		8*	7	6	5	4	3	2	1
1	2	3	4	5	6	7	8	9	0
1 Type	Up to 1 year	0.74	0.69	0.34	0.36	0.30	0.47	0.63	x
	yearlings	0.79	0.74	0.27	0.44	0.15	0.50	0.58	x
	2-year-old	0.61	0.46	0.14	0.09	0.12	0.43	0.62	x
	3-year-old and adults	0.66	0.66	0.41	0.31	0.28	0.39	0.63	x
2 Trunk	Up to 1 year	0.78	0.71	0.48	0.32	0.35	0.50	x	0.001
	yearlings	0.80	0.74	0.44	0.50	0.05	0.44	x	0.001
	2-year-old	0.65	0.50	0.18	0.17	0.22	0.39	x	0.001
	3-year-old and adults	0.68	0.68	0.43	0.34	0.30	0.47	x	0.001

Table 2 – contd.

1	2	3	4	5	6	7	8	9	10
3 Limbs	Up to 1 year	0.68	0.61	0.38	0.29	0.30	x	0.001	0.001
	yearlings	0.60	0.53	0.12	0.23	0.08	x	0.001	0.001
	2-year-old	0.58	0.42	0.21	0.14	0.21	x	0.004	0.001
	3-year-old and adults	0.57	0.54	0.32	0.21	0.30	x	0.001	0.001
4 Walk	Up to 1 year	0.61	0.50	0.41	0.37	x	0.001	0.001	0.001
	yearlings	0.33	0.25	–0.03	0.19	x	0.374	0.588	0.085
	2-year-old	0.56	0.32	0.20	0.30	x	0.057	0.049	0.266
	3-year-old and adults	0.56	0.42	0.36	0.22	x	0.001	0.001	0.001
5 Trot	Up to 1 year	0.68	0.61	0.54	x	0.001	0.001	0.001	0.001
	yearlings	0.73	0.66	0.38	x	0.026	0.007	0.001	0.001
	2-year-old	0.65	0.64	0.47	x	0.006	0.212	0.117	0.410
	3-year-old and adults	0.61	0.58	0.37	x	0.001	0.001	0.001	0.001
6 Canter	Up to 1 year	0.74	0.66	x	0.001	0.001	0.001	0.001	0.001
	yearlings	0.58	0.56	x	0.001	0.692	0.181	0.001	0.002
	2-year-old	0.62	0.65	x	0.001	0.073	0.057	0.117	0.231
	3-year-old and adults	0.71	0.61	x	0.001	0.001	0.001	0.001	0.001
7 Overall impression	Up to 1 year	0.93	x	0.001	0.001	0.001	0.001	0.001	0.001
	yearlings	0.94	x	0.001	0.001	0.004	0.001	0.001	0.001
	2-year-old	0.86	x	0.001	0.001	0.004	0.001	0.001	0.001
	3-year-old and adults	0.90	x	0.001	0.001	0.001	0.001	0.001	0.001

* Trait no 8 – sum of points.
In bold – statistically significant correlations and the non-statistically significant P-value.

Discussion

The obtained means and standard deviations are in accordance with the subjective evaluations in other countries in sport horse breeding for the means and on the lower level within the range for the standard deviations. International data collected by the Interstallion group working on sport horses from main sport horse studbooks of the World Breeding Federation for Sport Horses reached 6–7 points as a mean with standard deviations of 0.7 to 1.7 for subjective evaluations (Bruns et al., 2001).

The statistical model used in the analysis was constructed to be optimal for the conducted research and dataset. Some studies include date/month/place effects in such type of analysis (Bruns et al., 2001; Koenen et al., 2004). The effect of the date/year could not be used because the age group and sire was considered. The effect of the place of evaluation is almost covered by the effect of the breeder, so it could be not independent from the genetic influences. The effect of the judge, although possibly significant (Lewczuk et al., 2013), is very seldom used in the official calculations

(e.g. breeding value estimation) or studies, probably because of its complexity. Most official performance test results are assessed by the judges' committees giving only one note for every trait as it is in our case. The coefficient of determination of the statistical model used in our study was on an acceptable level from 0.3 to 0.4. The highest R^2 was noted for the canter, the lowest for the walk.

Most results from the analysis of variance showed understandable existing trends like the significant sire effect being a genetic influence or the highest values for movement traits for horses representing national state studs that keep their breeding traditions from a longer time. The highest values for stallions seem to be connected with the higher selection level usually existing in male selection. The highest selection level in males gives a wider possibility for progress because of the numbers of the progeny left. So, according to well known rules for higher male selection, breeders could exclude weaker male foals from the breeding earlier than females. Investigated results for the effect of the age and the unexpected differences between ages classes should be discussed more widely. A very high evaluation of the youngest foal group and its structure described by the correlations demonstrated an inaccurate selection and the lack of informative data for horse breeders. Such results can be also connected with the more difficult character of these traits for judgment. Some regular connections can be observed mainly between the overall impression with canter, trot and the total sum of points. Such correlations suggest that these traits have the greatest impact for the general view of the horse and are the more important traits for the judges. A regular follow down in connections between some traits observed with the increase of the age seems to be connected with the overestimation of these traits in the early age. This was also noticed in the analysis of variance, as the youngest horses kept the higher notes for every trait. Such examples are as stated earlier – limbs, walk and trot that lower their connection with the sum of points with each age class. The observed overestimation in the foals group younger than 1 year is not very surprising, as it can be expected that young foals give a hugely positive impression to the human eye and the overall impression is the highest positive correlation with the sum of points that range from 0.86 to 0.94 in our study. The other reason for such high evaluations may be connected with the belief that every mistake by such young foals is thought to be correctable through the development, which is not the case in our report, as the correlations are decreasing with age. The evaluation of very young foals should be more informative for the breeders, as they should receive a more reliable assessment, even if the probability of selling very young horses is much less effective from the financial point of view. The accurate evaluation of foals is of great importance for future breeding decisions, especially if the heritabilities of conformational traits seem to be higher for younger than for older animals (Schöpke et al., 2013), probably because of the lower pre-selection. Future breeding decisions should be taken using more accurate evaluations. The subjective evaluation is always a biased one, however the research of Ducro and co-workers showed that the heritability of such evaluation is higher than for the linear conformation traits (Ducro et al., 2007). Finding a more appropriate system for horse evaluation is crucial, especially in the age of the new genetic century – genomic selection. Some authors conclude that direct and detailed traits are the key for the success of this genetic tool.

For example, the detailed and easy measured trait – height at withers was found to be explained by small numbers of single QTLs (Signer-Hasler et al., 2012). New directions in evaluation – precise and reliable character of this measure, developed further detailed systems and traits (Duensing et al., 2014; Druml et al., 2008; Kristjansson et al., 2013).

In the conclusions from our study, the current systems of assessment overestimate the evaluation of very young foals, because the means for all traits reached the highest values in the group of horses up to 1 year. Their evaluations seem to be overestimated mainly for the traits of limbs, walk and trot as the connections between these traits and the sum of the points regularly go down with increasing age. The evaluation of the Polish Trakehner horse is comparable with the other sport horse breeding within the means and standard deviations, as compared with the international Interstallion data. The evaluation of very young horses should be more informative as it is essential information for the breeders.

Acknowledgements

The authors thank Mrs. Zofia Szemplińska-Domian from the Polish Trakehner Association for the help with the data collections and Native Speakers Group (Szczecin) for the language corrections.

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Received: 25 IX 2015
Accepted: 8 I 2016