Factors other than training that influence horse driving scores

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Summary: The aim of the study was to analyze which factors other than training, influence horse scores in single class driving events. The data concerned 40 events at 3* level, held in 10 European countries over the course of three years. Of 824 turnouts at these events, a total of 729 entries with all three competitions (Dressage, Marathon, Cones) completed were considered in the main analysis. The following scores and ranks were used: numbers of penalties in the three competitions, total number of penalties, final classification and classification index, which related the placings to the number of completed turnouts at an event. The following factors were considered: the horse sex, age and coat color as well as the country of athlete origin and the location of the events. The data were analyzed with ANOVA GLM and the significant differences between means were determined using Tukey's test. The analysis revealed that most penalties are received in the Marathon competition, with fewer in Dressage and fewest in Cones. The scores and ranks are significantly influenced by the horses' age: the oldest horses (17–21 years old) and 10–11 year-olds perform best and the youngest horses (6–7 years old) perform worst. This can be associated not only with the horses' physical development but also experience and skills. Horse sex usually does not significantly affect the scores and ranks. A connection between coat color and the performance should be confirmed in future studies. Athletes from Middle Europe achieve better results than those coming from other parts of Europe, in addition to those from outside Europe, the latter of which tending to fare poorly. The variability in the mean scores within Marathon and Cones competitions indicates differences in the course difficulty depending on the location in which the events are run. Breeders, trainers and athletes, when considering the driving scores and ranks in terms of estimation of a horse, should also take into account the horse age and the fact that difficulty of course design at different events may vary substantially.

Keywords: horse, driving competition, scores, breeding, performance

Introduction

Although draught horses were for many ages the main power source for transportation of people and commodities, as well as for work in fields, these horses have lost their importance over the last century. However, an extremely attractive equestrian driving discipline developed and some horse breeds are almost exclusively focused on such use. Due to the high financial outlay and enormous effort needed to organize driving training and events, this discipline is less popular than jumping, dressage or eventing. The driving discipline consists of three competitions: Dressage, Marathon and Cones. The final classification for individuals is determined by adding together the penalties received in each competition (FEI Driving Rules 2017). The athlete with the lowest number of penalties is the winner of the event. Athletes who do not complete any one of the competitions are not included in the final classification. The level of difficulty of the events is defined by a progressive star rating system (1*–4*). The requirements for a level, among others course designs, should be unified with regard to the difficulty. A horse may only take part once in each competition at an event.

The horses are selected during the process of breeding, primarily according to their performance. However, estimation of performance is often subjective. Sport scores are a direct measure of performance; hence, successful scores are often considered as the focus of such breeding. The question remains however whether the scores accurately illustrate the performance. So many factors can influence the scores that the estimation can be significantly biased. On one hand, these are the structural and physiological factors of the horse, e.g. its conditional status, sex, age, breed or even coat color. As to the latter, breeders sometimes prefer certain coat colors in horses believing that the performance of differently colored horses vary. From the genetic point of view, such a relationship is potential because of possible close gene linkages or pleiotropy of some genes (*Stachurska* et al. 2007). On the other hand, technical abilities acquired during training may be of utmost importance. Simultaneously, a wide range of entirely external factors exist (*McKenzie* 2017). For instance, the obstacle color may affect whether a jump is clear or not, although the color is not officially determined by the rules (*Stachurska* et al. 2002, *Spaas* et al. 2014). Recent studies have revealed the influence of warm-up intensity on the jumping scores (*Stachurska* et al. 2018). Some important factors describing cross-country obstacles in eventing, were found (*Stachurska* et al. 2010). Similarly, dressage judging can be subjective, which may considerably affect the scores and classifications (*Stachurska* and *Bartyzel* 2011). Some effects may be limited as it is for example in the case of accurateness of judging, whereas most effects are fixed. However, the action of both kinds of factors should be known by the breeders to enable exact horse estimation and undertake a suitable breeding strategy.

Some studies consider the welfare and reactions to different stimuli in driving horses (*Dziezyc* et al. 2011, *Jahnke* 1994, *Kupczyński* and *Śpitalniak* 2015). To the authors' knowledge, there is no study analyzing basic factors that influence sport results in the horse driving discipline. The sport records are difficult to analyze in the case of pair and four-in hand classes, where the final classification concerns a total of two or four horses (FEI Driving Rules 2017). The objective of the present study was to analyze which factors other than training, influence horse scores in single class driving events.

Materials and Methods

Data were downloaded from the FEI website (https://data.fei.org 2017) and concerned 40 events held in 10 European countries (Austria, the Czech Republic, France, Ger-

many, Hungary, Lithuania, Netherlands, Poland, Slovakia, Slovenia) in 20 locations over the course of three years. The events were at 3* level. The FEI Driving Rules (2017) provide that horses at this level must be 6 years old or over. Generally, athletes are qualified as 3* when they successfully complete two 2* events. The countries that athletes came from were split into the following five groups: Northern Europe (Denmark, Finland, Norway, Sweden), Western Europe (Belgium, France, Germany, Great Britain, Italy, Luxemburg, Netherlands, Spain, Switzerland), Middle Europe (Austria, the Czech Republic, Hungary, Poland, Romania), Eastern Europe (Estonia, Latvia, Lithuania, Russia) and outside Europe (Australia, Canada, Chile, U.S.A.). For a more accurate analysis, only single class was considered. Of 824 entries at these events, a total of 729 entries completed all three competitions, and were thus considered in the main analysis.

Table 1   Driving scores and ranks with regard to the horse's sex | *Fahrergebnisse und Platzierungen in Abhängigkeit des Geschlechts der Pferde*

Horse's sex	N	Item	Penalties in Dressage	Penalties in Marathon	Penalties in Cones	Total penalties	Final classification	Classification index
Mares	198	$\bar{x}$	59.05a	91.01a	8.93a	158.89a	13.31a	0.50a
		sd	8.39	16.72	7.30	23.09	9.33	0.24
Stallions	80	$\bar{x}$	57.38a	87.09a	8.20a	152.63a	10.40b	0.41a
		sd	8.49	14.99	7.82	23.42	8.85	0.27
Geldings	451	$\bar{x}$	58.53a	88.78a	8.77a	156.11a	12.44a	0.47a
		sd	8.03	18.80	7.85	26.07	9.93	0.26

N – number of entries, $\bar{x}$ – mean, sd- standard deviation. Means marked in columns with different letters significantly differ at P ≤ 0.05.

Table 2   Driving scores and ranks with regard to the horse's age | *Fahrergebnisse und Platzierungen in Abhängigkeit des Pferdealters*

Age (years)	N	Item	Penalties in Dressage	Penalties in Marathon	Penalties in Cones	Total penalties	Final classification	Classification index
6–7	59	$\bar{x}$	60.24a	96.92a	14.17a	171.30a	13.25a	0.59a
		sd	5.49	17.20	10.62	25.25	9.96	0.23
8	79	$\bar{x}$	59.53a	91.44b	10.18b	160.95b	12.94ab	0.51b
		sd	8.20	15.42	7.99	23.95	8.43	0.24
9	111	$\bar{x}$	58.51a	89.98b	9.15b	157.62b	14.14a	0.50b
		sd	8.56	21.76	7.25	28.16	10.71	0.25
10	114	$\bar{x}$	56.32b	89.43b	8.25b	153.99c	10.83b	0.44bc
		sd	7.24	17.46	7.55	25.08	7.00	0.28
11	97	$\bar{x}$	57.82ab	91.50b	6.67c	155.99bc	11.03b	0.41c
		sd	8.23	17.70	6.85	23.71	9.10	0.26
12	91	$\bar{x}$	58.75a	88.43b	7.70bc	154.92c	11.76b	0.46bc
		sd	8.77	17.95	6.48	23.68	9.00	0.28
13	46	$\bar{x}$	61.04a	88.37b	7.85bc	157.26b	13.74a	0.52b
		sd	8.68	17.03	6.55	25.19	9.60	0.26
14	46	$\bar{x}$	59.99a	85.05bc	7.33bc	152.74c	12.91ab	0.47b
		sd	9.50	13.37	6.68	21.63	9.79	0.26
15–16	43	$\bar{x}$	60.24a	82.63c	9.16b	152.00c	14.77a	0.47b
		sd	8.28	14.66	8.37	20.63	10.49	0.23
17–21	43	$\bar{x}$	55.68b	80.19c	7.92bc	143.65d	10.91b	0.37d
		sd	7.32	16.05	6.15	22.07	9.29	0.25

N – number of entries, $\bar{x}$ – mean, sd – standard deviation. Means marked in columns with different letters significantly differ at P ≤ 0.05.

The following scores and ranks were used: (a) numbers of penalties in the three competitions (Dressage, Marathon, Cones), (b) total number of penalties, (c) final classification and (d) a classification index created in this study. The classification index related the placings to the number of turnouts completed at an event to make the final rank more objective. Five factors were considered: (A) horse sex (mares, stallions, geldings), (B) horse age group (6–7, 8, 9, 10, 11, 12, 13, 14, 15–16, 17–21 year-olds), (C) horse coat color (bay, chestnut, black, gray, roan, piebald) as well as the aforementioned European region that athletes came from (D) and (E), the location at which the events were run. Factor (E) directly concerned particular events, and hence it did not make sense to consider the ranks (c, d) in this case. Information on horse breed is usually unavailable, and thus this could not be included as a factor. The data were analyzed with ANOVA GLM and significant differences between means were determined using Tukey's test. Statistical significance was accepted at P < 0.05.

Results

Ninety five turnouts were eliminated/disqualified/retired/withdrawn from the events: 0.7% of the initial number of competitors dropped out from the Dressage competition, 7.9% from the competing turnouts in the Marathon and 3.1% from the remaining turnouts in Cones. The percentage of penalties imposed in Dressage, Marathon and Cones were 37.4, 57.0 and 5.6, respectively. ANOVA GLM results are presented in Tables 1–5. The interactions between the factors studied were not significant. Generally, the scores and ranks did not statistically differ with regard to sex (Table 1). Only stallions were classified higher than geldings and mares, although the classification index was similar for the three sex groups.

Most entries were 9 to 12 year-old horses (Table 2). The lowest penalties in Dressage were received by 17–21 and 10 year-olds and in Marathon by 15–21 year-olds, whereas 11-year-olds received the lowest penalties in Cones. Total penalties were the lowest for 17–21 year-old horses. The entries of horses at the age of 10–12 and 17–21 years old

held the highest classifications. According to the classification index, 17–21 year-old horses were best followed by 10–11 year-olds. The worst results in all parameters were observed in 6–7 year-olds.

Bay horses most often took part in the events (Table 3). There were also many entries of gray and chestnut horses. Piebald horses were rare, whereas roans competed only twice. All parameters were best in the case of piebald horses. Gray and chestnut horse entries resulted in not only the highest penalties in Cones but for total penalties overall. The chestnuts and roans were classified in last place.

Most turnouts came from Western and Middle Europe (Table 4). The horses from Middle Europe were rated amongst the best in terms of all parameters. Western Europe was poorer than Middle Europe in regards to the Marathon competition. The worst scores except for in Dressage, and ranks, were received by turnouts coming from outside Europe. Both final ranks were similar for all parts of Europe and significantly worse for turnouts from outside Europe.

The lowest penalties in Dressage were imposed in Dillenburg (Table 5). In Marathon, the turnouts had the lowest penalties in Piber Köflach and followed by Chablis and Wałbrzych – Książ. The penalties for this competition in Fabiansebestyen, Mezohegyes and Topolcianky, were highest. In turn, the penalties in Cones were lowest in Chablis and Le Pin au Haras, whereas they were highest in Mezohegyes. The turnouts obtained the lowest total penalties in Chablis, Pau, Piber Köflach and Wałbrzych – Książ, and the highest total penalties in Mezohegyes and Topolcianky.

Discussion

Driving events that include three competitions run in totally different circumstances are very attractive for audiences and represent a great challenge for athletes and horses. The difficulties in conducting statistical analyzes for eventing, which is similar in its structure to driving, was pointed out earlier

Coat color	N	Item	Penalties in Dressage	Penalties in Marathon	Penalties in Cones	Total penalties	Final classification	Classification index
Bay	460	x̄	58.02a	88.90a	8.10a	154.95a	11.97a	0.45a
		sd	8.09	18.01	7.40	24.79	9.57	0.26
Chestnut	95	x̄	58.39a	91.72a	10.26b	160.41b	14.89b	0.51a
		sd	7.15	17.95	8.46	25.41	11.13	0.25
Black	58	x̄	57.50a	88.02a	8.78a	154.73a	12.71a	0.50a
		sd	9.21	15.98	6.38	24.30	9.79	0.28
Grey	104	x̄	61.78a	89.29a	10.44b	161.49ab	12.68a	0.52a
		sd	7.77	18.84	8.45	26.11	8.52	0.24
Roan	2	x̄	69.79b	76.38b	7.78a	153.95a	17.00c	0.49a
		sd	15.80	3.59	5.04	29.42	12.73	0.36
Piebald	10	x̄	49.89c	80.77b	4.16c	134.82c	5.80d	0.23b
		sd	4.16	7.15	3.16	8.13	3.49	0.11

Table 3   Driving scores and ranks with regard to the horse's coat color | *Fahrergebnisse und Platzierungen in Abhängigkeit von der Fellfarbe*

N – number of entries, x̄ – mean, sd – standard deviation. Means marked in columns with different letters significantly differ at P ≤ 0.05.

(*Whitaker* and *Hill* 2005). According to FEI Driving Rules (2017), Dressage, Marathon and Cones competitions included in the horse driving discipline are considered together in the final classification. That means the penalties in particular competitions may be also analyzed as a whole. The classification index made for this study allowed to make the final rank independent of the number of turnouts at an event. As mentioned, pair and four-in hand classes are an additional limitation to analyses of horse driving performance. However, in the present study a large volume of material from single class driving at high-leveled events was collected, which enabled a comprehensive analysis.

The percentages of both incompleted competitions and penalties clearly show that the Marathon is incomparably more difficult than the other two driving competitions. It seems that these results are in agreement with intentions of the driving discipline creators (FEI Driving Rules 2017). The Marathon is most spectacular and demanding competition, hence its scores should also weigh the most. As it might be expected, the Cones were rated second according to the number of incompleted entries, however in terms of penalties, the second was Dressage.

The results show that it is mainly geldings that compete in driving. Mares participating in driving events were over twice as rare as geldings and stallions over five times as rare. It is likely that athletes and trainers do not choose stallions for driving because of their higher emotionality (*Janczarek* and *Kędzierski* 2011) and difficulties in separating them from other horses during transport and events. A tendency for slightly better variables in stallions perhaps does not sufficiently justify the use of stallions in the discipline. In eventing, stallions and geldings usually outperform mares (*Hanousek* et al. 2018).

The parameters turned out to be closely related to horse age. The oldest horses in the study, i.e. those between 17–21 years old were best in terms of all parameters; horses aged between 10 and 12 years were also classified highly, whereas young, 6–7 year olds had the worst results. This is an emphatic proof that experience and acquired skills are most important in the driving discipline. Old horses may be in relatively poorer physical condition (*Zsoldos* et al. 2014), however they still

preponderate over young and strong but inexperienced horses. These results cannot be interpret that e.g. younger horses competed on more difficult courses because at a particular event, horse age groups were differentiated and the interaction between the age group and event was not significant.

Differences in the parameters between differently colored driving horses may indicate that the coat color is associated with the performance. However, racing scores of Thoroughbreds of basic and gray colors did not show such a relationship (*Stachurska* et al. 2007). On the other hand, some behavioural differences were found between horses of basic colors (*Finn* et al. 2016, *Jacobs* et al. 2016). The present analysis may be considered only as a pilot study with regard to this factor, since the piebald horses, which performed significantly better, competed rarely and the association could have been coincidental. Instead, a tendency for better parameters in bays and blacks, and worse parameters for chestnuts may indicate that there is a weak connection between these colors with the driving performance.

Interestingly, best variables were achieved by athletes from Middle Europe, who made up to 30 % of entries. This may indicate that the horse driving discipline has become a domain of Austria, Czech, Hungary and Poland. In turn, the poor parameters observed for turnouts from outside Europe might be caused by long transport and difficulty in adaptation to different climatic conditions. These athletes were few. Many reasons could determine their decision to participate at European events, hence it is not possible to estimate the level of driving in their countries on the basis of this analysis.

It should be taken into account that Dressage scores are less objective than the results of Marathon and Cones because of the way of judging. .However, the Dressage competition is highly standardized and perhaps that is why penalties in Dressage hardly differed between various events. Low differences in these parameters indicate a high quality of judging and similar level of turnouts at different events. Instead, the high mean variation in Marathon and Cones penalties (from 72 to 113 and from 4 to 20, respectively) is opposite to the goal of the star rating system. This may illustrate great differences in the course difficulty depending on the location in which the events are run.

Table 4 Driving scores and ranks with regard to the part of Europe that athletes came from | *Fahrergebnisse und Platzierungen in Abhängigkeit der Herkunft der Pferde*

Part of Europe of athlete	N	Item	Penalties in Dressage	Penalties in Marathon	Penalties in Cones	Total penalties	Final classification	Classification index
Northern Europe	88	$\bar{x}$	61.01a	89.08a	8.64ab	156.34ab	13.32b	0.51ab
		sd	6.99	15.66	6.18	22.56	8.19	0.25
Western Europe	379	$\bar{x}$	57.44b	89.97a	7.63bc	154.89b	12.42b	0.45b
		sd	8.14	20.91	5.36	25.74	8.75	0.25
Middle Europe	223	$\bar{x}$	58.82b	85.76b	6.53c	148.71b	11.26b	0.39b
		sd	8.46	15.44	4.77	20.67	7.28	0.27
Eastern Europe	13	$\bar{x}$	64.58c	85.57b	7.45bc	152.17b	13.82b	0.44b
		sd	6.66	16.34	6.09	23.29	10.51	0.26
Outside Europe	26	$\bar{x}$	60.95a	89.85a	9.87a	161.24a	19.19a	0.59a
		sd	7.12	13.52	5.95	18.03	11.65	0.20

N – number of entries, $\bar{x}$ – mean, sd – standard deviation. Means marked in columns with different letters significantly differ at $P \le 0.05$.

Conclusion

The study performed on a great material shows some factors that influence the scores and ranks in single class horse driving events. Most penalties are received in the Marathon competition; fewer are received in Dressage and fewest in Cones. The age of the horse significantly influences the variables. The oldest horses (17–21 years old) and 10–11 year-olds perform best, likely due to their higher levels of experience and skills. These horses distinctly preponderate over young, 6–7 year old horses. The horse's sex is usually an insignificant factor. Athletes from Middle Europe achieve better scores and ranks than those coming from other parts of Europe in addition to those from outside Europe, which tended to fare poorly. The

Table 5 Driving scores with regard to the location of the event | *Fahrergebnisse in Abhängigkeit des Veranstaltungsortes*

Country	Location	M	N	Item	Penalties in Dressage	Penalties in Marathon	Penalties in Cones	Total penalties
Austria	Altenfelden	2	38	$\bar{x}$	58.45a	83.72b	9.07c	151.28b
				sd	6.77	9.16	7.59	15.79
	Piber Köflach	2	47	$\bar{x}$	56.12ab	72.11d	8.82ac	136.94d
				sd	7.73	17.39	5.81	22.51
Czech	Kladruby nad Labem	3	69	$\bar{x}$	60.82a	96.71a	7.60a	165.10a
				sd	9.17	19.41	5.00	27.83
	Nebanice	2	28	$\bar{x}$	59.07a	83.15b	9.89c	151.85b
				sd	9.37	19.13	7.33	30.85
	Nemcice u Kolina	3	28	$\bar{x}$	60.64a	88.29b	7.64a	157.57ab
				sd	12.00	18.90	5.66	32.59
France	Chablis	3	69	$\bar{x}$	60.06a	77.74bd	4.72d	142.52d
				sd	8.45	12.75	5.58	20.42
	Le Pin au Haras	2	17	$\bar{x}$	56.70ab	99.61ac	4.14d	160.45ab
				sd	8.37	17.98	6.28	24.88
	Pau	1	6	$\bar{x}$	55.65ab	81.16bd	6.19a	143.00d
				sd	6.41	7.06	3.90	13.47
	Saumur	3	45	$\bar{x}$	59.05a	94.08a	9.75c	162.65a
				sd	7.59	21.79	7.52	25.23
Germany	Dillenburg	3	78	$\bar{x}$	53.24b	90.00ab	8.99ac	152.10b
				sd	7.68	21.10	5.91	26.88
	Drebkau	2	51	$\bar{x}$	61.10a	88.37b	7.88a	157.16ab
				sd	6.96	9.55	7.51	15.82
Hungary	Aszár Kisber	1	28	$\bar{x}$	56.91ab	85.80b	15.65e	158.37ab
				sd	6.28	10.08	10.21	25.02
	Fabiansebestyen	2	35	$\bar{x}$	57.28a	105.07c	10.73c	173.29c
				sd	7.60	17.86	7.78	23.62
	Mezohegyes	1	3	$\bar{x}$	56.11ab	107.82c	20.07f	184.00e
				sd	5.54	8.33	13.00	13.79
Lithuania	Bendoriai	2	23	$\bar{x}$	59.01a	89.33b	9.26c	157.59ab
				sd	7.79	11.08	5.97	18.96
Netherlands	Horst	2	83	$\bar{x}$	59.51a	90.40ab	9.15c	159.06ab
				sd	6.72	9.03	6.79	16.98
Poland	Bogusławice	1	13	$\bar{x}$	59.90a	96.58a	14.04e	170.53a
				sd	6.92	14.60	4.94	19.51
	Wałbrzych – Książ	1	12	$\bar{x}$	56.11ab	77.60bd	6.81a	140.53d
				sd	6.66	5.06	3.74	12.00
Slovakia	Lipica	3	31	$\bar{x}$	59.78a	87.25b	5.99b	152.99b
				sd	8.31	13.83	3.72	19.00
Slovenia	Topolcianky	1	25	$\bar{x}$	61.42a	112.97c	13.23e	187.62e
				sd	7.03	12.62	9.20	21.51

M – number of events, N – number of entries, $\bar{x}$ – mean, sd – standard deviation. Means marked in columns with different letters significantly differ at P ≤ 0.05.

variability in the mean scores within the Marathon and Cones competitions indicates differences in course difficulty between particular places where the events are run. Breeders, trainers and athletes, when considering the driving scores and ranks in terms of estimation of a horse, should take into account the horse age and the fact that difficulty of course design at different events may vary substantially.

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Conflict of interest

The authors declare that they have no conflict of interest.

Animal welfare statement

The study did not need an approval of Ethical Committee for Animal Experiments since the data were downloaded from the Internet.

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