The Veterinary Journal 181 (2009) 48–52

Contents lists available at ScienceDirect

The Veterinary Journal

journal homepage: www.elsevier.com/locate/tvjl

A comparison of sympathetic and conventional training methods on responses to initial horse training

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ARTICLE INFO

Keywords:
Horses
Behaviour
Training methods
Welfare
Performance

ABSTRACT

In 'sympathetic horsemanship' the importance of the natural behaviour of the horse and the use of body language in communication is emphasised. However, it is unclear what effect sympathetic horsemanship has on the welfare of horses. During a 5-week starting period the effect of a sympathetic (ST) versus a conventional (CT) training method was studied using 28 young Warmblood horses. Behavioural observations during the starting period as well as during a standardised final riding test were performed by trained observers. A Wilcoxon matched-pair test was used to detect differences within groups, Mann-Whitney-U to test differences between groups, and principal component analysis (PCA) to evaluate the effect on multiple variables simultaneously.

A human-approach test showed that ST horses snorted significantly less compared to CT horses ($P = 0.006$) after the training period. Furthermore, CT horses showed more fear and stress-related behaviours during training such as 'body tension' ($P < 0.001$), 'high head carriage' ($P < 0.001$), 'lip movements' ($P = 0.008$) and 'teeth grinding' ($P = 0.03$). Principal component analysis demonstrated that horses showed consistent differences in a range of behavioural and heart-rate parameters between groups. Behavioural parameters and technical performance during the standardised final riding test did not differ significantly between groups, but mean heart rate was higher for CT horses ($P < 0.001$). The results suggest that applying a sympathetic training method when starting young horses did not compromise technical performance, but seemed to reduce stress during training compared to a conventional training method.

Introduction

In recent years, natural horsemanship, gentling and whispering have received much attention from horse-owners. 'Sympathetic horsemanship' practices emphasise the importance of the natural behaviour of the horse, the use of the horse ethogram (especially body language) in communication, as well as respecting the horse's natural needs (Waran et al., 2002; Polito et al., 2007). However, the welfare of the horses trained using sympathetic methods may not necessarily be better than that in conventionally trained horses.

Inappropriate training practices can lead to (chronic) conflict behaviours that jeopardise the safety of riders and handlers (Warren-Smith and McGreevy, 2008). The alarmingly high wastage rates in young horses have led to the suggestion that wastage arises from inappropriate training and/or management (McLean and McGreevy, 2006). Furthermore, Ödberg (2005) postulated that inappropriate riding and schooling probably create an underestimated welfare problem. Recently, Polito et al. (2007) showed that horses trained using a sympathetic method had more positive interactions with humans, which resulted in lower reactivity and higher compliance during specific manipulations in preparation for public auctions compared to horses trained with conventional methods. However, the effect of different training methods on technical performance has not been studied.

The aim of the present study was to compare the effects of sympathetic and conventional training methods during the starting period of performance horses. Since the differences in management of the horses are an integral part of each method, this was included in the study. We assessed effects of training method on the horses' reaction to human presence, as well as behavioural and heart-rate responses during specific predefined training phases and technical performances.

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doi:10.1016/j.tvjl.2009.03.009

Materials and methods

All procedures involving animal handling and testing were approved by the Animal Care and Use Committee of the Animal Sciences Group of Wageningen University and Research Centres in Lelystad, The Netherlands.

Animals and housing

Twenty-eight Dutch Warmblood horses (3.5 years ± 2 months of age) were subjected to two different training methods for starting horses. At the start of the experiment, horses were grouped according to sex, sire, previous grouping and results from human-approach and learning tests. They were then assigned to the 'conventionally trained' (CT) group ($n = 14$) or to the 'sympathetically trained' (ST) group ($n = 14$). Both groups comprised an equal number of geldings and mares and each group was transported to a different training location.

Horses were housed individually at the training locations in boxes measuring 3 × 3 m with straw bedding. No social/physical contact took place between the CT horses and they were not turned out; the ST horses had limited social contact through grids between the boxes and whole-day turn-out on pasture in two groups. The CT horses received exercise in a horse walker on non-training days. Additionally, all horses received between 40 and 60 min training exercise a day and a total of 20–25 h over the whole training period.

Training methods

The 5-week training period took place in autumn. Trainers at the two training centres were highly qualified with long-term experience of starting horses. Both training centres were briefed to achieve an end outcome of horses that would accept a rider, work in walk, trot and canter in order to fulfil a simple dressage test with changes of rein and large circles, with quiet acceptance of the bit. A dressage outline (and collection) was not required from the horses and this was emphasised to both training centres.

Conventional training method

The conventional training method used in this study was based on the system of Steinbrecht (1886). Horses were trained by advanced equitation students (one student per horse) and their trainer. Horses underwent equal daily training on a pre-determined stepwise schedule. Week one included lunging, acclimatisation to bridle and lunging, acclimatisation to saddle and lunging. In week 2, ridden work commenced and horses were also long-reined and lunged with double lines. Within one session the rider leaned over the saddle, then mounted fully and horses were walked and trotted on the lunge with little rein contact. The rider then increased contact and by the end of week two horses worked off the lunge in walk and trot. After this, emphasis was placed on outline and rhythm in all paces.

Sympathetic training method

The sympathetic training method used in this study was based on a freestyle training method developed in The Netherlands. Horses were trained by a team of experienced freestyle trainers. All aids were learned stepwise and one by one before they were introduced as a whole. An individual training schedule was applied for each horse and adjusted according to its progress. During the process the following techniques were used: groundwork, teaching to avoid pressure, working on long lines and getting habituated to frightening objects and events. During sessions the rider started to lean over the bareback horse. After full acceptance of this, the rider moved into a sitting position and the horse was led. The next step involved saddling the horse (bareback pad), putting on a bridle (leather bit) and lunging with both. For some horses a bitless bridle was used temporarily depending on oral conformation. Riders first worked on the double lines. Finally, groundwork was alternated with free riding.

Measuring comparable training events during the 5-week training period

The authors were aware of the potential constraints of comparing such differing integral methodologies. Since observations were performed during the actual training, our observers were not blinded. However, at each training centre three trained observers were stationed for 5 weeks to record behaviour and the exact training schedule on a daily basis for each horse. Most important, two 'events' were standardised across training methods, during which behaviour and heart-rate responses were measured. Event 1 comprised first-time lunging with a saddle during the training period; Event 2 was first-time trotting under a rider during the training period. In both training centres these events occurred at different stages, but the measurements were taken by the trained observers at the first occurrence.

After 5 weeks' training all horses were returned to the research station in Lelystad. Before, during and after the training period, the horses' behavioural and heart-rate responses were assessed in a human-approach test, during predefined training events, and in a final standardised riding test. Behavioural and heart-rate measurements obtained during these tests are shown in Table 1. Behaviour was scored using a direct scan sampling method and all occurrences, depending on the behaviour measured. Heart rate was measured using a Polar S610i unit during the training period and final riding test, and using a Polar S810 unit during the human-approach test.

Human-approach test

A human-approach test, as has been performed by Søndergaard and Halekoh (2003), was performed once before horses left for their training period and once after they returned. Horses were led into an indoor testing area measuring 10 × 15 m. After 2 min habituation, an unfamiliar handler entered the testing area and stood motionless for 5 min, not seeking eye contact, in the middle of the area. Next, the handler walked straight toward the horse's left shoulder in order to catch it. Behavioural parameters as well as heart rate and heart-rate variability were assessed (see Table 1). In the post-training test handler and observers were blinded to previous treatment.

Final riding test

The final riding test after the training period took place in an indoor riding school familiar to all horses, and followed a pre-determined dressage exercise. The test included halt, walk, trot and canter on both reins. Figures included a large circle and a change of direction across the diagonal. Each horse was first ridden by a familiar rider, and 10–15 min later by an unfamiliar professional rider. Horses were asked to walk across a pole only by the unfamiliar rider. Four observers assessed the behaviour of the horses, exactly as they had done during the 5 weeks of training, and five experienced judges assessed the technical performance. Observers and judges were not blinded for treatment since equipment differed between groups. Mean heart rate (average at 5 s intervals) was also taken (see Table 1).

Statistical analysis

The significance level was set as $P < 0.05$ and an effect was considered a trend when P was between 0.05 and 0.1. Differences in measurements (Table 1) and in scores of principal components obtained with the use of principal component analysis (see below) between training groups were analysed with the Mann-Whitney-U test for independent samples. Differences within training groups between measures recorded during the human-approach test before and after the training period were analysed using the Wilcoxon matched-pairs signed-rank test for dependent samples. Principal component analysis (PCA) without rotation was used to examine patterns of intercorrelation between behavioural and heart-rate measures recorded during the two specific events whilst the training was in progress, and to evaluate the effect of training on these multiple variables simultaneously.

With the use of PCA, correlated measures are condensed into so-called principal components. These are linear combinations of the original measures, reflecting independent characteristics (or dimensions) underlying the correlation matrix. The first component explains most of the variance (expressed in terms of the first eigenvalue); the second component explains most of the remaining variation, and so forth. The loading of each measure on a principal component represents the correlation between the latent characteristic and the original measure and thus indicates the importance of a measure for a principal component. *Measures with high loadings on the same principal component of the same sign are positively correlated, and loadings of the opposite sign are negatively correlated.* If the reactivity of the horses to training was mediated by a single underlying trait, PCA of heart rate and a range of various behavioural measures recorded during the training period would be expected to produce at least one major component (i.e., underlying dimension) with high loadings from multiple measures. Next to the mean heart rate, eight behavioural parameters recorded during both events were included in a separate PCA per event. These behavioural parameters were body tension, head against hand, head position high, head position medium, head position low, lip movements, teeth grinding, and tail swishing. Measures were scaled prior to PCA (i.e., the analysis was performed on the Pearson correlation matrix). The first two principal components with eigenvalues >1 were retained for further consideration. All statistical analyses were conducted using Genstat 7.0.

Results

Human-approach test

Horses did not show differences between groups in frequencies of snorting, whinnying, defecating, and latency and frequency of touching the unfamiliar human during the human-approach test preceding the training period. Compared to preceding training period frequencies, the ST horses showed a significant decrease (5.5 to 1.1; $P = 0.006$) in snorting frequency after the training period, whereas the CT horses showed a slight but not statistically

Table 1
Definitions of the relevant measures assessed during different tests.

Measures	Definition	Human-approach test	Training event	Final riding test
Snorting	Sound produced upon forceful quick exhalation of less than 1 s duration (McDonnell, 2003)	✓		
Whinnying	Loud, prolonged call, typically 1–3 s, beginning at high pitch and ending at lower pitch (McDonnell, 2003)	✓		
Defecating	With tail raised, expelling of faeces through the anus (McDonnell, 2003)	✓		
Frequency touch	Number of times horse touches the unfamiliar human with its nose	✓		
High head position	Nose above the withers		✓	
Normal head position	Nose between the withers and the abdominal line		✓	
Low head position	Nose between the abdominal line and the carpus		✓	
Lip movements	Extraneous moving of the tongue in and out of the mouth (McDonnell, 2003)		✓	
Teeth grinding	With jaws clenched, moving the jaws back and forth and rubbing the upper and lower teeth (McDonnell, 2003)		✓	
Tail swishing	Strong lateral and dorsoventral movements of the tail (McGreevy et al., 2005)		✓	
Body tension	Stiffness and tightness of the muscles		✓	
Head against hand	Frequent up-and-down headshaking movements with rein tension		✓	
Heart rate	Mean number of heart beats per minute	✓	✓	✓
Heart-rate variability	Root mean square of successive differences (RMSSD)	✓		
General impression	Body tension, willingness to work and performance of the tasks (score 1–5)			✓
Response to correction	Attentive response with correction (score 5) to an irritated response without correction (score 1)			✓
Response to cue for new task	Attentive response and correct performance of new task (score 5) to an irritated response and incorrect performance of new task (score 1)			✓

significant increase (3.5 to 5.1). At the same time, ST horses showed a significant increase (0.7 to 2.5; $P = 0.006$) in whinnying frequency after the training period, while the CT horses showed a slight decrease (1.4 to 0.6).

There were no significant differences in defecating frequency or latency and frequency to touch the unfamiliar human between the human-approach tests before and after the training period. In addition, there was no significant effect of training method on the latency time to approach the handler after the trainings period (CT: 1.5 ± 0.5 min; ST: 1.9 ± 0.6 min).

Overall, average heart rate during the human-approach test after the training period was lower than during the human-approach test before the training (before: 85.3 ± 4.1 beats per minute [bpm]; after: 74.3 ± 3.8 bpm). The root mean square of successive beat-to-beat differences (RMSSD) was used as a parameter of heart-rate variability. The RMSSD was higher during the human-approach test after the training period compared to the human-approach test before the training period (before: 37.0 ± 4.8; after: 45.2 ± 6.7). However, there were no significant differences in either measure between training methods.

Responses during 5-week training period

During the first event (first-time lunged with a saddle), the ST horses showed significantly less body tension, a more relaxed head position, fewer lip movements and less teeth grinding, and a lower mean heart rate (see Table 2). During the second assessment event (first-time trotting with rider), the ST horses displayed less body tension, held their heads a significantly longer proportion of the time in a medium position, showed a lower number of lip movements and a lower mean heart rate (see Table 3).

To obtain an overall picture of the effects of both training methods a Principal Component Analysis (PCA) was performed. For the first event (first-time lunged with saddle), the first two components had an eigenvalue >1 and cumulatively accounted for 67.2% of the variance amongst horses. The first component explained 51.4% of the total variance and had high (>0.5) loadings for 8/9 input parameters. For the second event (first-time trotting with rider), the first two components cumulatively accounted for 57.5% of the variance. The first component explained 39.6% of the variance and had high (>0.5) loadings for 6/9 input parameters (see Table 4).

In Figs. 1 and 2, the individual horses are plotted as a function of their scores on the first (*X*-axis) and second (*Y*-axis) principal components. The CT and the ST horses were situated on different sides of the first principal component (*X*-axis). In both instances (first-time lunging with saddle and first-time trotting with rider), there was a significant difference ($P < 0.01$) between the CT and ST horses in their average score of the first principal component. There were no significant differences between the CT and ST horses in scores of the second principal component.

Table 2
Behavioural and heart-rate responses of conventionally (CT) or sympathetically (ST) trained horses during first-time lunging with a saddle during the training phase. Wilcoxon matched-pairs signed rank, $P < 0.05$ (SEM).

Measures	Training method		P
	CT	ST	
Body tension (% time)	24.0 (3.2)	5.3 (1.9)	<0.001
Head position high (% time)	29.8 (3.3)	14.5 (2.3)	<0.001
Head position medium (% time)	45.6 (3.0)	70.3 (2.0)	<0.001
Head position low (% time)	4.2 (1.1)	13.1 (1.7)	<0.001
Lip movements (number)	16.6 (4.8)	3.4 (0.9)	<0.01
Teeth grinding (number)	12.8 (4.2)	1.7 (0.7)	<0.05
Tail swishing (number)	2.9 (1.9)	2.1 (0.6)	0.160
Mean heart rate (bpm)	112.3 (4.5)	63.4 (2.7)	<0.001

Table 3
Behavioural and heart-rate responses of conventionally (CT) and sympathetically (ST) trained horses during first-time trotting while ridden during the training phase. Wilcoxon matched-pairs signed rank, $P < 0.05$ (SEM).

Measures	Training method		P
	CT	ST	
Body tension (% time)	25.9 (3.8)	7.6 (1.8)	<0.001
Head against hand (% time)	18.0 (3.1)	14.4 (3.3)	0.325
Head position high (% time)	39.0 (5.7)	28.6 (4.2)	0.302
Head position medium (% time)	43.2 (4.9)	63.2 (3.7)	<0.01
Head position low (% time)	7.4 (2.1)	7.4 (1.8)	0.756
Lip movements (number)	28.6 (7.0)	3.1 (1.1)	<0.001
Teeth grinding (number)	16.8 (4.8)	5.8 (1.8)	0.130
Tail swishing (number)	2.1 (0.8)	3.3 (1.0)	0.535
Mean heart rate (bpm)	108.2 (2.1)	87.4 (2.1)	<0.001

Table 4
Loading pattern of the principal component analysis (PCA) for first-time lunging with saddle and first-time trotting while ridden during the training phase. PCA component (PCA C) percentage of variation and eigenvalue are shown. For each measure the loading on the different components is shown.

Event	First-time lunging with saddle		First-time trot with rider	
	PCA C1	PCA C2	PCA C1	PCA C2
Percentage variation	51.4	15.8	39.6	17.9
Eigenvalue	4.6	1.4	3.6	1.6
Measures				
Body tension (% time)	0.89	−0.12	0.79	−0.15
Head against hand (% time)	0.59	−0.41	0.32	0.04
Head position high (% time)	0.84	−0.04	0.76	−0.59
Head position medium (% time)	−0.88	−0.09	−0.74	0.44
Head position low (% time)	−0.66	0.62	−0.40	0.48
Lip movements (number)	0.70	0.27	0.64	0.65
Teeth grinding (number)	0.75	0.49	0.72	0.41
Tail swishing (number)	0.16	0.73	−0.41	−0.33
Mean heart rate (bpm)	0.70	0.05	0.68	0.33

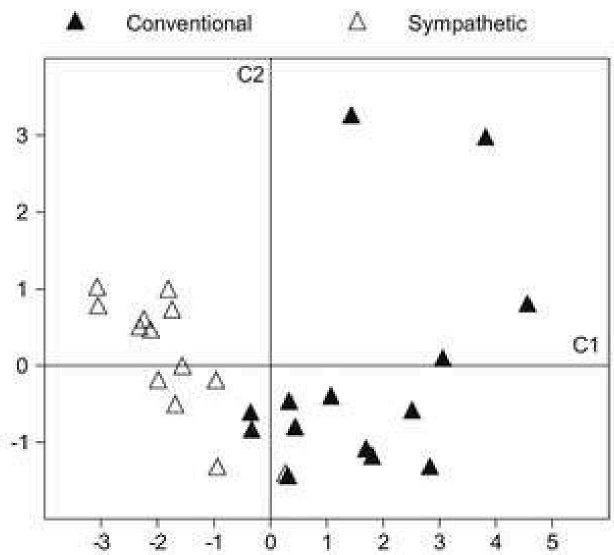

Fig. 1. Distribution of individual horses, either conventionally (black triangle ▲) or sympathetically trained (white triangle △), for an observation period of 5 weeks obtained during *first-time lunging with a saddle* during the training phase, in relation to their scores on to the first (C1, X-axis, 51.4% variation) and second principal (C2, Y-axis, 15.8% variation) components extracted after principal component analysis of behavioural and heart-rate measures. Due to missing values for mean heart rate one horse of the sympathetic trained group was excluded from the PCA analysis.

Final riding test

The judges' scores did not show any significant differences between training methods for the technical performance (general impression, response to correction and response to cue). Similarly, there were no statistically significant differences in behaviours observed between the CT and the ST horses (with both the familiar and unfamiliar rider), although the CT horses had a significantly higher average heart rate than ST horses (familiar rider: 98.4 ± 2.4 bpm and 84.2 ± 2.1 bpm, respectively; unfamiliar rider: 103.6 ± 2.1 bpm and 87.8 ± 2.7 bpm, respectively, $P < 0.001$).

Discussion

During initial training, horses must habituate to frequent human handling in a short period, so they learn both to suppress some aspects of natural responses and to develop new responses. In the present study, the management of the horses followed the philosophy of two training methods (CT and ST). These training methods were an integral part of the 5-week training period and therefore the contrasting approaches to horses during that training period, not just the training hours, were assessed. The greater use of habituation or familiarisation towards humans and objects as an integral part of the ST method could explain the lower fear and fewer stress behaviours in the ST horses.

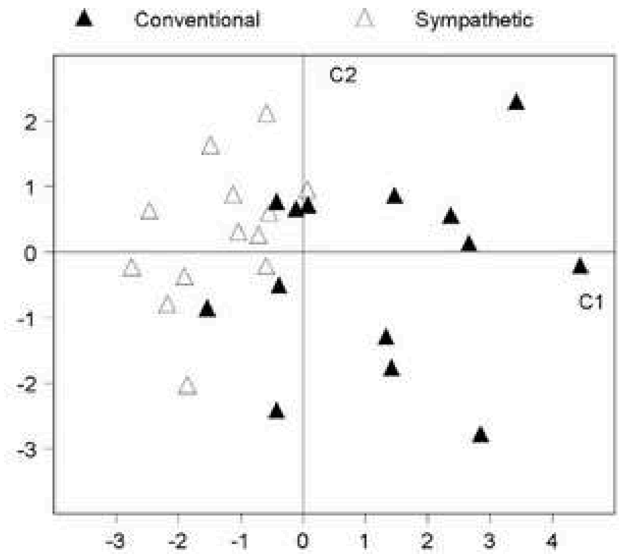

Fig. 2. Distribution of individual horses, either conventionally (black triangle ▲) or sympathetically trained (white triangle △), for an observation period of 5 weeks, obtained during *first-time trotting while ridden* during the training phase, in relation to their scores on the first (C1, X-axis, 39.6% variation) and second principal (C2, Y-axis, 17.9% variation) components extracted after principal component analysis of behavioural and heart-rate measures. Due to missing values for mean heart rate one horse of the sympathetic trained group was excluded from the PCA analysis.

The human-approach test before and after training allowed us to ensure completely controlled conditions. Although Polito et al. (2007) reported increased contact and licking behaviour in sympathetically trained horses, our study did not confirm this during the human-approach test following the training period.

In lay journals 'licking' is often described as a 'submissive' gesture toward the presence of a human and this assumption could be challenged. However, there were differences between the treatments in behaviours indicative of fear and stress. The ST horses snorted significantly less compared to CT horses ($P < 0.01$). Although not statistically significant, the ST horses displayed a slightly higher heart-rate variability (as measured by RMSSD) compared to the CT horses during the human-approach test (45.2 versus 39.5, respectively). This finding is in line with the results of Polito et al. (2007), in which the sympathetically trained horses displayed a heart-rate variability of 54.7 and the conventionally trained horses a heart-rate variability of 33.7 during a test in which a girth was tightened.

A higher heart-rate variability usually indicates a lower level of stress (Von Borell et al., 2007). The significant increase in vocalisation for ST horses ($P < 0.01$) and the decrease in whinnies for CT horses ($P < 0.01$) from the first to the second human-approach test, could be directly related to the management systems at the two training yards. In the sympathetic training yard horses had contact with one another both in the paddock and when stabled, while at the conventional training yard, horses were isolated and not turned out.

Training methods in the current study differed considerably regarding the timing and the way new events were introduced. Therefore, only two sufficiently standardised events could be used to compare the horses' responses between training methods. During both events responses were significantly different between the two training methods. The ST horses were less tense and displayed a lower mean heart rate, carried their heads for a longer duration in a normal (medium height) position, showed less teeth grinding and fewer lip movements. These results support a recent finding by Warren-Smith et al. (2007), which showed that when horses were forced to lower their heads by external pressure, they were less likely to lick and chew. This is in contrast to the popular belief that head lowering is associated with voluntary licking and chewing. Alternative explanations have been suggested for lip movements such as lip smacking as a displacement activity (Goodwin, 1999; Bachmann et al., 2003), or a manifestation of a behavioural conflict (McGreevy, 2004), or a response to a dry mouth as a result of increased adrenaline concentrations (P.D. McGreevy, personal communication).

In the present study, multivariate analysis showed that a new condensed measure of reactivity of horses during training, represented by the first component of the PCA (summarising tension, high head carriage and high heart rate) was clearly able to discriminate between the two training methods. Conventionally trained horses were more tense, displayed a higher head carriage and had a higher heart rate. A posture characteristic of a hyper-reactive ridden horse exhibiting conflict behaviour is an attempt to escape the aversive situation by the horse raising its head, quickening the pace, shortening its neck and stride and bracing its back (McGreevy et al., 2005). Our observations are in agreement with this as well as with those of Polito et al. (2007), in which horses that were trained in a conventional manner had a heightened overall activity and reactivity level compared to horses trained using the sympathetic method.

In the current study, conventionally and sympathetically trained horses clustered with distinct and almost separate scores on the first principal component (*X*-axis) in Figs. 1 and 2. This indicates that, in our study, training methods consistently affected a range of correlated behavioural and heart-rate measures, summarised in the first principal component. The results of the PCA not only indicated that behavioural and physiological (i.e., heart-rate) measures recorded in horses during two training events were consistently interrelated, but also suggest that these measures may all be related to the same underlying trait or characteristic, defining, for example, the propensity of individual horses to be easily excited. Following this line of reasoning, the training method might have influenced a more basic underlying trait rather than there being a specific response in a specific situation. Further work is necessary to examine the consequences of training methods for responsiveness and adaptive capacities of horses in a wider range of contexts.

The final riding test was used to measure the effects of the training methods on both technical performance as well as on behavioural reactions. Unfortunately, neither members of the jury nor behavioural observers could be fully blinded to the treatments. Judges recorded no differences in technical performance between the CT and the ST horses. Both groups of horses had reached the same level of technical performance within this short time frame. In addition, observers did not detect any behavioural differences in the final riding test between training methods, although these had been very clear during the training.

Conclusions

The present study suggests that two prevailing training methods may be experienced by horses in a different way, without affecting the level of technical performance that is ultimately achieved. Thus, applying a sympathetic training method in the starting of young horses did not compromise technical performance, but seemed to reduce stress during training practices and this may be beneficial to the welfare of horses. The long-term effects of early training methods on the ability of horses to cope with future stressful situations needs to be investigated.

Conflict of interest statement

None of the authors of this paper has a financial or personal relationship with other people or organisations that could inappropriately influence or bias the content of the paper.

Acknowledgements

We would like to thank all trainers and staff at both training facilities for their dedication and hard work. We would also like to thank the staff at the Equine Research Station in Lelystad and the students who made this project possible. This project was partially funded by the Dutch Ministry of Agriculture, Nature and Food Quality and the Dutch Horse Industry.

References

Bachmann, I., Bernasconi, P., Herrmann, R., Weishaupt, M.A., Stauffacher, M., 2003. Behavioural and physiological responses to an acute stressor in crib-biting and control. Applied Animal Behaviour Science 82, 297–311.
Goodwin, D., 1999. The importance of ethology in understanding the behaviour of the horse: the role of the horse in Europe. Equine Veterinary Journal 28, 15–19 (Suppl.).
McDonnell, S.M., 2003. A Practical Field Guide to Horse Behaviour—the Equid Ethogram. The Blood-Horse Inc., Hong Kong, China (375 pp.).
McGreevy, P.D., 2004. Equine Behavior: A Guide for Veterinarians and Equine Scientists. WB Saunders, London UK (412 pp.).
McGreevy, P.D., McLean, A., Warren-Smith, A.K., Waran, N., Goodwin, D., 2005. Defining the terms and processes associated with equitation. In: Proceedings of the First International Equitation Science Symposium, Melbourne, Australia, pp. 110–143.
McLean, A., McGreevy, P., 2006. Reducing wastage in the trained horse: training principles that arise from learning theory. In: Proceedings of the Second International Equitation Science Symposium, Milano, Italy, p. 22.
Ödberg, F.O., 2005. The evolution of schooling principles and their influence on the horse's welfare. In: Proceedings of the First International Equitation Science Symposium, Melbourne, Australia, pp. 4–9.
Polito, R., Minero, M., Canali, E., Verga, M., 2007. A pilot study on Yearlings' reactions to handling in relation to the training method. Anthrozoös 20, 295–303.
Søndergaard, E., Halekoh, U., 2003. Young horses' reactions to humans in relation to handling and social environment. Applied Animal Behaviour Science 84, 265–280.
Steinbrecht, G., 1886. Das Gymnasium des Pferdes. Olms Presse, Potsdam, Germany (240 pp.).
Von Borell, E., Langbein, J., Despres, G., Hansen, S., Leterrier, C., Marchant-Forde, J., Marchant-Forde, R., Minero, M., Mohr, E., Prunier, A., Valence, D., Veissier, I., 2007. Heart rate variability as a measure of autonomic regulation of cardiac activity for assessing stress and welfare in farm animals—a review. Physiology and Behavior 92, 293–316.
Waran, N., McGreevy, P., Casey, R.A., 2002. Training methods and horse welfare. In: Waran, N. (Ed.), The Welfare of Horses. Kluwer Academic, Dordrecht, The Netherlands, pp. 151–180.
Warren-Smith, A.K., McGreevy, P.D., 2008. Equestrian coaches' understanding and application of learning theory in horse training. Anthrozoös 21, 153–162.
Warren-Smith, A.K., Greetham, L., McGreevy, P.D., 2007. Behavioral and physiological responses of horses (*Equus caballus*) to head lowering. Journal of Veterinary Behavior: Clinical Applications and Research 2, 59–67.