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Original Research

Temporary Turnout for Free Exercise in Groups: Effects on the Behavior of Competition Horses Housed in Single Stalls

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A B S T R A C T

In Germany, most competition horses are housed in single stalls and free exercise is not permitted in many cases. The reason for not allowing free exercise is mostly the risk of injury. Additionally, opinions exist that the horses' demand for exercise is fulfilled by training and that the horses' willingness to perform is negatively influenced by free exercise. In the present study, three turnout practices were investigated with regard to their effect on the behavior of four horses: daily training without free exercise (no turnout), 2-hour turnout (for free exercise) before training, and 2-hour turnout after training. The aim of this study was to determine any differences in the horses' behavior between the three treatments. The horses' behavior in the stable was observed through video recordings. The behavior during turnout was observed directly and during training was evaluated by the riders with the aid of a questionnaire. Additionally, the distance covered during turnout was measured by Global Positioning System devices. The behavior within the stall was more restless in the treatment without turnout—which became apparent in significantly more frequent changes between behaviors as compared with the treatments with turnout. The results of Global Positioning System measurement during turnout showed a significantly shorter distance covered when horses were trained before they were turned out compared with turnout before training. If the horses were turned out after training, they also showed less trotting and cantering and more dozing. The horses' willingness to perform was not significantly different between the three treatments.

1. Introduction

In Germany, most competition horses are housed in single stalls, in many cases without any opportunity for free exercise outside the stall [1]. This way of life constricts the natural behavior patterns of a horse to a great extent. In the wild, horses spend a maximum of 16 hours a day foraging for food, which generally happens in a slow and steady walk [2,3]. Trotting is performed in exploration and display behavior in reproduction. Cantering is demonstrated only for short times in flight or playing behavior [4]. This is why the German guidelines for the evaluation of equine housing systems regarding aspects of animal protection explicitly state that horses housed in single stalls need exercise according to their physiological requirements for several hours a day [5]. These guidelines also point out that controlled exercise is not able to replace free exercise. In practice, the limitation of free exercise, especially in competition horses, is widespread and mostly justified by the concomitant risk of injury. Furthermore, there are assumptions that the demand of exercise in the horse is satisfied by training or that free exercise reduces the willingness of the horse to perform. As a consequence of a life

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predominantly spent in stables, many horses suffer from diseases of the musculoskeletal system [6-8] and respiratory system [9,10], as well as abnormal behavior [11-13].

As behavior is a consequence of motivational states, behavior quantification indicates the intension of motivation in the animal. Therefore, to the experienced observer, the behavior of an animal provides information on the state of its well-being, and thus on the animal welfare qualities of a particular housing system [14]. Earlier investigations have revealed that locomotion activity during turnout is reduced if horses are trained in a circular horse walker before turnout as compared with no training at all [15]. It was concluded that training is able to partly fulfill a horse's exercise requirements. Furthermore, it was found that horses behave much quieter during turnout if it happens daily compared with turnout once a week [16]. Caanitz et al [17] observed that horses that were trained on a treadmill five times a week spent more time lying down at night as compared with a group that was not trained.

The aim of the present study was a systematic investigation of the influences of three turnout practices on the behavior of a group of competition horses housed in single stalls. As they are widely used in Germany, the turnout practices "2-hour turnout before training" (TBT), "2-hour turnout after training" (TAT), and "training without turnout" (no turnout = NT) were selected. The behavior patterns of the horses in the stable, during turnout and training were considered so that it could be revealed which of the investigated treatments combine both the horses' and the riders' requirements in the best way possible.

2. Materials and Methods

2.1. Location of the Study

The research was undertaken in a stable in Settmarshausen (county of Goettingen, Lower Saxony, Germany) in the period between May 11, 2008 and June 19, 2008. The stable contained 24 single stalls (size: 3.00 m × 3.80 m) in two rows, with an aisle (width: 3.00 m) in the middle (Fig. 1). The stalls were separated by 1.20 m hardwood walls with 2.05 m vertical lattice bars (distance between bars: 5.80 cm) on top. The fronts had sliding doors (width: 1.50 m) made up of the same material. The brick walls of the stable building formed the back of the stalls. There was no way in which the horses could possibly put their heads outside or into the aisle. The stable ceiling height was 3.26 m. Along the long sides of the stable, 28 windows (size: 1.00 m × 1.00 m) in a row formed light bands underneath the ceiling. The windows were left open slightly for ventilation. Two doors (size: 3.00 m × 3.00 m) at the ends of the aisle were open day and night. Each stall was equipped with a feeding trough for concentrates, an automatic drinking trough, and a salt block. Four stalls situated next to each other were used for the investigation (Fig. 1).

Next to the stable, to the east, was a 35 m × 50 m sand area used for riding and turnout. The area was bordered by a wooden fence (height: 1.5 m), with an electrical band on top. For the study, a turnout area of 10 m × 35 m was separated by an electrical fence. This size was selected to give the horses enough space for free exercise (walk, trot, and canter were possible; the German guidelines advise a minimum of 150 m^2 for two horses [5]) and to allow training of the horses in the remaining area.

During the investigation, the air temperature varied between 9°C and 23°C and the relative humidity varied between 51% and 99%.

2.2. Animals

Four German Warmblood Horses (height between 1.63 and 1.70 m; weight between 600 and 650 kg) were used for the investigation. All four horses were schooled in dressage and show jumping and—except for horse 3—were deployed in competitions in one of these disciplines. Horse 1 (H1) was a 9-year-old Hanoverian mare, who had competed in dressage up to intermediate class and was schooled in show jumping at novice level. Horse 2 (H2) was an 8-year-old Hanoverian mare, who had competed in show jumping up to advanced class and was schooled in dressage at intermediate level. Horse 3 (H3) was a 5-year-old Hanoverian gelding, schooled in dressage and show jumping at prenovice level. Horse 4 (H4) was an 11-year-old gelding from Saxony-Anhalt, who had competed in show jumping up to advanced class and was schooled in dressage at intermediate level. All four horses were housed

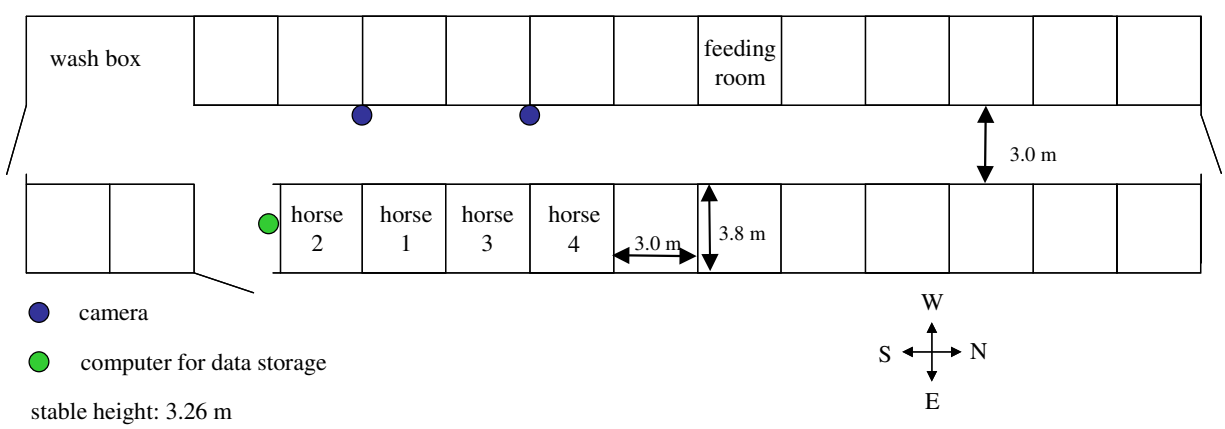

Fig. 1. Outline of the stable including the positions of the experimental stalls (horses 1 to 4) cameras, and computer.

in the experimental stable and turned out three to four times a week (for 1–2 hours in groups of two to four horses) for a minimum of 3 months before the investigation was started. For the investigation, H1 and H2 remained in their own stalls. They were also used to joint turnout. H3 and H4 were moved into their experimental stalls and acclimatized to joint turnout 2 weeks before the investigation started. The riders were asked to retain their way of training during the investigation according to their normal routine.

2.3. Bedding Materials and Feed

All experimental stalls were strewn with wheat straw. New straw (about 10 kg per stall) was given every morning after feeding. The stalls were mucked out once every 4 weeks.

Concentrates (oats and barley, 3:1 mix) were fed three times a day (06:30 AM, 12:00 AM, 05:00 PM). At 12:00 AM, soaked sugar beet pulp was given additionally and at 05:00 PM mineral feed was added to the concentrates. Hay was given once a day at 04:30 PM. The particular amounts of feed were specific for each horse (according to requirement and performance; Table 1) and remained constant over the course of the experiments. Feeding quality and type also remained constant. Water was available at all times for each individual horse.

2.4. Measurement Techniques

Two video cameras (Panasonic CCTV WV-BP 310, Panasonic Corporation, Kadoma, Osaka, Japan) were fixed underneath the ceiling opposite to the experimental stalls (Fig. 1), such that each camera could record the behavior of two horses. To allow recording at night, infrared light sources were fixed underneath the ceiling inside each stall. The videos were recorded in digital format using MV4R Digital Time Lapse board (MSH Video, Riga, Latvia). A computer to record data (HP Compaq dx2200 Microtower, Hewlett-Packard Company, Palo Alto, CA) and a monitor screen to control recordings were located in a metal box within the stable. The recordings were stored daily on external hard disks. Subsequently, all the data were analyzed using the Observer XT 8.0 (Noldus Information Technology, Wageningen, The Netherlands).

Two global positioning system devices—Garmin Forerunner 205 (Garmin, Olathe, KS, USA)—were used to record the distance covered by the horses during turnout. The devices were fixed on the head collars of the horses. Afterward, the measurement data were read out and stored using the software program Garmin Training Center (Garmin, Olathe, KS, USA). The behavior of the horses in the turnout area was documented by direct observation using a scan sampling method (observation interval: 5 minutes).

The riders registered the horses' behavior during training with the aid of a questionnaire. Among others, the horses' behavior during the working phase (answer possibilities: particularly quiet, rather quiet, normal, rather agitated, particularly agitated), its concentration (answer possibilities: particularly good, rather good, normal, rather bad, particularly bad), and contumacy (answer possibilities: particularly little, rather little, normal, rather intense, particularly intense) had to be described.

During the experiments, two Tinytag Plus 2 (Gemini Data Loggers Ltd., Chichester, UK) recorded temperature and relative humidity every hour, both within and outside the stable.

2.5. Experimental Design

The whole investigation took 6 weeks and was divided into three 2-week-periods. The experimental horses were divided into two groups (group 1 = H1 and H2; group 2 = H3 and H4). During the investigation all horses passed through three treatments, each lasting for 2 weeks. In the first treatment, the horses were trained daily (between 8.00 and 12.00 AM) and free exercise was not allowed (NT). In the second treatment, the horses were turned out from 8:00 to 10:00 AM and trained between 10:00 and 12:00 AM (TBT). In the third treatment, the horses were trained between 8:00 and 10:00 AM and turned out between 10:00 ando 12:00 AM (TAT). The test procedure is presented in Table 2. In the first period of the experiments (weeks 1 and 2), both groups passed the treatment NT. In the second period (weeks 3 and 4), group 1 passed TBT and group 2 passed TAT. In the third period (weeks 5 and 6), group 1 passed TAT and group 2 passed TBT. Depending on the particular training time, between training and turnout—respectively turnout and training—the horses spent 10 to 60 minutes within their stall. Training was carried out by two experienced riders (one training the mares, one

Table 1
Amounts of feed used during the investigation

Horse	6:30 AM	12:00 AM	4:30/5:00 PM
Horse 1	2 kg oats and barley (3:1 mix)	2 kg oats and barley (3:1 mix) 2 kg soaked sugar beet pulp	4 kg hay 2 kg oats and barley (3:1 mix) 50 g mineral feed
Horse 2	2 kg oats and barley (3:1 mix)	2 kg oats and barley (3:1 mix) 2 kg soaked sugar beet pulp	7 kg hay 2 kg oats and barley (3:1 mix) 50 g mineral feed
Horse 3	1.5 kg oats and barley (3:1 mix)	1.5 kg oats and barley (3:1 mix) 2 kg soaked sugar beet pulp	6 kg hay 1.5 kg oats and barley (3:1 mix) 50 g mineral feed
Horse 4	2.5 kg oats and barley (3:1 mix)	2.5 kg oats and barley (3:1 mix) 2 kg soaked sugar beet pulp	4 kg hay 2.5 kg oats and barley (3:1 mix) 50 g mineral feed

Table 2
Test procedure

Period of time	Group 1 (Horse 1 + 2)	Group 2 (Horse 3 + 4)
Period 1 (week 1 + 2)	NT	NT
Period 2 (week 3 + 4)	TAT	TBT
Period 3 (week 5 + 6)	TBT	TAT

NT, no turnout; TAT, turnout after training; TBT, turnout before training.

training the geldings) who also rode the horses in competitions. The horses' behavior during turnout and training was recorded every other day for each group (one day group 1, next day group 2). Because the horses needed to get used to the new rhythm (turnout and training times), the first 3 days of each period were not analyzed.

2.6. Data Collection

Video recordings of the horses' behavior in the stalls were analyzed on 3 days of each period of the investigation. Because the horses were supposed to acclimatize to the treatment (rhythm of the day), the days at the end of the second week were chosen for behavior observation. Continuous observations were carried out by one person between 12:30 PM and 7:30 AM the next morning (19 hours), while all horses were in their stalls. Frequency, mean duration per appearance, and total duration within the 19 hours were documented for each type of behavior. The observed behaviors were grouped into nine categories: "eating" (including eating hay and concentrates), "standing alert" (including watching the surroundings attentively or nervously), "occupation with equipment" (investigating stall equipment like trough, salt block, etc.), "occupation with bedding" (investigating or eating bedding material), "dozing" (stand quietly, one hind leg relaxed), "sternal recumbency," and "lateral recumbency"; additionally, the frequencies of "aggressive behavior" (kicking, ears back, or biting directed at their neighbors) and "locomotion" (more than three steps without interruption) were recorded.

Direct observations were also carried out by one person and produced 22 behavior protocols in period 2 and 22 in period 3. The behaviors "standing/dozing," "standing/watching," "standing/occupation," "walking," "trotting/cantering," and social "interaction" were recorded in the protocols. The observed horses also carried global positioning system devices measuring the distance covered and the speed.

To create more concrete statements about the horses' willingness to perform out of the differentiated answers revealed by the questionnaire, the riders' answers about behavior during the working phase, including the horses' concentration and contumacy, were summarized into the feature "willingness to perform." In addition to the questionnaire, the total duration of training was documented.

2.7. Statistical Analysis

The statistical evaluation of the data was performed using the software program SAS 9.1 (SAS Inst. Inc., Cary, NC, USA). For all of the data, the analysis of variance of normally distributed data was computed using the general linear model (GLM) procedure. For data that could not be transformed into Gaussian distribution, influences of fixed effects and interactions were estimated using the NPAR1-WAY procedure and WILCOXON TWO-SAMPLE TEST to test the significance of the effects. The significance level was $P \leq .05$, and P-values between .05 and .1 were noted as tendencies (t-test).

In total, the video observations created 36 datasets (3 days in three treatments for four horses). The behavior data were transformed into Gaussian distribution if possible by the procedures shown in Table 3. For each of the behaviors, the fixed effects of horse and treatment (NT, TBT, TAT) and the interaction between "horse and treatment" were considered.

The direct observation of the horses during turnout generated 32 behavior protocols. In the analysis, as the observation interval was 5 minutes, each recorded behavior was considered to have lasted for 4.17% of the total turnout time (ie, for 5 minutes out of a total turnout of 120 minutes).

The behavior data had to be transformed into Gaussian distribution by taking the logarithm for the behavior "stand/dozing" and by taking the square root for the behavior "walk." The behaviors "social interaction" and "trot/canter" could not be transformed into Gaussian distribution. The fixed effects horse and treatment (TBT, TAT), turnout hour and the interaction between "horse and treatment," "horse and hour," and "hour and treatment" were considered for all the behaviors.

Measurements of the distance covered (km) and average speed (km/h) during turnout were available for 28 days. The data were available in Gaussian distribution. The fixed effects of horse and treatment, the interaction between "horse and treatment," and the covariable of the temperature were considered. Additionally, the coefficient of

Table 3
Data transformation of the behavior patterns in the stable to create Gaussian distributions

Transformation	Total Duration	Mean Duration	Frequency
No transformation necessary	Occupation with bedding, dozing, sternal recumbency	Dozing	Standing alert
Logarithm	Standing alert	Standing alert, occupation with bedding, eating	Occupation with bedding, dozing, eating, locomotion, sternal recumbency
Square root	Eating		Occupation with equipment
No transformation possible	Occupation with equipment, lateral recumbency	Occupation with equipment, sternal recumbency, lateral recumbency	Aggression, lateral recumbency

correlation (Pearson's product-moment correlation coefficient, r) between distance and speed was computed.

Questioning the riders about the horses' willingness to perform produced 46 analyzable questionnaires. The data of the duration of training were available in normal distribution and the fixed effects of horse and treatment and the interaction between "horse and treatment" were considered. Additionally, the coefficient of correlation (Pearson's product-moment correlation coefficient, r) between the duration of training and the behavior of the horse in the working phase of training was computed.

3. Results

3.1. Behavior in the Stall

For the daily observation time of 19 hours, no significant differences could be found in total duration of the behaviors "standing alert," "occupation with bedding," "dozing," "sternal recumbency," "lateral recumbency," and "eating." Only "occupation with equipment" was performed significantly longer in the treatment NT compared with the treatments with turnout (TAT $P = .0382$; TBT $P = .0435$). The mean duration per appearance revealed significant differences in the behaviors "standing alert" and "dozing." In the treatment TAT, the mean duration of "standing alert" was significantly longer compared with the other treatments (NT: $P = .0054$; TBT: $P = .0272$). "Dozing" also showed the longest mean duration in the treatment TAT, which was significantly longer than "dozing" in the treatment NT ($P = .0031$). The treatments NT and TBT were not significantly different (Table 4). Figure 2 shows the mean frequency of appearance of the behaviors "standing alert," "aggression," "occupation with equipment," "occupation with bedding," "dozing," "sternal recumbency," and "lateral recumbency." All of the behaviors—except "occupation with bedding"—were performed most frequently in the treatment NT. The difference was significant as compared with the treatment TAT in the behaviors "aggression," "occupation with equipment," "dozing," and "sternal recumbency" ($P \leq .05$). "Occupation with equipment" was also performed significantly more frequently in the treatment NT as compared with the treatment TAT ($P = .0071$), whereas "dozing" showed a tendency in this direction ($P = .0856$). Tendencies showing the described direction also existed in "aggression" and "occupation with equipment" ($0.1 < P > .05$). "Occupation with bedding" showed the least frequency in the treatment NT. The difference was significant as compared with both treatments with turnout ($P \leq .05$). The behavior "locomotion" did not show any differences in frequency between the treatments.

3.2. Behavior During Turnout

The behavior of the horses during the 2-hour turnout is presented in Figure 3. In the treatment TBT, the horses showed significantly more active behavior during turnout, such as "walking" ($P = .0278$) and "standing/watching" ($P = .0122$). If training happened before turnout (TAT), "walking" was reduced by 30.58% and "trotting/cantering" was reduced by 66.67%. Resting behavior like "standing/dozing" was performed significantly longer in the treatment TAT ($P = .0013$; extended by 58.88%). Social interaction was performed for about 13 minutes (16% of turnout time) as well as before after training. All behaviors were performed in both turnout hours, whereas "standing/occupation," "walking," "trotting/cantering," and "interaction" were performed slightly longer in the first hour and "standing/watching" and

Table 4
Total duration (hours) and mean duration per appearance (minutes) of the behaviors "standing alert," "occupation with equipment," "occupation with bedding," "dozing," "sternal recumbency," "lateral recumbency," and "eating" in the stable, subdivided according to treatment

Behavior	Treatment	n	Total Duration (Hours)		Mean Duration (Minutes)	
			LSM/*M*	SE/*SD*	LSM/*M*	SE/*SD*
Standing alert	NT	12	2.16[a]	0.33	6.38[a]	0.87
	TAT	12	2.70[a]	0.33	9.96[b]	0.87
	TBT	12	1.92[a]	0.33	7.22[a]	0.87
Occupation with equipment	NT	12	*1.74*[a]	*1.15*	*7.03*[a]	*4.66*
	TAT	12	*0.55*[b]	*1.08*	*4.72*[a]	*6.66*
	TBT	12	*0.62*[b]	*0.63*	*5.48*[a]	*5.03*
Occupation with bedding	NT	12	4.81[a]	0.41	16.82[a]	1.97
	TAT	12	6.06[a]	0.41	20.37[a]	1.97
	TBT	12	6.67[a]	0.41	20.37[a]	1.97
Dozing	NT	12	4.13[a]	0.31	16.73[a]	1.93
	TAT	12	4.19[a]	0.31	25.70[b]	1.93
	TBT	12	4.90[a]	0.31	20.38[a,b]	1.93
Sternal recumbency	NT	12	3.01[a]	0.20	*22.35*[a]	*11.44*
	TAT	12	2.51[a]	0.20	*21.62*[a]	*13.32*
	TBT	12	2.58[a]	0.20	*23.64*[a]	*14.36*
Lateral recumbency	NT	12	*0.24*[a]	*0.24*	*2.40*[a]	*2.04*
	TAT	12	*0.23*[a]	*0.29*	*2.11*[a]	*2.22*
	TBT	12	*0.21*[a]	*0.15*	*2.66*[a]	*2.39*
Eating	NT	12	3.04[a]	0.40	25.29[a]	5.90
	TAT	12	2.40[a]	0.40	35.94[a]	5.90
	TBT	12	2.36[a]	0.40	32.57[a]	5.90

n, number of values; LSM, least squares means; SE, standard error; *M*, means; *SD*, standard deviation; NT, no turnout; TAT, turnout after training; TBT, turnout before training.

[a,b]Least squares means/means within a behavior with different letters are significantly different ($P < .05$).

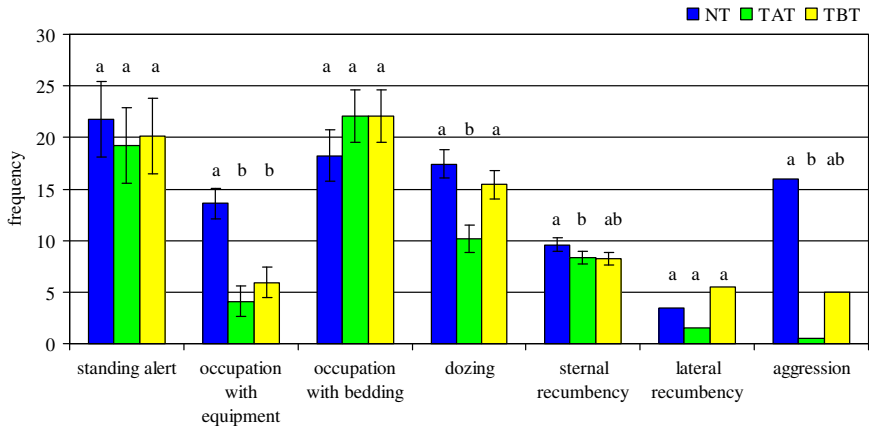

Fig. 2. Least squares means and standard errors of the frequency of standing alert, occupation with equipment, occupation with bedding, dozing and sternal recumbency; median of the frequency of lateral recumbency and aggression, subdivided according to treatment (observation period 19 hours; n = 36; NT, no turnout; TAT, turnout after training; TBT, turnout before training; a, b = least squares means/median within a behavior with different letters are significantly different [$P < .05$]).

"standing/dozing" slightly longer in the second hour. The only significant differences between the first and second hour were found in TAT in the behaviors "standing/dozing" (significantly longer in the second hour; $P = .0194$) and "standing/occupation" (significantly shorter in the second hour; $P < .0001$).

3.3. Distance Covered During Turnout

The distance covered by the horses during turnout was significantly shorter when they had been trained before turnout (TAT) as compared with TBT ($P = .0003$; Fig. 4). But the individual horses did not show the same reaction regarding the particular turnout time. H1 and H2 covered a significantly shorter distance in TAT ($P = .0090$ and $P = .0002$, respectively). The distances of H3 and H4 were not significantly different ($P = .1114$ and $P = .3379$, respectively), but H4 covered a longer distance when it was turned out after training (TAT). The distance covered during training did not significantly influence the distance covered during turnout ($P = .4416$). The distance covered was significantly correlated to the speed the horses moved at during turnout ($r = 1$; $P < .0001$).

3.4. Willingness to Perform

The horses showed "good" willingness to perform most frequently in the treatment TBT and "bad" willingness to perform most frequently in the treatment NT (Fig. 5). Hardly any variation in behavior was documented in the treatment TAT, the horses showed "normal" performance most frequently. The duration of training was significantly shorter in the treatments with turnout compared with the treatment NT ($P < .02$). In addition, it was seen that the more quietly the horse behaved in the working phase of training, the shorter was the duration of training ($r = 0.39$; $P = .0085$).

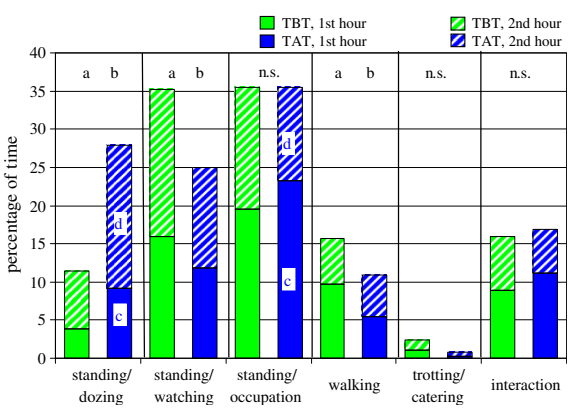

Fig. 3. Least squares means of percentage for the behaviors "standing/dozing," "standing/watching," "standing/occupation," "walking" and means for the behaviors "trotting/cantering" and "interaction" during turnout subdivided according to turnout hour and treatment (n = 32 [16 measurements in each treatment]; NT, no turnout; TAT, turnout after training; TBT, turnout before training; n.s., not significant; a, b = least squares means/means within a behavior with different letters are significantly different; c, d = least squares means/means within the bar [first and second hour] with different letters are significantly different [$P < .05$]).

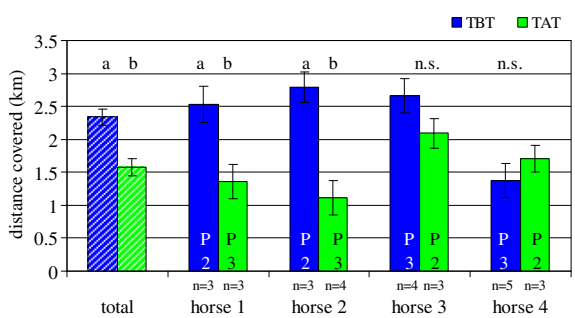

Fig. 4. Least squares means and standard error of the distance covered during turnout subdivided according to treatment. P2 and P3 mark the research period in which each horse was subjected to the respective treatment (n = 28; NT, no turnout; TAT, turnout after training; TBT, turnout before training; n.s., not significant; a, b = least squares means within a horse with different letters are significantly different [$P < 0.05$]).

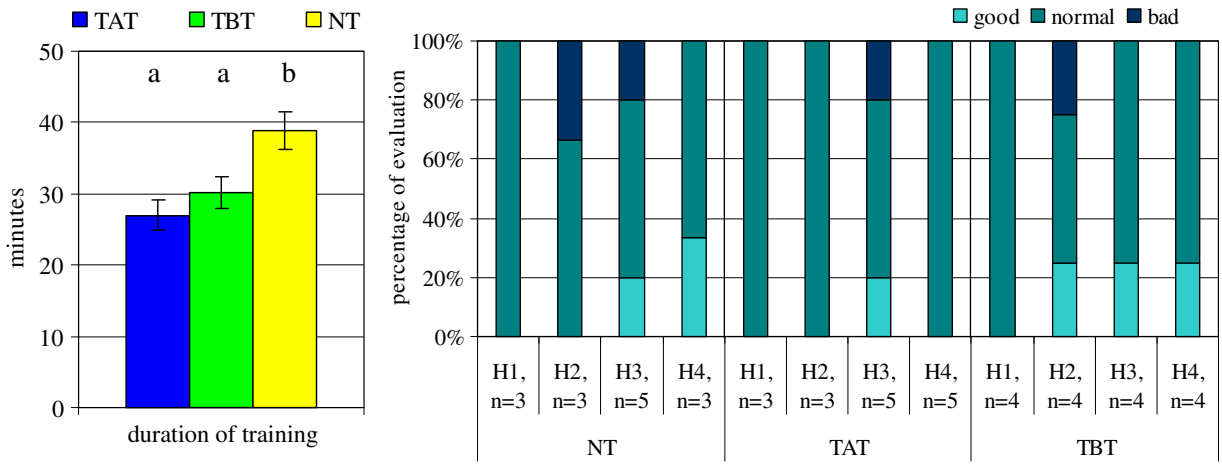

Fig. 5. Left: Least squares means and standard error of the duration of training subdivided according to treatment (n = 44; a, b = least squares means with different letters are significantly different [$P < .05$]). Right: Evaluations of willingness to perform (good, normal, bad) in percent subdivided according to treatment and horse (H1–H4). NT, no turnout; TAT, turnout after training; TBT, turnout before training.

4. Discussion

4.1. Behavior in the Stable

The total duration of the recorded behaviors in the stable was not influenced by the treatment. The observed total duration that the horses spent lying was almost exactly the same as that observed by Werhahn et al. [18] for the riding horses in their group (between 2.5 and 3.0 hours). Similar results (between 2.5 and 3.5 hours spent lying) were shown by Kiley-Worthington [3] in free-ranging and stalled horses in different housing systems. The horses in the present study showed the highest frequency of appearance of all the behaviors in the treatment NT, although the total duration was not different. Therefore, the horses changed their behavior more frequently in this treatment, which indicates a greater degree of nervousness and restlessness [19]. The horses seemed to be unsettled as well. Earlier studies also registered that the prevention of exercise leads to an accumulation of unspent energy [20], as does a long-term stay in stimulus-poor environments [21]. The decreased aggressive behavior against their neighbors in the treatments with turnout supports the observation of a more relaxed behavior in these horses. In the treatment TAT, the four horses showed the least frequency of all behaviors, which indicates the most relaxed behavior in this study. The relaxed behavior in this treatment was also observed during turnout (comparatively little activity and distance covered), whereas the horses' willingness to perform was predominantly evaluated as "normal."

4.2. Behavior and Distance Covered During Turnout

The horses showed less activity, and thus covered a smaller distance during turnout, when training was carried out before turnout (TAT). This result indicates that training does fulfill the demand for exercise at least to some extent. This was also observed by Jørgensen and Bøe [15] who found more time spent standing and less time spent walking among horses on exercise days than on no exercise days. The fact that the horses still showed active behavior (walking, trotting, and cantering) when they were turned out after training (TAT), and thus still covered a certain distance (only about 35% less than before training), indicates that the demand for exercise was not fulfilled entirely by training. Chaya et al. [16] also observed significantly more active behavior in a group of horses that was turned out once a week as compared with a group of horses that was turned out six times a week, although both groups were ridden daily. They concluded that riding is not a sufficient substitute for turnout. This hypothesis can be supported by the present study. According to Hogan et al. [20], limiting natural behavior, particularly grazing opportunities, is linked to increased activity when turnout is allowed.

Against expectations, the distances covered by group 2 did not differ significantly between the treatments. As observed in group 1, it was expected that the horses would show considerably less locomotion activity when they are trained before they are turned out as compared with when they are turned out initially. The results in this study might have been caused by the order of the treatments. In the first period of the study, NT was allowed for either group, thus the horses accumulated unspent energy [20], which was expressed in the second period of the study when they were turned out (group 1: TBT; group 2: TAT). Presumably, the horses performed a compensatory increase in locomotion as a consequence of their confinement. This reaction has been observed previously in horses [19,21] and calves [22,14]. The fact that training was carried out next to the turnout area might have caused some distraction. But, because training was carried out at both turnout times, the effect was the same for both groups.

In the present study, the horses were not able to practice social interaction in the stable. The bars between the stalls only allowed visual and olfactory contact. The results indicate that social interaction is deployed independent of the particular time of turnout, as was shown for about 16% of the turnout time both before and after training. Because

horses are gregarious animals, direct social interaction has great importance for their welfare. If direct contact is missing, horses easily develop stereotypic behavior or problems in handling occur [5]. The study supported this hypothesis because the horses showed more aggressive behavior when they did not have the possibility to practice social interactions during turnout.

4.3. Willingness to Perform

The analyses of the riders' evaluation of the horses' willingness to perform had the best results in the treatment TBT. In this treatment, the horses showed most frequently quiet behavior, good concentration, and little contumacy. Therefore, no findings on turnout having any negative effects on the willingness to perform were obtained. On the contrary, in the treatment NT, the horses showed a bad willingness to perform (increased restlessness and contumacy, decreased concentration) most frequently according to the riders' answers. Rivera et al. [23] observed that young horses kept on pasture acclimatize easier to a training environment and equipment than those housed in a stable. They traced this observation back to the fact that horses on pasture train their ability to adapt to new situations better than those in a low-stimulus environment, such as a stable. The stalled horses also showed more activity, such as jumping and bucking, which was predicted by Hogan et al. [20] as being the result of unspent energy as a result of stabling. In the present study, the significantly longest duration of training occurred in the treatment NT. Furthermore, it was found that the duration of training was extended when the horses behaved restlessly and/or were agitated during the working phase. This was also found to occur tendencially in the study by Rivera et al. [23]. The authors explained this observation with the longer time the stabled horses needed to habituate to the equipment. This cannot be the reason in the present study because the horses were used to training. The unspent energy as a result of stabling [20] seems to also be an adequate explanation for the result in the present study.

5. Conclusions

In conclusion, the study shows that allowing or not allowing free exercise (ie, turnout) and the particular time of turnout affects the behavior of horses in the stable as well as those in training and during turnout. The behavior of the horses in the stable was more relaxed when turnout was allowed in addition to training. The behavior during training was also more relaxed and the willingness to perform was not negatively affected by turnout. Furthermore, the study indicates that training does not fulfill the exercise requirements of the horses. Regarding the risk of injury caused by free exercise, it is advised to allow TAT because locomotion activity is decreased with this order of events as compared with TBT. By contrast, the horses' willingness to perform was evaluated as being better when turnout was allowed before training (TBT).

Because of the manifold individual experiences encountered by a horse until it becomes a competition horse, riders and trainers need to decide which way of management is the best for each individual animal. Generally, it has to be considered that for conventionally stalled horses, turnout in groups is the only possibility for them to perform social interactions, which is an essential element of natural behavior and so is of great importance for animal welfare.

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