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Results of behavioural tests of horses are predictive of perceived safety in riders

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Behavioural problems and shyness are prevalent horse-related causes of accidents in equitation. The aim of the present study was to examine whether tests developed to measure the intensity of reaction to social separation and to novelty and suddenness can predict how riders perceive their safety when handling and riding a horse. Thirteen leisure horses were subjected to the battery of three fear tests, separation test and a test ride.

The horses that were more fearful toward a novel surface were perceived to be less secure when handling. The horses showing fear in the startling object test were also perceived as less secure in both handling and riding. Unexpectedly, in the separation test, the more time the horse had remained a standing position, the more insecure when saddling, mounting, walking and trotting was scored. Similarly, a relaxed body posture with the head in a low position was predictive to a low security score by riders. It may be supposed that the horses that are comfortable when isolated are self-reliant and independent in comparison to other horses, but probably also in other situations, which might make them difficult to be managed by humans.

Behavioural tests could be predictive not only for equine personality traits, but also may be applied in the assessment of rider's perceived safety. Thus, they may serve as tools to differentiate horses in terms of their suitability for leisure riders.

KEY WORDS: reactivity tests / separation tests / safety / equitation / horse / rider

Equitation is an activity with a high injury rate [Jaggin *et al.* 2005, Jagodzinski and DeMuri 2005]. It has been reported that riders indicate behavioural problems

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(34.5%) and shyness (17.7%) of horses as prevalent horse-related causes of the accidents [Jastrzębska *et al*. 2012].

Several tests have been developed for experimental assessment of different behavioural characteristics of the horse [Morris *et al*. 2002, Seaman *et al*. 2002, McCall *et al.* 2006, Lansade *et al*. 2008a,b,d, Visser *et al.* 2001]. As a social prey animal, horses are particularly sensitive to the separation from herd mates [Lansade *et al*. 2008b] as well as to novel and suddenly moving objects [Lansade *et al*. 2008a]. A violent reaction of the horse to isolation from conspecifics and to novel static or moving objects, which routinely occurs during the ridden use of horses, may jeopardize the safety of riders. The tests developed to measure horses' reactivity in these two situations (fear tests and separation tests) were used in the appraisal of equine temperamental traits [Lansade *et al*. 2008a,b,d, Visser *et al.* 2001, Momozawa *et al.* 2007, Górecka-Bruzda *et al*. 2011]. These methods were also used for the assessment of horse-rider cooperation [Visser *et al.* 2003, Lansade 2008c]. However, it has never been tested whether the results of the horse in fear or separation tests may predict the actual feeling of safety of the rider ridding a mount with a given level of reactivity.

Thus, the present study was aimed at testing whether the tests developed for the intensity of reaction to social separation and to novelty and suddenness can predict how riders perceive their safety when handling and riding a horse.

Material and methods

Animals

Thirteen leisure horses (7 geldings, 6 mares) used for equitation in the Academic Riding Club of the University of Warmia and Mazury, (Olsztyn, Poland) were subjects of the battery of three fear tests, separation tests and a test ride. Mean age of recorded horses was 8 years (ranged from 3 to 19). Four additional horses (2 geldings and 2 mares) were used in the test ride to increase the number of ridden horses. The results of fear tests for these horses were unavailable. The experiments were approved by the Local Commission for Ethics in Animal Experimentation, the University of Warmia and Mazury, Olsztyn (Poland).

Behavioural tests

Fear tests. These tests comprised three separate tests for the reaction to: 1/ a novel surface (white blanket), 2/ a novel static and 3/ a novel startling object.

Novel surface test. The experimenter placed a bucket with food close to the entrance to the box. The horse was allowed to feed for 30 seconds and then the bucket was removed. Next, a white blanket (2x2m) was put on the ground and the bucket was put back in the previous place. In order to feed from the bucket the horse had to step on the blanket. In the case when the horse did not start feeding within 300 s it was given 301 s.

Static novel object test. Then, the blanket was withdrawn and a novel object, i.e. a 5l plastic container filled with dry wood sticks, with a 4m cord attached to it, was placed next to the bucket and the cord was hung over the box wall. The horse was presented the feed bucket next to the container.

Startling novel object test. After 300s had passed, the experimenter pulled the cord from outside the box and the bottle was quickly lifted 1 m high and then dropped, emitting a muffled noise. The time to start feeding the stimulus food was measured after the exposure of the horse to each of the elements of the fear test battery (maximum allowed time: 300 s). Moreover, the number of snortings, duration of alertness and the intensity of the startle reaction were recorded. All behavioural variables and their definitions are presented in Table 1.

Table 1. Variables measured in fear tests, separation test and rider survey

Variable	Description
Fear tests	
SURF	Latency to feed, bucket on the novel surface (seconds)
SURF-S	Snorting (strong expulsion of the air from the nostrils with a typical loud sound) in surface test (frequency)
SURF-A	Time in alert posture with high head carriage and active ears when exposed to novel surface (seconds)
OBJ	Latency to feed, bucket near the novel object (seconds)
OBJ-S	Snorting (strong expulsion of the air from the nostrils with a typical loud sound) in novel object test (frequency)
OBJ-A	Time in alert posture with high head carriage and active ears when exposed to novel object (seconds)
STARTOBJ	Latency to feed, startling novel object (seconds)
STARTOBJ-S	Snorting (strong expulsion of the air from the nostrils with a typical loud sound) in startling object test (frequency)
STARTOBJ-A	Time in alert posture with high head carriage and active ears when exposed to startling object (seconds)
STARTOBJ-R	Intensity of reaction to startling object (1 – no reaction; 2 – head, ears turned to the object; 3 – as in 2, horse crouches and withdraws by one step length; 4 – as in 3, horse startles and withdraws by the full length of the box)
Separation test	
STAND	Time in standing position (seconds)
WALK	Time spent walking (seconds)
TROTCANT	Time spent trotting or cantering (seconds)
ALERT	Time in alert posture with high head carriage and active ears (seconds)
HEADLOW	Time spent with the head carried below belly line (seconds)
EXIT	Time spent next to the hall exit (seconds)
SNORT	Strong expulsion of the air from the nostrils with a typical loud sound (frequency)
TAIL	Time with tail carried in high position (seconds)
Rider survey	Obedience of the horse
OBED-brush	Was the horse: disobedient (0); rather disobedient (1); rather obedient (2); obedient (3)
OBED-saddle	Was the horse: disobedient (0); rather disobedient (1); rather obedient (2); obedient (3)
OBED-lead	Was the horse: disobedient (0); rather disobedient (1); rather obedient (2); obedient (3)
OBED-mount	Was the horse: disobedient (0); rather disobedient (1); rather obedient (2); obedient (3)
OBED-walk	Was the horse: disobedient (0); rather disobedient (1); rather obedient (2); obedient (3)
OBED-trot	Was the horse: disobedient (0); rather disobedient (1); rather obedient (2); obedient (3)
OBED-canter	Was the horse: disobedient (0); rather disobedient (1); rather obedient (2); obedient (3)
Rider survey	Safety of the horse
SEC-brush	You felt: completely insecure (0); for most of the time insecure (1); for most of the time secure (2); completely secure (3)
SEC-saddle	You felt: completely insecure (0); for most of the time insecure (1); for most of the time secure (2); completely secure (3)
SEC-lead	You felt: completely insecure (0); for most of the time insecure (1); for most of the time secure (2); completely secure (3)
SEC-mount	You felt: completely insecure (0); for most of the time insecure (1); for most of the time secure (2); completely secure (3)
SEC-walk	You felt: completely insecure (0); for most of the time insecure (1); for most of the time secure (2); completely secure (3)
SEC-trot	You felt: completely insecure (0); for most of the time insecure (1); for most of the time secure (2); completely secure (3)
SEC-canter	You felt: completely insecure (0); for most of the time insecure (1); for most of the time secure (2); completely secure (3)

Separation test. The separation test was adapted from Visser *et al*. [2001]. Six months after fear tests the horses were introduced individually to a familiar riding hall for 5 minutes. Duration of the time spent on the standing still, standing next to the exit, walking, trotting or cantering and being alert, as well as the time of low head carriage and high tail carriage were measured (Tab. 1).

Test ride and survey of riders. The riders were students of the Faculty of Animal Bioengineering of the University of Warmia and Mazury, Olsztyn (Poland). They had basic riding skills (they could effectively manage the horse in walk, trot and canter). They were volunteers and the participation in the present project followed their educational profile in horse using and breeding and involved their normal activity in the Academic Riding Club.

Test rides started in the week following separation tests and were spread over one month. Three horses were ridden together by three experienced riders (all females). Before the ride, the riders were asked to prepare the horse for the ride in the standard way (brushing, bridling and saddling), then to lead it to the riding arena and mount the horse. The ride lasted about 50 minutes and involved exercises in walk (20 minutes), trot (20 minutes) and canter (10 minutes), as demanded by the instructor. The riders were asked to perform circles around the riding hall, volts, half-volts, halts, hand and gait changes. The level of exercises was adequate to the riders' and horses' skills and was similar for all riders and all horses. After the ride the riders were surveyed to score perceived safety, the obedience of the horse when preparing it for the ride (when brushing and saddling) and during the ride (in walk, trot and canter, Tab. 1). Each horse was tested once with behavioural tests, and three times was ridden by test riders.

Statistical analyses

The analyses included the calculation of descriptive statistics and Spearman rank correlations (r_s) between the variables measured in behavioural tests and in riders' survey (averaged for three riders). SAS9.3 statistical package (PROC UNIVARIATE and PROC CORR) were used.

Results and discussion

Fear tests

The descriptive statistics of variables measured in fear tests are given in Table 2. The horses had shown varied intensity of responses to presented stimuli, as represented by high ranges of measured variables. Thus, it could be assumed that the studied sample differed sufficiently in terms of their individual reaction to unpredicted events occurring during the ride or when handled by a rider. The response to each of the fear tests was represented by the increase of the time to resume feeding and/or by the occurrence of alert behaviour. In the novel surface tests, almost each horse unwilling to approach the stimulus food showed an alert behaviour (r_s=0.98, P<0.01 – Tab. 3). The same relationship occurred in the novel object (r_s=0.83, P<0.01) and novel startling object tests (r_s=0.97, P<0.01 – Tab. 3). This means that the time to approach a novel or startling object is a valid measure of fearfulness in horses, which is in line with our previous work on cold-blood horses [Górecka-Bruzda *et al*. 2011]. The occurrence of the particular behaviour of horses, i.e. snorting, was found to be higher in horses avoiding approach to the bucket in the startling object test (r_s=0.75,

Table 2. Descriptive statistics of variables measured in fear tests, separation test and rider survey

Variable (unit)	Mean±standard deviation	Median [minimum; maximum]
Fear tests		
SURF (s)	37.2 ± 35.2	28 [10; 141]
SURF-S (occurrence)	1.3 ± 1.4	1 [0; 4]
SURF-A (s)	24.3 ± 23.0	20 [6; 89]
OBJ (s)	19.8 ± 18.9	11 [8; 77]
OBJ-S (occurrence)	0.8 ± 0.9	0 [0; 2]
OBJ-A (s)	8.1 ± 8.3	5 [2; 29]
STARTOBJ (s)	58.5 ± 46.4	45 [15; 159]
STARTOBJ-S (occurrence)	1.8 ± 1.6	1 [0; 5]
STARTOBJ-A (s)	39.4 ± 29.8	32 [9; 120]
STARTOBJ-R (score)	2.8 ± 0.7	3 [2; 4]
Separation test		
STAND (s)	89;8 ± 36.2	100 [22; 135]
WALK (s)	52.7 ± 28.7	48 [8; 110]
TROTCANT (s)	29.3 ± 44.2	0 [0; 149]
ALERT (s)	13.9 ± 8.7	11 [2; 35];
HEADLOW (s)	69.6 ± 31.2	59 [7; 113]
EXIT (s)	114.6 ± 42.4	119 [54; 180]
SNORT (occurrence)	2.3 ± 2.7	1 [0; 7]
TAIL (s)	46.3 ± 49.8	39 [0; 149]
Rider survey		
OBED-brush (score)	2.5 ± 0.4	2.5 [1.7; 3]
OBED-saddle (score)	2.6 ± 0.8	3 [0.3; 3]
OBED-lead (score)	2.8 ±0.3	3 [2.3; 3]
OBED-mount (score)	2.4 ± 0.3	2.3 [2; 3]
OBED-walk (score)	2.4 ± 0.3	2.7 [2; 3]
OBED-trot (score)	2.0 ± 0.2	2 [1.7; 2.3]
OBED-canter (score)	1.9 ± 0.5	2 [1; 2.5]
SEC-clean (score)	2.5 ± 0.4	2.7 [1;7; 3]
SEC-saddle (score)	2.6 ± 0.6	2.7 [1; 3]
SEC-lead (score)	2.6 ± 0.3	2.7 [2; 3]
SEC-mount (score)	2.5 ± 0.3	2.7 [2; 3]
SEC-walk (score)	2.5 ± 0.2	2.7 [2; 2;7]
SEC-trot (score)	2.3 ± 2.3	2.3 [1;3; 2;7]
SEC-canter (score)	2.1 ± 0.6	2.5 [1; 2;5]

Table 3. Spearman rank correlation coefficients between variables measured in fear tests

Variable	SURF-S	OBJ	STARTOBJ	STARTOBJ-S
SURF-A	0.98**			
OBJ-S	0.64*			
OBJ-A		0.83**		
STARTOBJ				
STARTOBJ-S			0.75**	
STARTOBJ-A			0.97**	0.79**
STARTOBJ-R			0.56*	0.69**

*Significant at P<0.05; **Significant at P<0.01.
Only significant correlations are shown.

P<0.01) and it was consistent with the time of alert behaviour in this test (r_s=0.79, P<0.01 – Tab. 3). The frequencies of snorting in the surface and novel static object tests were correlated (r_s=0.64, P<0.05 – Tab. 3). It has been suggested [Blendinger 2002] that snorting involves the production of infrasound by horses, which may be helpful in the assessment of distance and the object dimensions, but this hypothesis needs to be confirmed.

Separation test

The results of horses in the separation test (descriptive statistics) are given in the Table 2. The horses spent most of the time standing next to the exit door (114.6±42.4 s), but also presented high locomotor activity (walking, trotting and cantering, on average 82 s) and alert behaviour (snorting, high tail carriage). The responses of individual horses were less individualised than in the fear tests, as shown by standard deviations for a majority of measured variables (Tab. 2).

When individually released in the riding arena, more aroused horses spent more time trotting and cantering and, obviously, walked less (r_s=-0.79, P<0.01 – Tab. 4). They presented high tail (r_s=0.57, P<0.05) and head (r_s=0.67, P<0.05 – Tab. 4) positions. In turn, the horses that were less alarmed by separation with conspecifics were standing for longer periods, mostly close to the exit door (r_s=0.91, P<0.01), with the head in a low position (r_s=-0.57, P<0.05 – Tab. 4). It may be stated that the individual differences in social dependence were validly measured by the separation test.

Table 4. Spearman rank correlation coefficients between variables measured in separation test

Variable	STAND	WALK	TROTCANT	HEADLOW
TROTCANT		-0.79**		
HEADLOW			-0.67*	
EXIT	0.91**			0.57*
TAIL			0.57*	

*Significant at P<0.05; **Significant at P<0.01.
Only significant correlations are shown.

The variables in the fear and separation tests were not correlated to each other, thus it can be confirmed that in the present study the two types of tests had measured different aspects of horse personality: fearfulness and social dependence (or independence) – Lansade *et al.* [2008 a,b].

Test ride and survey of riders

The riders in the present study had in general a high perception of safety. Actually, this is evident, considering that they had agreed and were able to ride seventeen differently behaving horses. However, they could differentiate the horses, since they did not feel equally safe with all the horses, as evidenced by high ranges of security scores (Tab. 2). Thus, some horses were rated by all riders with score 1 (most of time

I felt insecure) and some with 3 (all the time I felt secure). Similarly, the riders were able to differentiate the horses in terms of their obedience (Tab. 2).

Several variables from the fear tests correlated with the safety perceived by riders (rank correlation coefficients and P-values are given in detail in Tab. 5). Only two of the three fear tests were predictive of riders' feeling of safety: the novel surface test and the startling object test. The horses that were more fearful toward the novel surface were perceived to be less secure when handling (brushing, leading and mounting, Tab. 5). Similarly, the horses showing fear in the startling object test were also perceived as less secure in both handling and riding (Tab. 5). This is an important result of the present study, as it has been shown that fear tests could be used to predict horse safety as perceived by riders. The horse-rider relationship is very important in horse riding. It has been shown that the emotional reactions of humans may be transferred to their mounts [Górecka *et al.* 2007, Keeling *et al.* 2009]. In the latter study, horses' heart rate increased in parallel to human pulse when the riders were informed about the planned startling event during the ride. In the present study an inverse, but similar situation took place, as the riders were informed about their feeling after experiencing the behaviour of the horse during preparation and test rides. Thus, the mutual communication between the horse and the rider influence emotions of both of them.

Likewise, the variables assessed in the separation test were predictive for the riders' perception of safety, especially during the ride (Tab. 5). It was assumed that, as based on the observations of ridden horses, a lack of a close visual contact with other horses would provoke reactions similar to these in a fearful situation (increased locomotor activity, alert postures, alarmed behaviour). This was observed in separated horses in our study, but the horses that had not reacted with alertness surprisingly were actually scored by riders as less trustful. The more time the horse had remained in a standing position when isolated, the more insecure it was scored when saddling, mounting, walking and trotting (Tab. 5). Similarly, a relaxed body posture with the head in a low position was predictive to a low security score by riders (leading, saddling, mounting and in walk). The horses that had stood mainly next to the hall exit were scored less secure when saddling and in walk (Tab. 5). It may be supposed that most relaxed horses were the individuals that are comfortable in isolation, seem to be self-reliant and independent of other horses. This was confirmed by the verbal description of these horses by the instructor as to their high social independence and dominant behaviour in relation to other horses. It may be speculated that these horses are also independent in other situations, including handling and riding, which may make them more difficult to manage. Then, it is possible that the separation test actually measures a more general trait, i.e. dependence (or independence, self-reliability). This is in line with the classification of equine personality as proposed by Suwała *and Górecka-Bruzda* [2013]. Unexpectedly, the horses that frequently trotted and cantered when isolated obtained a higher safety score (Tab. 5). As the results of the fear tests and the separation test were not related to each other, high locomotor activity in the separation test could be interpreted not as a fear response to isolation, but higher sensitivity to the

Table 5. Spearman rank correlation coefficients between variables measured in fear and separation tests and rider survey scores

Variable	Perceived safety (SEC)	Perceived obedience (OBED)
Fear test		
SURF	SEC-brush (r_s=-0.63*)	OBED-brush (r_s=-0.62*)
	SEC-lead (r_s=-0.69**)	OBED-lead (r_s=-0.72**) OBED-mount (r_s=-0.59*)
	SEC-mount (r_s=-0.58)	
SURF-S	SEC-brush (r_s=-0,62**)	OBED-brush (r_s=-0,55*) OBED-lead (r_s=-0,57*)
SURF-A	SEC-brush (r_s=-0,54*)	OBED-lead (r_s=-0,61*)
	SEC-lead (r_s=-0.62*)	OBED-mount (r_s=-0,55*)
	SEC-mount (r_s=-0,54*)	
OBJ		
OBJ-S		OBED-trot (r_s=-0,61*)
OBJ-A		
STARTOBJ		
STARTOBJ-S		OBED-brush (r_s=-0,57*)
STARTOBJ-A		
STARTOBJ-R	SEC-brush (r_s=0,57*)	OBED-brush (r_s=0,58*) OBED-saddle (r_s=0,80**)
	SEC-saddle (r_s=0,64*)	OBED-lead (r_s=0,55*)
	SEC-lead (r_s=0,65*)	
	SEC-canter (r_s=0,77**)	
Separation test		
STAND	SEC-saddle (r_s=-0,54*)	
	SEC-mount (r_s=-0,54*)	
	SEC-walk (r_s=-0,76**)	
	SEC-trot (r_s=-0,54*)	
WALK		OBED-mount (r_s=-0,65*)
TROTCANT	SEC-mount (r_s=0,61*)	OBED-mount (r_s=0,60*)
	SEC-walk (r_s=0,54*)	
ALERT		
HEADLOW	SEC-lead (r_s=-0,62*)	OBED-mount (r_s=-0,54*)
	SEC-saddle (r_s=-0,69**)	
	SEC-mount (r_s=-0,71**)	
	SEC-walk (r_s=-0,60*)	
EXIT	SEC-saddle (r_s=-0,56*)	
	SEC-walk (r_s=-0,70**)	
SNORT		
TAIL		

*Significant at P<0.05; **Significant at P<0.01.

unsatisfied need of social security. This is in line with Lansade et al. (2008d), who found that locomotor activity may result from various mental characteristics of the horse.

The results of the fear and separation tests were also correlated to riders' rating of obedience of horses (Tab. 5). Again, except for the occurrence of snorts in response to a novel object, the novel surface and startling object tests were most predictive to obedience scores given to horses by the riders.

The ratings of obedience and safety were highly correlated. The more obedient the horse was, the more secure during brushing (r_s=0.91, P<0.01), saddling (r_s=0.81, P<0.01), leading (r_s=0.84, P<0.01) mounting (r_s=0.63, P<0.01), walking (r_s=0.58, P<0.01), trotting (r_s=0.65. P<0.01) and cantering (r_s=0.55, P<0.05) was scored. This seems evident, as the obedience of the horse provides the rider with the possibility to manage the horses in difficult situations.

Our results showed that behavioural tests are able to detect not only the differences in reactivity to fearful objects or events, but may serve as a tool to predict the behaviour of horses in similar situations, including the ride. It is particularly important for leisure riders, as professionals could better cope with an unpredictable or dangerous behaviour of the horse. However, although professionals are more experienced than amateur equestrians, they suffer a high number of accidents, probably as a consequence of self-confidence [Hausberger *et al.* 2008].

Fearfulness in horses was the object of many studies [e.g. Christensen 2007, Lansade *et al.* 2008a, Flentje 2008], as this trait is the most important to safe use of horses not only in equitation. The correlation between the strength of reaction to fearful situations in the horse and the perception of safety in riders seems obvious, as a frightened horse is very difficult to manage and is inclined to violent reactions. The behaviour of a frightened horse involves monitoring of the surroundings, attentive listening (high activity or total immobility of ears directed to the frightening cue), visual observation of the source of anxiety, and reflex preparation of the organism for high expenditure of the energy in the flight reaction: the tension of muscles and an increased heart rate. Relatively to the perceived danger and aversiveness of the real or potential threat, the horse may mobilise all means to avoid it. In the most extreme case, the horse may engage in a behaviour that may cause self-injury or lethal situations. However, in some cases the flight reaction of the horse may not be predicted by riders, as it may not be preceded by behavioural patterns as described above. In such cases, the behaviour of the horse is really dangerous for the human.

As to the outcome of the separation test, our findings need to be confirmed with the tool assessing different aspects of equine personality. With a more general appraisal of mental characteristics of the horse, the testing of the suitability of equines for different types of human activity would be more comprehensive.

It may be concluded that behavioural tests to fearful stimuli and to social separation could be predictive not only for equine personality traits, but also could be applied in the assessment of the feelings of the rider about his/her safety. Thus, they may serve as tools to differentiate horses in terms of their suitability for leisure riders.

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