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Lea Lansade
French Horse and Riding Institute

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Reactivity to humans: A temperament trait of horses which is stable across time and situations

Léa Lansade *, Marie-France Bouissou

Laboratoire de Comportement, Neurobiologie et Adaptation, UMR 6175 Physiologie de la Reproduction et des Comportements, INRA-CNRS-Université de Tours-Haras Nationaux, F-37380, Nouzilly, France

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Abstract

The aim of this study was to test the existence of a ''reactivity-to-humans'' trait which is stable over time and across situations. For this purpose, four test situations were repeated on the same animals at 8 months, 1.5 years ($N = 110$ horses) and 2.5 years of age ($N = 54$ horses). These situations involved a ''familiar passive human test'' during which a familiar person stayed motionless in the test pen, a ''familiar active human test'' and an ''unfamiliar active human test'' during which a familiar or unfamiliar person attempted to touch the horse, and a ''halter-fitting and heart-rate measurement test'', during which the horse was haltered and equipped with a surcingle and then had its heart-rate measured. Many behavioural variables were recorded during the tests, and correlations between ages and variables measured during other situations were investigated. When correlations were found, we concluded that the variables corresponded to temperament traits which are stable over time and across situations. The horses tested were divided into four groups according to breed (Anglo-Arab and Welsh) and year of birth (2001 and 2002). Data for each group were analysed separately with Spearman rank correlations.

Regarding stability over time, there was a strong correlation between ages in the frequency of licking/nibbling the passive human, the time taken by a familiar or unfamiliar person to touch the horse, and the time taken to fit a halter (e.g. the time taken to touch the horse's muzzle was significantly correlated between ages in 7 out of the 8 possible cases: $0.40 \leq R \leq 0.67$).

Regarding stability across situations, results indicate that the more frequently a horse sniffed, licked or nibbled a passive human, the easier it was for either a familiar or unfamiliar active human to touch and halter it. Moreover, a horse which could be touched easily by a familiar human could also be touched and haltered easily by an unfamiliar human. These behaviours, which are linked directly to humans, therefore indicate good stability over time and across situations.

In conclusion, this stability suggests the existence of a ''reactivity-to-humans'' temperament trait, whether the human is passive or active, familiar or unfamiliar. When the animals do not have frequent

* Corresponding author. Tel.: +33 2 4742 7279; fax: +33 2 4742 7743.
E-mail address: lansade@tours.inra.fr (L. Lansade).

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contact with humans, this reactivity is stable over time and can be measured as early as 8 months of age using the behavioural variables cited above.

Keywords: Horse; *Equus caballus*; Reactivity to humans; Temperament trait; Personality; Behavioural consistency

1. Introduction

In many species, humans induce avoidance reactions, flight or other stress reactions, probably because of their size and rapid unpredictable movements (for a review: Rushen et al., 1999). Domestic animals are frequently exposed to human presence or handling during their life (Price, 1984; Serpell, 1986), and this is considered to be one of the main causes of stress in these species. Human-induced stress has negative effects on productivity, reproductive capacity and welfare (for a review: Rushen et al., 1999). Excessive reactions towards humans can make horses difficult to handle and ride, and can sometimes lead to accidents (Hausberger et al., 2008). Thus, the possibility of detecting an animal's level of reactivity towards humans at an early stage has practical implications.

An animal's early experience with humans can strongly affect its later reactions towards them, and one which has never been in contact with humans will have different reactions than one which has been frequently handled (e.g. for horses: Heird et al., 1986; Jezierski et al., 1999; Søndergaard and Halekoh, 2003; Lansade et al., 2004, 2005; for reviews: Hausberger et al., 2008; Lansade et al., 2007b). However, animals living in the same environment and with similar human contact react to humans with a strong inter-individual variability, some being very easy to approach and handle, others presenting strong avoidance reactions (e.g. goats: Lyons et al., 1988; horses: Hausberger and Muller, 2002).

Thus, reactivity to humans could be considered as a temperament trait, i.e. a behavioural tendency present early in life and relatively stable across various kinds of situations and over the course of time (Goldsmith et al., 1987; Bates, 1989).

Some studies have shown that reaction to humans remains stable across different situations. For instance, in cattle, Grignard et al. (2001) found correlations between responses to a ''docility test'' (during which a handler tried to lead the animal and then maintain it in the corner of a pen) and to a ''crush test'' (in which the animal was isolated in a crush with its head held in a head gate, then exposed to a passive human, and finally had its forehead stroked). The authors concluded that there is a general reactivity to handling in cattle, whether or not the animal is restrained. However, in this study, both situations also involved social isolation, which could explain these correlations. Fordyce et al. (1982) also described stability of responses in cattle between two situations involving either a passive human (standing motionless in front of the animal) or an active human (walking towards the animal).

Stability over time of reactions towards humans, during handling or in the presence of a passive human, has also been described over a period of several weeks (e.g. cattle: Grandin, 1993), several months (e.g. goats: Lyons et al., 1988; sheep: Viérin, 2002) or even several years (Bighorn ewes: Réale et al., 2000). This stability over time has also been studied in horses, but with different results. For instance, Seaman et al. (2002) found no stability of reaction to a passive human over a period of a few days, while Visser et al. (2001) observed stability of reactions during a ''handling test'' (horses were led across a bridge) over a period of 1 month, but no long-term stability (between 9 and 22 months of age). However, this ''handling test'' measured not only reaction to humans, but also reaction to novelty (the bridge), so it is not possible to say whether it was specifically the reaction to humans or to the bridge which was stable.

The aim of the present study was to test whether "reactivity to humans" is a temperament trait of horses which is stable over time and across situations. To that end, different situations involving a human (active or passive, familiar or unfamiliar) were repeated yearly between the ages of 8 months and 2.5 years; the variables which remained the most stable over time and across situations were considered to be the best indicators of this trait.

This paper is part of a more general study (Lansade, 2005) which attempted to assess several possible temperament traits in horses such as gregariousness (Lansade et al., 2008), fearfulness (Lansade et al., submitted for publication) and activity level (Lansade et al., 2003, 2006).

2. Animals, material and methods

2.1. Animals

A total of 110 horses, comprised of 22 Anglo-Arabs (AA01) and 33 Welsh ponies (W01) born in 2001, and 22 Anglo-Arabs (AA02) and 33 Welsh ponies (W02) born in 2002, were divided into four groups. Five horses had to be excluded from the study, due to illness ($N = 2$) or injury ($N = 3$). The number of horses tested at each age is shown in Table 1. The animals of the two breeds were born and reared in different places.

The two breeds of horses born in 2001 were tested three times (at 8 months, 1.5 and 2.5 years) and those born in 2002 were tested twice (at 8 months and 1.5 years).

All animals were maintained on pasture with their dam until weaning at 6 ± 1 months of age (complete and definitive separation from the mother). Males were castrated around 12 months of age. The animals were housed indoors from 6 to 11 months, 20 to 23 months and 32 to 35 months, corresponding to both the winter and the test periods.

The Anglo-Arab horses were housed individually on sawdust bedding, in a 6 m × 3 m loose box adjacent to an individual 3 m × 3 m outside area (Fig. 1). Boxes were separated from each other by metal hurdles so that the horses could see all the animals in the barn and interact with their neighbours (sniffing, licking, biting, grooming, etc.). The outside area was separated from the inside area by a door. When horses were outside and the door was closed, they could not see inside the barn.

Welsh ponies were housed together in a 15 m × 15 m straw-bedded pen and were moved to an outdoor paddock every day for 4 h.

Table 1
Age and number of horses in the two breeds (AA: Anglo-Arab; W: Welsh Pony) and two birth years (01: 2001; 02: 2002) at the three moments of testing

	2002	2003	2004
AA01	8 months 22 (22)	1.5 years 21 (20)	2.5 years 21 (20)
AA02		8 months 22 (21)	1.5 years 19 (19)
W01	8 months 33 (26)	1.5 years 33 (33)	2.5 years 33 (21)
W02		8 months 33 (32)	1.5 years 32 (22)

The numbers in brackets represent the number of horses whose heart rate was measured.

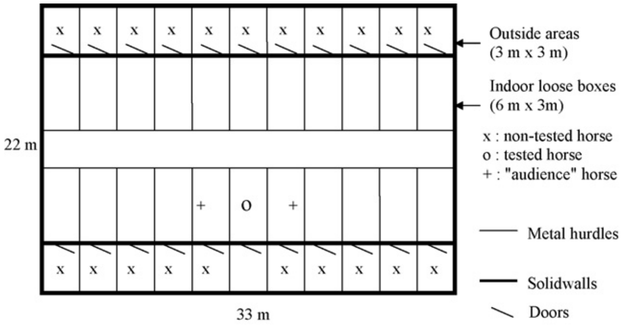

Fig. 1. Layout of the building where the Anglo-Arab horses were housed and tested.

Horses and ponies were fed twice a day with commercial pellets and hay. Water was available ad libitum.

Outside the test periods, horses and ponies were maintained on pasture. They received similar, limited human contact for routine husbandry: feeding when indoors, moving to a different field, and emergency veterinary care when necessary.

2.2. Experimental procedure

To examine only the reactions specific to the stimulus under study, animals were tested in as neutral a context as possible: the place was familiar and animals were habituated to the experimental procedure for a minimum of 3 days prior to the tests.

Anglo-Arab horses were tested in their loose boxes, while non-test horses were kept in their outside areas (Fig. 1). Welsh ponies were tested in a pen close to the one where they lived (Fig. 2). In both cases, the test pens were 6 m long and 3 m wide (Fig. 3), divided into 6 equal-sized sectors (1.5 m $\times$ 2 m) traced with plaster powder on the floor. During the test period, the Welsh ponies were moved randomly in groups of four or five to four loose boxes (4 m $\times$ 6 m) adjacent to the test pen for 4 h per day. A horse to be tested was led by a handler from the outside area (Anglo-Arab) or from its box (Welsh) to the test pen where the test began immediately. The other horses and the tested horse could not see each other.

Horses were randomly assigned to a testing order for each test. During the habituation phase and the tests, the experimenters were hidden behind a one-way mirror. To avoid the tested horse being alone in the pen during the habituation phase and the tests, two "audience" horses were tethered at each side of the test

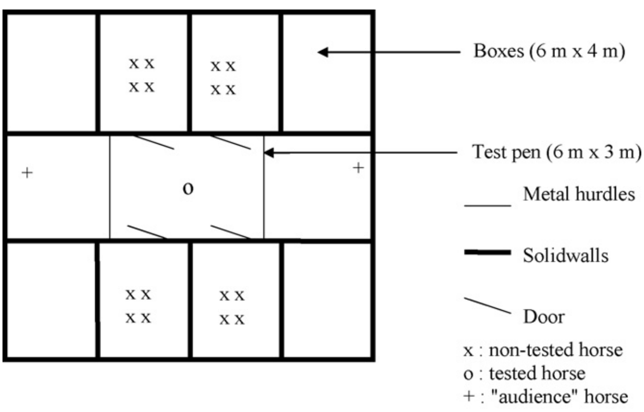

Fig. 2. Layout of the building where the Welsh ponies were housed and tested.

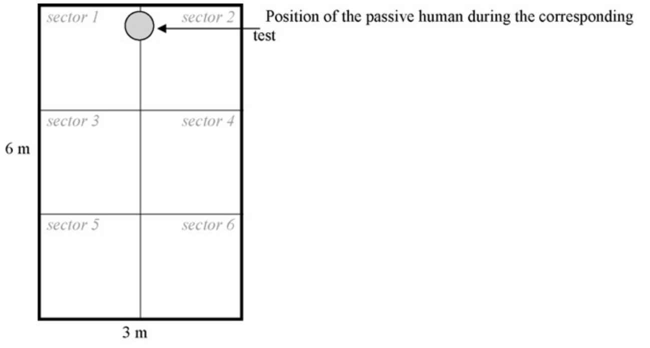

Fig. 3. Layout of the test pen.

pen, at a distance of about 3 m (Figs. 1 and 2). They were unfamiliar to the tested horse at the beginning of the study. They were chosen because they were known to be particularly calm and would be likely to stand still throughout the test period.

2.2.1. *Habituation to the test pen*

This phase involved habituating the horse to being led into the test pen (without being haltered) and staying there without reacting. The test horses were placed in this situation for 5 min a day until they no longer displayed the following behaviours – neighing, defecating, trotting or galloping – for 3 consecutive days. A single occurrence of one of these behaviours during the 3 consecutives days was tolerated. For example, if a horse neighed once on 3 consecutive days during the test period, but did not defecate, trot or gallop, it was considered to be habituated. Three to 6 days were required for habituation.

2.2.2. *Test situations*

The tests investigated the horses' reactions in four situations involving a familiar or unfamiliar, passive or active human. The situations were selected on the basis of previous experiments on horses (e.g. Simpson, 2002; Søndergaard and Halekoh, 2003; Lansade et al., 2004, 2005; Henry et al., 2005), indicating their feasibility and ability to show inter-individual variability.

2.2.2.1. Familiar passive human test. An experimenter who was familiar to the horses, having handled them during the habituation period, entered the loose box and stayed motionless beside a wall for 5 min (Fig. 3). Twenty behavioural variables were recorded (Table 2).

2.2.2.2. Familiar active human test. At the end of the familiar passive human test, the same experimenter moved slowly towards the horse and when 1 m away tried to put his hand on its shoulder for 1 s and on its muzzle for 3 s. The time taken to perform each move was recorded. A maximum time of 120 s was allocated. If the experimenter did not manage to touch the horse in this time, the test was terminated and a time of 121 s was recorded for both measures. Eleven other behavioural variables were also recorded (Table 2).

2.2.2.3. Unfamiliar active human test. On another test day, an unfamiliar experimenter, who had never been in contact with the test horses, entered the test pen, moved slowly towards the horse and tried to put his hand on the horse's shoulder and muzzle, following exactly the same procedure as before. The same variables were recorded (Table 2).

2.2.2.4. Halter-fitting and heart-rate measurement. After the unfamiliar active human test, the experimenter tried to fit the horse with a halter, always moving slowly, and never trying to facilitate the task by pinning the horse in a corner. A maximum time of 10 min was allocated. If the experimenter did

Table 2
Behavioural parameters recorded during the tests and definitions when necessary

Parameters and definitions (when necessary)	Passive human	Active human (familiar and unfamiliar)	Halter-fitting, heart-rate measurement
Glances at the human (*l*, *f*) the horse stands still, with raised neck, head and ears pointing towards the human	X		
Sniffing the human (*l*, *f*)	X		
Licking/nibbling the human (*l*, *f*)	X		
Contact with the human (*d*)	X		
Time spent near the human (both forelegs placed in sectors 1 and 2 of the test pen	X		
Time spent far from the human (with both forelegs placed in sectors 5 and 6 of the test pen)	X		
Time to touch the shoulder		X	
Time to touch the muzzle		X	
Time to fit a halter			X
Time to fit a surcingle			X
Neighing (*l*, *f*)	X[a]	X[a]	X[a]
Defecation (*l*, *f*)	X[a]	X[a]	X[a]
Trotting (*f*)	X[a]	X[a]	X[a]
Pawing the ground (with the foot) (*f*)	X[a]	X[a]	X[a]
Startle responses (*f*)	X[a]	X[a]	X[a]
Alert position (*f*) (the horse stands still, with raised neck, head and ears pointing anywhere except towards the stimulus)	X	X	X
Sniffing the ground (*f*)	X	X[a]	X[a]
Blowing (*f*) (forceful expulsion of air through the nostrils preceded by a rasping inhalation)	X	X	X
Sectors entered (*n*) (the number of sectors entered by the horse was quantified for the whole duration of each test as an indicator of its locomotor activity)	X	X	X

l: latency, *f*: frequency, *d*: duration, *n*: number.
[a] Behaviours expressed by less than 15% of the individuals and not taken into account in the statistical analyses.

not manage to fit the halter within this time, a helper entered the pen, and another 20 min was allowed to catch and halter the animal, pinning it in a corner if necessary. If they did not succeed within this time, the test was terminated. If they did succeed, they also fitted the horse with a surcingle. The time taken to fit a halter and a surcingle was recorded. The number of horses undergoing the complete test is shown in Table 1. Eleven other behavioural variables were also recorded (Table 2).

A heart-rate monitoring system (Polar Accurex Plus), set to record the heart rate every 5 s, was placed under the surcingle. The experimenter then led the horse to the middle of the pen where he tried to keep it motionless for 3 min, holding it by its halter while the heart rate was recorded. The average heart rate was calculated for the 3 min.

2.2.2.5. Statistical analysis. In many studies using similar tests, the authors attempt to describe temperamental traits from numerous variables using a principal component analysis (PCA). The use of synthetic factors obtained with a PCA can help determine links between different variables. However, it does not enable us to identify the most stable behavioural variables across situations and over time which could constitute the best indication of temperamental traits. We therefore chose to analyse each of the variables individually using correlation analyses.

The same protocol was repeated twice in two groups (AA02 and W02) and three times in the other two (AA01 and W01). The data from these different time points and groups were not combined for several reasons. Firstly, the groups were not tested under exactly the same conditions since the two breeds were tested in different places, and the two generations in different years. Secondly, repeating the same statistical analysis several times (ten times to investigate links between variables and four times to investigate consistency over time, see below) counterbalances the large number of correlations performed for each analysis. Thirdly, obtaining the same result several times from analyses performed on several independent groups is more reliable than obtaining a conclusion from only one analysis on one group. Finally, links between behaviours might be specific to one group, but not another (Knapp and Moore, 1997).

Some behavioural variables were expressed by less than 15% of animals and were not taken into account in the statistical analysis, in accordance with Viérin and Bouissou (2003). They are presented in the results. Two different analyses were performed: the first concerned the links between variables measured at different ages (stability over time), and the second was aimed at quantifying the relationship between different variables at the same point in time (stability across situations: inter-test correlations). Spearman rank correlations were calculated to study the relationship between variables, since they are more robust with regard to data non-normality than Pearson correlations. Correlations were considered statistically significant when $p < 0.05$.

The relationship between variables (stability across situations) was calculated for ten separate sets of data (Groups AA01 and W01 were tested 3 times, and groups AA02 and W02 were tested twice, resulting in ten sets, see Table 3). The number of significant positive or negative correlations out of ten are presented in matrix form showing only the variables which are correlated with one or more variable from the other tests in five or more sets out of ten. On the other hand, investigating stability over time involves fewer possible correlations, and the significant correlations ($p < 0.05$) are therefore presented in a table with the Spearman correlation coefficient (R-value). To investigate stability over time, 8 correlation possibilities were calculated (8 months vs. 1.5 years for all four groups, 8 months vs. 2.5 years and 1.5 years vs. 2.5 years for groups W01 and AA01, see Table 3).

No parameter was established to accept or reject the hypothesis of stability, on the assumption that stability can be measured on a gradient, with some variables never correlated over time or with each other, and some which are correlated in 100% of cases.

3. Results

3.1. Behaviours expressed by less than 15% of the individuals

The behaviours of neighing, defecation, trotting, pawing the ground and exhibiting a startle response were not expressed often enough in any of the tests to be included in the statistical analysis. The same applied to sniffing the ground during the active human tests and halter-fitting tests.

3.2. Stability over time: investigating correlations between variables measured at different ages

The R-values of these correlations are presented in Table 4. Only the variables which are correlated in at least half of the sets are described in the text; the other variables are presented in the table.

Table 3
Number of sets of correlations between situations and ages tested

Correlations between situations were investigated in 10 sets									
AA01			AA02		W01			W02	
8 months	1.5 years	2.5 years	8 months	1.5 years	8 months	1.5 years	2.5 years	8 months	1.5 years

Correlations between ages were investigated in 8 sets							
AA01			AA02	W01			W02
8 months–1.5 years	1.5 years–2.5 years	8 months–2.5 years	8 months–1.5 years	8 months–1.5 years	1.5 years–2.5 years	8 months–2.5 years	8 months–1.5 years

Table 4
Stability over time

	Number of significant correlations out of 8	W1			W2	AA1			AA2
		8 months–1.5 years	1.5 years–2.5 years	8 months–2.5 years	8 months–1.5 years	8 months–1.5 years	1.5 years–2.5 years	8 months–2.5 years	8 months–1.5 years
Familiar passive human									
Licking/nibbling the human (*f*)	6	0.43	0.45		0.41	0.42	0.41	0.66	
Sectors entered (*n*)	3	0.42	0.60	0.47					
Looking at the human (*f*)	2		0.41	0.55					
Licking/nibbling the human (*l*)	2		0.38					0.57	
Sniffing the human (*f*)	1		0.39						
Time spent near the human	1						0.63		
Contact with the human (*d*)	1		0.57						
Familiar active human									
Time to touch the muzzle	7	0.40	0.58	0.59	0.50	0.44	0.45		0.53
Time to touch the shoulder	5	0.45	0.50	0.67			0.39		0.60
Sectors entered (*n*)	4		0.75	0.39			0.59	0.41	
Unfamiliar active human									
Time to touch the muzzle	7	0.51	0.67	0.55	0.48	0.60		0.40	0.51
Time to touch the shoulder	5	0.40	0.63			0.68		0.42	0.40
Sectors entered (*n*)	5	0.42	0.62			0.57		0.51	0.47
Halter-fitting and heart-rate measurement									
Time to fit a halter	6	0.47	0.65		0.53	0.58		0.43	0.66
Sectors entered (*n*)	4		0.48		0.51	0.52			0.59
Time to fit a surcingle	3	0.41			0.49				0.64
Heart rate	2				0.67	0.45			

This table presents the parameters which are correlated at least once between two different ages. For each test, they are classified from the most to the least frequently correlated. The numbers presented in the table correspond to the spearman correlation coefficient (*R*-value). This number is presented only when the correlation was significant ($p < 0.05$). *l*: latency, *f*: frequency, *d*: duration, *n*: number.

3.2.1. Familiar passive human test

The only variable which was correlated over time in at least half of the sets was the frequency of licking/nibbling the human (in 6 sets out of 8).

3.2.2. Familiar active human

The time to touch the muzzle was correlated over time in 7 sets out of 8, the time to touch the shoulder in 5 sets, and the number of sectors entered in 4 sets.

3.2.2.1. Unfamiliar active human. The time to touch the muzzle was correlated over time in 7 sets out of 8, the time to touch the shoulder and the number of sectors entered in 5 sets out of 8.

3.2.2.2. Halter-fitting and heart-rate measurement. The only variables correlated in at least half of the sets during this test were the time to fit a halter (in 6 sets out of 8) and the number of sectors entered (in 4 sets).

3.2.2.3. Stability across situations: investigating correlations between variables measured during different tests (inter-test correlations). Only the variables which were correlated with one or more variable of the other tests, in more than 5 sets out of 10 are presented in the text and the table.

3.2.2.4. Familiar passive human and familiar active human. The familiar active human test variables which were the most frequently correlated with those of the familiar passive human test were those which were also the most stable over time (Table 5), namely the times to touch the muzzle and the shoulder and the number of sectors entered.

The familiar passive human variables which were the most frequently correlated with these variables were the frequency and latency of licking/nibbling the human, the frequency of looking at the human, the latency and frequency of sniffing the human and the time spent in contact with

Table 5
Parameters which are correlated between the familiar passive human test and the familiar active human test

		Familiar active human (number of significant correlations between ages)		
		7/8 Time to touch the muzzle	5/8 Time to touch the shoulder	4/8 Sectors entered
Familiar passive human (number of significant correlations between ages)				
6/8	Licking/nibbling (*f*)	**8** (−)	**9** (−)	**7** (−)
2/8	Looking at the human (*f*)	**7** (+)	**9** (+)	**7** (+)
2/8	Licking/nibbling (*l*)	**8** (+)	**9** (+)	**7** (+)
1/8	Sniffing (*f*)	**6** (−)	**8** (−)	4 (−)
1/8	Contact with human (*d*)	**6** (−)	**8** (−)	3 (−)
1/8	Time spent near human	2 (−)	**5** (−)	1 (−)
0/8	Sniffing (*l*)	**6** (+)	**9** (+)	**7** (+)

The numbers indicated in the table correspond to the number of sets out of 10 with significant correlations and the direction of the relationship (+: positive correlation; −: negative correlation). Only the parameters which are correlated with one or more parameter of the other test and in more than 5 sets out of 10 are presented. For these parameters, the number of correlations which were found significant in more than 5 sets out of 10 is presented in bold. The parameters are presented from the most to least stable over time.

Table 6
Parameters which are correlated between the familiar passive human test and the unfamiliar active human test

		Unfamiliar active human (number of significant correlations between ages)		
		7/8 Time to touch the muzzle	5/8 Time to touch the shoulder	5/8 Sectors entered
Familiar passive human (number of significant correlations between ages)				
6/8	Licking/nibbling (*f*)	**7** (−)	**5** (−)	**5** (−)
1/8	Sniffing (*f*)	**5** (−)	**6** (−)	**5** (−)
1/8	Contact with human (*d*)	**6** (−)	**5** (−)	4 (−)

For legend see Table 5.

her. However, for this test, only the frequency of licking/nibbling the human was also correlated over time.

3.2.2.5. Familiar passive human and unfamiliar active human. Again, the unfamiliar active human test variables which were correlated the most often with those of the familiar passive human test were also those which were the most stable over time (Table 6), namely the times to touch the muzzle and the shoulder and the number of sectors entered.

The familiar passive human variables which were the most frequently correlated with these variables were the frequencies of licking/nibbling and sniffing the human and the contact time, but only the first of these was also correlated over time in more than half of the sets.

3.2.2.6. Familiar passive human and halter-fitting and heart-rate measurement. The time to fit a halter was negatively correlated with the frequencies of licking/nibbling and sniffing the familiar passive human in 5 sets out of 10 (Table 7). The time to fit a halter and the frequency of licking/nibbling were also frequently correlated over time.

3.2.2.7. Familiar active human and unfamiliar active human. The times to touch the muzzle and the shoulder and the number of sectors entered were correlated between the two tests in at least half of the sets (Table 8). All these variables were also correlated over time in at least half of the sets.

Table 7
Parameters which are correlated between the familiar passive human test and the halter-fitting and heart-rate measurement test

		Halter-fitting and heart-rate measurement test (number of significant correlations between ages) 6/8 Time to fit a halter
Familiar passive human (number of significant correlations between ages)		
6/8	Licking/nibbling (*f*)	**5** (−)
1/8	Sniffing (*f*)	**5** (−)

For legend see Table 5.

Table 8
Parameters which are correlated between the familiar active human test and the unfamiliar active human test

		Unfamiliar active human (number of significant correlations between ages)		
		7/8 Time to touch the muzzle	5/8 Time to touch the shoulder	5/8 Sectors entered
Familiar active human (number of significant correlations between ages)				
7/8	Time to touch the muzzle	**8** (+)	**5** (+)	**5** (+)
5/8	Time to touch the shoulder	**7** (+)	**5** (+)	**7** (+)
4/8	Sectors entered	**5** (+)	**6** (+)	**6** (+)

For legend see Table 5.

Table 9
Parameters which are correlated between the familiar active human test and the halter-fitting and heart-rate measurement test

		Halter-fitting and heart-rate measurement test (number of significant correlations between ages)	
		6/8 Time to fit a halter	3/8 Time to fit a surcingle
Familiar active human (number of significant correlations between ages)			
7/8	Time to touch the muzzle	**6** (+)	**7** (+)
5/8	Time to touch the shoulder	**7** (+)	**5** (+)

For legend see Table 5.

3.2.2.8. Familiar active human and halter-fitting and heart-rate measurement. The times to fit a halter and a surcingle were correlated with the times to touch the muzzle and the shoulder in at least half of the sets (Table 9). All these variables, except the time to fit a surcingle, were also correlated over time in at least half of the sets.

3.2.2.9. Unfamiliar active human and halter-fitting and heart-rate measurement. The time taken to fit a halter and surcingle, the number of sectors entered, and the heart-rate measurement during the halter-fitting and heart-rate measurement test were correlated in at least half of the sets with the times to touch the muzzle and the shoulder and the number of sectors entered during the unfamiliar active human tests (Table 10). All these variables, except the time to fit a surcingle and heart-rate measurement, were also correlated over time in at least half of the sets.

4. Discussion

The aim of this study was to investigate the existence of a ‘‘reactivity-to-humans’’ trait which is stable over time and across situations. A further aim was to identify which variables are the most stable over time and across situations and can thus be considered as the best indication of a ‘‘reactivity-to-human’’ trait. For this purpose, four test situations involving either a familiar or unfamiliar, passive or active human were performed at 8 months, 1.5 and 2.5 years of age.

With regard to stability over time, some of the variables measured were frequently correlated between the ages tested, namely, the frequency of licking/nibbling the passive human, the time

Table 10
Parameters which are correlated between the unfamiliar active human test and the halter-fitting and heart-rate measurement test

		Halter-fitting and heart-rate measurement test (number of significant correlations between ages)			
		6/8 Time to fit a halter	4/8 Sectors entered	3/8 Time to fit a sucingle	2/8 Heart rate
Unfamiliar active human (number of significant correlations between ages)					
7/8	Time to touch the muzzle	**10** (+)	**6** (+)	**10** (+)	**5** (+)
5/8	Time to touch the shoulder	**10** (+)	**6** (+)	**10** (+)	**6** (+)
5/8	Sectors entered	**7** (+)	**8** (+)	**6** (+)	**5** (+)

For legend see Table 5.

for a familiar or unfamiliar human to touch the horse's muzzle, and the time to fit a halter. They can thus be considered to demonstrate good stability over time.

With regard to stability across situations, significant correlations were found between certain behaviours displayed during the different tests. Interestingly, these behaviours are also generally those which are the most stable over time. These inter-test correlations suggest that the more a horse approaches a passive human (sniffing, licking/nibbling and spending time in contact with him), the easier it is for a familiar or unfamiliar active human to touch and halter it. Moreover, a horse which can be touched easily by a familiar human can also be touched easily by an unfamiliar human, the same being true for fitting a halter and surcingle. This response stability across different situations involving a human suggests that there is a general reaction towards humans, whether they are passive or active, familiar or unfamiliar. This result is in line with the work of Fordyce et al. (1982) and Grignard et al. (2001) who also reported a general reaction of cattle to handling and human presence.

Thus, all these correlations suggest that horses have a reactivity-to-humans trait. The best behavioural indicators of this trait appear to be the frequency of licking/nibbling the familiar passive human, the time for a familiar or unfamiliar active human to touch the muzzle, and the time taken to fit a halter. The other variables measured are not sufficiently stable to indicate this trait.

Previous experiments with horses found either no stability over time for reactions to humans (Seaman et al., 2002) or only short-term stability (Visser et al., 2001), and the present study appears to be the first to demonstrate a long-term stability of reactions to humans. The absence of stability over time found by Seaman et al. may have been due to the fact that their study (which corresponded to our passive-human test) did not measure human-specific behaviours, such as the frequency of nibbling, which was the most stable variable in the present experiment. In Visser et al.'s experiment, the absence of long-term stability could be explained by the fact that their test, which involved leading a horse across a bridge, measured different aspects of temperament including reactivity to both a novel place and to humans.

It is also interesting to note that Lansade et al. (2007a) found that the response to an active human was not stable over time from birth to 6 months of age. This result was explained by the fact that human avoidance behaviour is almost non-existent in very young animals but appears progressively with age; stability over time of reactions towards humans seems to become established between 6 and 8 months of age, corresponding to the weaning period. It has frequently been reported that individual differences in behaviour have poor or moderate consistency during the early stages of development, but that this increases with age (e.g. dogs:

Goddard and Beilharz, 1984; pigs: Ruis et al., 2000; Janczak et al., 2001; calves: Van Reenen et al., 2004).

At this stage in the discussion, two points need to be clarified. First, the stability over time found in this study does not mean that reactivity to humans will never change during the animal's life. Throughout the present experiment, horses received similar and limited human contact. However, reactivity to humans can be enhanced or impaired by appropriate or inappropriate handling. Many papers show that some specific experiences with humans, such as handling a foal during weaning (Lansade et al., 2004), or even handling a mare when the foal is young (Henry et al., 2005), can have a long-term effect on the way a horse reacts to humans (for reviews: Hausberger et al., 2008; Lansade et al., 2007b). Thus, had the horses in our study been regularly handled between two test sessions, they would probably have been easier to touch during the second than the first session. In that case, handling would probably have affected the stability over time of certain variables, such as "time to touch the horse".

Secondly, it is important to specify that the stability of responses across different situations, and particularly towards familiar or unfamiliar humans, does not mean that animals are unable to distinguish between different people, an ability which is well-known in many species (e.g. cattle: de Passillé et al., 1996; sheep: Boivin et al., 1997; pigs: Tanida and Nagano, 1998; Koba and Tanida, 2001). However, Rushen et al. (1999) suggested that animals may not necessarily have any reason to react differently to different people and that it depends on the amount and type of handling the animals have received. In our experiment, horses had a relatively limited experience with the familiar human (no direct contact), and in principle this experience was neither particularly negative nor positive for the animal. By contrast, if an animal experiences negative or positive treatment from a given person, it will probably show specific reactions towards that person (e.g. calves: de Passillé et al., 1996; pigs: Tanida and Nagano, 1996; horses: Henry et al., 2006). In this hypothetical case, it is possible that no correlation would be found between the reactions towards this person and an unfamiliar person.

To further the findings of the present experiment regarding stability across situations, it would be interesting to determine whether the responses to the four tests correlate with responses to various others situations involving humans, for example the "Approach-stroking test at pasture", used by Henry et al. (2005), in which the horse is approached when it is at pasture with other conspecifics.

Finally, a physiological variable, heart rate, was recorded when the horse was held by a human. This measure cannot be considered as a good indicator of reactivity towards humans as it showed poor correlations with the best behavioural indicators of this trait and there was almost no correlation over time (it was correlated between ages in only 2 sets out of 8). The poor correlations of heart rate between different ages and with behavioural variables have previously been reported in a paper on fearfulness (Lansade, 2005) which showed that the heart-rate measured during a suddenness test (during which an umbrella was suddenly opened in front of the horse) did not show stability over time and was not correlated with the best indicators of a fearfulness trait. It is possible that the heart-rate measure is too sensitive and non-specific, because it is not only influenced by the test situation (in this case, restraint by a human), but also by elements that were not controlled, such as the horse's internal emotional and physiological state at the time of testing, movements, or different minor external events (noise, etc.), which can all cause an immediate increase in heart rate which could interfere with the results. This result is not in accordance with Visser et al. (2002) who found that a horse's heart rate during a handling test (a handler leading a horse over a bridge) was correlated between the ages of 9 and 22 months, suggesting that it is a reliable temperament indicator. However, the difference in methodology between the two tests could explain the conflicting results. Furthermore, Visser et al.'s heart-rate measurement was more precise than in our study.

5. Conclusion

To conclude, these results suggest the existence of a ''reactivity-towards-humans'' trait in horses, whether the human is passive or active, familiar or unfamiliar. When the animals do not have any specific contact with humans, this reactivity is stable over time and can be determined using behavioural variables measured during short and simple tests from as early as 8 months of age.

In the future, it would be interesting to determine whether this trait is independent of the other temperament traits previously identified in horses (e.g. gregariousness: Le Scolan et al., 1997; Lansade et al., 2008; fearfulness: Lansade et al., submitted for publication; flightiness: Visser et al., 2001; sensory sensitivity: Lansade et al., 2007c, etc.), or whether it is the result of an interaction between different traits such as fearfulness and sociability.

From a practical point of view, it is important to identify which level of reactivity to humans is the most relevant for riding activities. For instance, an over-reactive horse which always avoids humans would obviously be difficult and even dangerous to handle and ride. On the other hand, an under-reactive animal may respect humans less. However, these hypotheses require further investigation.

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