



**HAL**  
open science

## Horse's emotional state and rider safety during grooming practices, a field study

Léa Lansade, Coralie Bonneau, Céline Parias, Sophie Biau

### ► To cite this version:

Léa Lansade, Coralie Bonneau, Céline Parias, Sophie Biau. Horse's emotional state and rider safety during grooming practices, a field study. *Applied Animal Behaviour Science*, 2019, 217, pp.43 - 47. 10.1016/j.applanim.2019.04.017 . hal-02624790

**HAL Id: hal-02624790**

**<https://hal.inrae.fr/hal-02624790v1>**

Submitted on 25 Oct 2021

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial 4.0 International License

1 **Horse's emotional state and rider safety during grooming practices, a**  
2 **field study**

3

4 Léa Lansade<sup>a\*</sup>, Coralie Bonneau<sup>a</sup>, Céline Parias<sup>a</sup>, Sophie Biau<sup>b</sup>

5

6 Affiliations:

7 <sup>a</sup> PRC, INRA, CNRS, IFCE, University Tours, 37380 Nouzilly, France

8 <sup>b</sup> I.F.C.E. Ecole Nationale d'Equitation, Terrefort, BP 207 49411, Saumur Cedex,  
9 France

10

11 \*Corresponding author

12 mail: lea.lansade@inra.fr

13 phone number: 0033 247 427 279

14 Full postal address: INRA Centre Val de Loire, PRC, 37380 Nouzilly, France

15 **Abstract**

16 Care given to animals, such as grooming for horses, can be a source of well-  
17 being when carried out correctly. However, it can cause discomfort when  
18 badly perceived lead to potentially dangerous reactions. This study aimed to  
19 describe how grooming is conducted in the field, in terms of the horse's  
20 emotional state and also rider safety. Our observations carried out on 69  
21 horses in riding centres and sports stables show that grooming produces more  
22 negative than positive emotions. Indeed, only 5% of horses showed mutual  
23 grooming, approach or relaxed behaviour, whereas four times more horses  
24 expressed avoidance and threatening behaviours. These results have  
25 consequences for handler safety. Regarding threatening behaviours, nine  
26 incidents (a hoof or teeth passing within 10cm of the rider's body or head)  
27 were recorded. Concerning riders, 100% behaved in a risky way at least once:  
28 passing behind or under the head of the horse without keeping it in the field of  
29 view (97%) or squatting by its feet (42%). On average, riders carried out  $6.7 \pm$   
30  $0.49$  dangerous behaviours per session, and sometimes up to 19. Moreover,  
31 only 7% of them wore a hard hat when preparing their horse, while the risk of  
32 concussion is just as high on foot as in the saddle. Finally, 88% of them  
33 showed posture which was risky for their backs when picking out hooves.  
34 Surprisingly, riders' experience had no effect on the parameters recorded. In  
35 particular, horse professionals were just as exposed to risky situations, did not  
36 protect their backs, and their horses showed similar levels of defensive  
37 behaviours or signs of discomfort as the less experienced riders ( $p>0.05$ ). This  
38 result is undoubtedly linked to the lack of importance granted to this practice  
39 and little teaching about reading horse signals indicating comfort and  
40 discomfort. We hope that our results will make riders aware of how important  
41 grooming is for the horse's welfare as much as for their own health and safety.

42 **Key words**

43 Equus caballus, welfare, emotion, accidents, riding activity

44

45 **Highlights**

- 46 - Grooming should constitute a source of well-being for the horse.
- 47 - However, in the field (n=69) grooming was observed to be a source of
- 48 discomfort.
- 49 - Numerous dangerous behaviours were observed, from the rider as
- 50 well as the horse.
- 51 - Riders do not improve their practice with experience.
- 52 - This study aims to raise awareness of the importance of good
- 53 grooming practices.

54

55

56

57 **1. Introduction**

58 Grooming is a basic practice, but generally little training is provided for this.

59 Yet, it can impact both the horse's welfare and the rider's health and safety.

60 Regarding the welfare, since grooming is often repeated daily throughout the

61 life of many horses (20-30 years) it can have a cumulative effect. This can

62 result in a long-term incidence on the horse's welfare and its relationship with

63 humans. Welfare can be defined as an individual's subjective perception of its

64 physical and mental state regarding how it copes with its environment

65 (Broom, 1998). It can also be viewed in terms of affective states and their

66 balance over time (Ahloy-Dallaire et al., 2018). Thus, improving welfare not

67 only involves reducing negative affective states, but also fostering positive

68 states (Boissy et al., 2007; Fraser, 2009; Mellor and Beausoleil, 2015). To

69 induce positive emotional states in animals is difficult and few methods to

70 achieve this have been described in the literature. However, tactile contact

71 through grooming has been reported to be successful in different species

72 (Nielsen, 2018), including horses (Feh and De Mazières, 1993; McBride et al.,

73 2004; Schmied et al., 2008; Reefmann et al., 2009). When grooming is

74 appreciated by the horse and regularly repeated, it can improve general

75 welfare and lead to physiological changes such as changes in basal levels of

76 blood oxytocin (Lansade et al., 2018). However, if badly perceived by the

77 animal, grooming can result in negative emotions (Lansade et al., 2018). One

78 way of determining how an animal perceives grooming is by observing

79 approach and avoidance behaviours. These behaviours are indicators of

80 positive and negative emotional valence respectively (Mendl et al., 2010; Corr,

81 2013). To date, no study investigating horses' perception of grooming in the

82 field has been conducted. This information could play an important role in

83 improving horse welfare.

84

85 Regarding the rider's safety, how grooming is perceived can also have an  
86 impact. In particular, if the horse perceives grooming negatively it can  
87 gradually develop reactions and defensive behaviours which in the long-term  
88 make it dangerous to handle (review: Hall et al., 2018). A study showed that  
89 70% of accidents with horses result from the horse's behaviour (Silver and  
90 Parry, 1991). Handling a horse on foot can be as dangerous as riding it. A  
91 quarter of accidents involving horses that require hospital treatment take  
92 place while the rider is on foot (Giebel et al., 1993). Furthermore, against all  
93 odds, when on foot children had significantly more severe injuries and were  
94 also twice as likely to require intensive care or surgery, and were eight times  
95 more likely to sustain a severe head injury than when riding (Wolyncewicz et  
96 al., 2018). In a study conducted on 284 patients who were victims of an  
97 accident involving a horse, three deaths were recorded (Carmichael et al.,  
98 2014). All of these happened while the rider was on foot (being knocked over,  
99 or kicked in the head or chest). To prevent tragedies and for riding to remain a  
100 pleasure, care should be taken when interacting with horses, during grooming  
101 especially.

102 Although not involving accidents, when incorrect gestures are performed  
103 repeatedly while preparing a horse there can also be long-term consequences  
104 for the rider's back. A causal link has been highlighted between back pain  
105 (concerning 75% of professional riders) and activities around horses  
106 including grooming, whereas no link has been established with riding itself  
107 (Biau et al., 2016). This back pain often becomes chronic in professional riders  
108 and can affect the length of their career (prevalence in this population: 9% of  
109 chronic neck pain, 13% of chronic thoracic spine pain and 23% of chronic low  
110 back pain). To avoid this pain, recommendations include avoiding a risky

111 posture when carry a load (such as picking out hooves) by bending the knees  
112 when your back is inclined forward at an angle greater than 30 degrees. In this  
113 way the back can be kept straight, respecting the natural curve of the spine.  
114 However, we do not know whether riders apply this recommendation in the  
115 field.

116 The present study aimed to assess grooming as carried out in the field to: 1)  
117 analyse the emotional perception of horses through observing approach and  
118 avoidance behaviours, 2) quantify rider and horse behaviours or postures that  
119 could be at the root of accidents and back pain, 3) determine whether riders  
120 improve their practice with experience. The effect of horse's gender and breed  
121 was also tested.

122

## 123 **2. Material and Methods**

124

### 125 **2.1 Subjects**

126 The study investigated 69 rider-horse pairs in 12 different riding  
127 establishments in France. There were 12 mares and 57 geldings (46 horses  
128 and 23 ponies). They were divided into groups according to the rider's  
129 experience: beginners in a riding school (n=18); intermediate to advanced  
130 riders in a riding school (n=25); horse owners with an advanced level (n=9);  
131 horse professionals (n=17). The beginners were people who rode horses once  
132 a week in a riding school, and had a low level of riding (the French riding  
133 qualification "*Gallop 1 to 3*"). The intermediate to advanced riders rode horses  
134 once or twice a week in a riding school and had an intermediate to advanced  
135 riding level (the French riding qualification "*Gallop 4 to 7*"). The horse owners  
136 had their own horse and all of them had an advanced riding level of (the

137 French riding qualification “*Gallop 7*”), they rode their horse several times a  
138 week. Horse professionals could be either professional riders, or professional  
139 grooms who worked with different horses every day. The pairs were  
140 independent of each other. The mean ages of horses and riders were  
141  $11.7 \pm 0.67$  years and  $24.31 \pm 1.75$  years (mean  $\pm$  sem), respectively.

142

## 143 **2.2 Video recording protocol**

144 On arriving at a riding establishment which had previously been contacted, we  
145 asked riders who were getting ready to ride if they agreed to be filmed while  
146 they groomed their horse (brushing and picking out hooves). Each grooming  
147 session was filmed in its entirety using a digital video camera recorder (DCR-  
148 SR21E, Sony) on a tripod at a distance of 3.5m (horses were filmed in profile).

149

## 150 **2.3 Behavioural observations**

151 The behaviours or postures of each horse and rider were recorded by the  
152 same observer from the video footages of the whole grooming sessions  
153 (mean  $\pm$  sem duration: 11min40  $\pm$  0.47).

### 154 **2.3.1 Horse behaviours**

155 The horse behavioural repertoire consisted of two behavioural categories:  
156 avoidance behaviours and approach/relaxed behaviours (Table 1). These  
157 behaviours were recorded continuously during the whole session, as  
158 described in Lansade et al. (2018). When a behaviour lasted more than three  
159 seconds without interruption, the observer noted its occurrence every three  
160 seconds.



### 161 2.3.2 Handler safety

162 The observer recorded the number of dangerous behaviours for each rider  
163 continuously: passing just behind the horse or under its neck without having  
164 the horse in their field of view, squatting beside the horse's foot, kneeling on  
165 one knee next to the horse's foot. We also recorded the number of times a  
166 potentially dangerous incident was narrowly avoided when a horse showed  
167 threatening behaviour, that is to say when the horse's hoof or teeth came  
168 within 10cm of the rider's body or head. For the ergonomic data, by using  
169 freeze frames during hoof picking we record whether the rider took a risky  
170 position for their back: bending over more than 30 degrees without bending  
171 their knees. Finally, we also recorded whether the rider was wearing a  
172 hardhat or protective jacket.

173

### 174 **2.4 Statistical Analyses**

175 For the horse behaviours, many individuals had zero values (between 97%  
176 and 78% zero values according to the variable). Thus, we transformed the  
177 continuous data into binary data (expressed / did not express this behaviour).  
178 We compared the number of horses which expressed one of the behaviours  
179 mentioned above at least once between the categories of behaviours  
180 (approach/relaxed attitude vs avoidance) using Z tests. The proportion of  
181 horses which expressed these behaviours were also compared between  
182 gender and category of breeds (ponies vs horses) using Z tests and between  
183 groups of riders using the Monte Carlo method to compare multiple  
184 proportions followed by a Marascuilo Procedure for post hoc tests. For  
185 handler safety, the data were analysed in the same manner (expressed / did  
186 not express), but also as continuous data and compared between groups using

187 Kruskal-Wallis tests (except for the number of riders kneeling, since they were  
188 96% of zero values). The statistical analyses were performed with XLStat  
189 software (Addinsoft Software, Paris, France). The significance threshold was  
190 set at 0.05.

191

## 192 **2.5 Ethic statement**

193 The authors read the policy relating to animal ethics and confirm that their  
194 study complied. We only observed the horses during grooming in a field  
195 condition, and the animals underwent no specific experimental procedures for  
196 this research.

197

## 198 **3. Results**

199

### 200 **3.1 Horse behaviours**

201 There were four times more horses which expressed avoidance rather than  
202 approach/relaxed behaviours during grooming (avoidance: 15/69,  
203 approach/relaxed: 4/69, Z test for proportion  $z=-2.54$ ;  $P=0.01$ ). This indicates  
204 that only 5.7% of horses expressed approach/relaxed behaviours. Looking in  
205 detail at the avoidance behaviours, 12 horses were observed carrying out  
206 threatening behaviour, three moved away and two contracted their belly or  
207 back (some horses combined several behaviours). For approach/relaxed  
208 behaviours, two horses attempted to nibble the handler, two encouraged  
209 contacts and one showed a relaxed attitude. Some horses expressed avoidance  
210 behaviours up to 16 times during a single grooming session, compared to only  
211 a maximum of five times for approach/relaxed behaviours.

212 Gender had no effect on the number of horses expressing avoidance or  
213 approach/relaxed behaviours (avoidance: 4/12 mares vs 11/57 geldings, Z  
214 test for proportion  $z=0.62$ ;  $P=0.54$ ; approach/relaxed: 1/12 mares vs 3/57  
215 geldings  $z=0$ ;  $P=1$ ). There were no differences between the horse and pony  
216 categories (avoidance: 5/23 ponies vs 10/46 horses, Z test for proportion  
217  $z=0$ ;  $P=1$  approach/relaxed: 1/23 ponies vs 3/46 horses,  $z=0$ ;  $P=1$ ).

218

### 219 **3.2 Handler safety**

220 All the riders showed a behaviour considered to be dangerous at least once:  
221 97% passed just behind the horse or under the neck without having the  
222 animal in their field of view, 42% squatted down beside the horse's foot and  
223 4% knelt near the horse's foot. The riders carried out  $6.7 \pm 0.49$  (mean  $\pm$ sem)  
224 dangerous behaviours in one session and this figure could be as high as 19.  
225 Regarding the threatening behaviours of horses, nine potentially dangerous  
226 incidents were observed (teeth or hoof passing within 10cm of the rider's  
227 body or head). Regarding risky postures for the back during hoof picking, 88%  
228 of riders demonstrated this. Finally, 7% of riders wore a hardhat to prepare  
229 their horse (three children in a riding centre and two horse professionals) and  
230 no one wore a protective jacket.

231

### 232 **3.3 Experienced rider effect**

233 Among the variables presented above, only two differed significantly  
234 according to the rider's experience. The other, including the length of the  
235 session, never differed significantly between groups ( $p>0.05$ ).

236 Regarding horse behaviours, only the percentage of horses displaying  
237 “encouraging contact” differed significantly between groups ( $\text{Chi}^2=13.9$ ;  
238  $p=0.01$ ): this was only observed in privately-owned horses (Fig. 1). However,  
239 given the fact that this behaviour was expressed at a very low level (two out of  
240 the nine privately-owned horses, and none in the other categories) extreme  
241 caution should be taken in interpreting this difference.

242 Regarding handler safety, the “percentage of riders squatting beside the  
243 horse’s foot” differed between groups (Fig. 2). Fewer beginner riders than  
244 intermediate to advanced riders squatted ( $\text{Chi}^2 = 8.09$ ;  $p=0.04$ ). No other  
245 percentage of riders differed between groups. The Kruskal Wallis tests on the  
246 number of dangerous behaviours carried out per rider gave no significant  
247 difference between groups for any variable.

248

## 249 **Discussion**

250 This study highlights that in the sport stables and riding schools that we  
251 visited, only 5% of the horses observed expressed mutual grooming, approach  
252 or relaxed behaviour, whereas avoidance and threatening behaviours were  
253 expressed by four times more horses. When considering the former as  
254 indicators of positive emotional valence and the latter as indicators of  
255 negative emotional valence (Feh and De Mazières, 1993; Mendl et al., 2010), it  
256 can be concluded that in the field grooming induces less positive than negative  
257 emotional states. These results are not linked to a bias in the observation  
258 method because in a previous study using the same method, we observed that  
259 100% of the horses expressed an approach response during gentle grooming  
260 which was adapted to the horse’s reactions (Lansade et al., 2018). Our results  
261 also showed that the proportion of horses that expressed avoidance or

262 approach behaviours were independent of their gender or breed. This could  
263 suggest that these behaviours were less due to the horses' characteristics,  
264 than to the way they were groomed.

265 These results are far from insignificant for the horse or for the rider. For the  
266 horse, the fact that grooming sessions can be repeated daily throughout its  
267 whole life (20-30 years) could have a cumulative effect which when negatively  
268 perceived would be deleterious to its welfare (Boissy et al., 2007). Indeed, as  
269 little as two weeks of daily grooming has been reported to modify a horse's  
270 physiology, with a change in basal blood oxytocin level (Lansade et al. 2018).  
271 It has also been shown that the way a horse perceives handling sessions can  
272 have a long-term impact on its relationship with humans and how it perceives  
273 and reacts to subsequent situations involving people (Sankey et al., 2010;  
274 Lansade et al., 2018).

275 Concerning rider safety the way a horse perceives humans can influenced the  
276 level of risk during handling (Hall et al., 2018), and this is supported by our  
277 results. Indeed, regarding the threatening behaviours demonstrated by the  
278 horses, nine potentially dangerous incidents were observed (teeth or a hoof  
279 passing within 10cm of the rider's body or head). The riders often did not see  
280 what had happened, because the horse was not in their field of vision when  
281 the incident occurred. Fortunately, the incidents observed in our study did not  
282 lead to injury. However, when these data are compared with the rate and  
283 severity of accidents with riders on foot, which are much higher than for  
284 riders in the saddle, it can be seen that it is not always the case (Wolyncewicz  
285 et al., 2018). These results are also in line with research that has shown that  
286 70% of accidents would be linked to horses' reactions (Silver and Parry,  
287 1991).

288

289 In addition to horses' potentially dangerous reactions, this study also showed  
290 that 100% of riders demonstrated behaviours considered as risky, such as  
291 squatting beside the horse's foot. Moreover, only 7% of riders wore a hardhat  
292 when preparing their horse and none of them wore a safety jacket, while the  
293 risk of concussion is at least as high on foot as in the saddle (Wolyncewicz et  
294 al., 2018). Finally, 88% of riders demonstrated a risky posture for their back  
295 when picking out hooves. This could explain why riders' back problems are  
296 linked more to grooming than to riding (Biau et al., 2016). These figures  
297 underline that grooming practised in the field can cause discomfort for the  
298 horse, and is also a potential source of back problems and accidents for riders.  
299 Surprisingly, almost none of the parameters considered in this study differed  
300 between the levels of rider experience. In particular, the horse professionals  
301 demonstrated just as many potentially dangerous behaviours and took no  
302 more care of their backs, and their horses showed no fewer defensive  
303 behaviours or signs of discomfort than the less experienced riders. This is in  
304 line with studies that have shown that horse professionals are as or more at  
305 risk of accidents than amateurs (Hausberger et al., 2008). This result is  
306 probably linked to the lack of importance given to grooming and learning to  
307 groom. However, a limitation of this comparison should be noted due to the  
308 relative low number of subjects in the "owners" group (n=9).

309 Nevertheless, it would be relatively simple to improve grooming practices to  
310 induce positive behaviours. In Feh and de Mazières' study (1993) many  
311 positive behaviours were induced when the horse was massaged in its  
312 preferred zones. To find the horse's preferred zones it is simply a question of  
313 being attentive to approach and avoidance behaviours and also facial  
314 expressions which constitute a particularly sensitive way to detect the horse's  
315 emotional state (Hintze et al., 2016; Lansade et al., 2018). An eyebrow that is

316 raised, low neck carriage, eyes half closed and lips extended are signs of  
317 positive emotional state during grooming, and should encourage the handler  
318 to continue brushing that area. By contrast, a raised neck, eyes wide open and  
319 even slight tensing of the corner of the mouth indicate a negative emotional  
320 state and should lead the person to change their way of brushing. Even worse,  
321 a grimace of pain, as describe by Dalla Costa (2014) should also alert the  
322 handler.

323 Improving grooming practices could have numerous benefits on welfare and  
324 rider safety as discussed above, but also on the efficiency of the riding session  
325 that generally follows the grooming. Indeed, there is a huge amount of  
326 literature reporting the effects of emotions on learning abilities (example in  
327 horses: Christensen et al., 2012; Valenchon et al., 2017; Fortin et al., 2018; Hall  
328 et al., 2018). Thus, it is highly probable that the emotions induced during  
329 grooming could impact the subsequent training session, either by increasing  
330 or decreasing its effectiveness.

331

332 In conclusion, this study shows that in general riders pay little attention to  
333 their horse's threats and signs of discomfort, and thus sometimes put  
334 themselves in danger during grooming. Yet, it would be easy to enhance this  
335 practice to improve the horse's welfare and rider safety simply by observing  
336 the horse's behaviour and facial expressions and adapting the brushstrokes  
337 accordingly. Regarding the number and severity of accidents on foot linked to  
338 horses and the high prevalence of back pain, raising riders' awareness to  
339 grooming best practices in the field seems essential.

340

341

342 **References**

343 Ahloy-Dallaire, J., Espinosa, J., Mason, G., 2018. Play and optimal welfare: Does  
344 play indicate the presence of positive affective states? *Behav. Processes* 156, 3-15.  
345  
346 Biau, S., Fouquet, N., Mounster, R., Brunet, R., 2016. Prevalence of back pain and  
347 its risk factors in professional horse riders, 12th International Equitation Science  
348 Conference Understanding horses to improve training and performance, Saumur,  
349 France.  
350  
351 Boissy, A., Manteuffel, G., Jensen, M.B., Moe, R.O., Spruijt, B., Keeling, L.J.,  
352 Winckler, C., Forkman, B., Dimitrov, I., Langbein, J., Bakken, M., Veissier, I.,  
353 Aubert, A., 2007. Assessment of positive emotions in animals to improve their  
354 welfare. *Physiol. Behav.* 92, 375-397.  
355  
356 Broom, D.M., 1998. Welfare, Stress, and the Evolution of Feelings, in: Anders Pape  
357 Møller, M.M., Peter, J.B.S. (Eds.), *Adv Study Behav*, Academic Press, pp. 371-403.  
358  
359 Carmichael, S.P., Davenport, D.L., Kearney, P.A., Bernard, A.C., 2014. On and off  
360 the horse: Mechanisms and patterns of injury in mounted and unmounted  
361 equestrians. *Injury-Int. J. Care Inj.* 45, 1479-1483.  
362  
363 Christensen, J.W., Ahrendt, L.P., Lintrup, R., Gaillard, C., Palme, R., Malmkvist, J.,  
364 2012. Does learning performance in horses relate to fearfulness, baseline stress  
365 hormone, and social rank? *Appl. Anim. Behav. Sci.* 140, 44-52.  
366  
367 Corr, P.J., 2013. Approach and Avoidance Behaviour: Multiple Systems and their  
368 Interactions. *Emot. Rev.* 5, 285-290.  
369  
370 Dalla Costa, E., Minero, M., Lebelt, D., Stucke, D., Canali, E., Leach, M.C., 2014.  
371 Development of the Horse Grimace Scale (HGS) as a Pain Assessment Tool in  
372 Horses Undergoing Routine Castration. *PLoS ONE* 9.  
373  
374 Feh, C., De Mazières, J., 1993. Grooming at a preferred site reduces heart rate in  
375 horses. *Anim. Behav.* 46, 1191-1194.  
376  
377 Fortin, M., Valençon, M., Levy, F., Calandreau, L., Arnould, C., Lansade, L., 2018.  
378 Emotional State and Personality Influence Cognitive Flexibility in Horses (*Equus*  
379 *caballus*). *J. Comp. Psychol.* 132, 130-140.  
380  
381 Fraser, D., 2009. Animal behaviour, animal welfare and the scientific study of  
382 affect. *Appl. Anim. Behav. Sci.* 118, 108-117.  
383  
384 Giebel, G., Braun, K., Mittelmeier, W., 1993. Horse riding accidents involving  
385 children. *Chirurg* 64, 938-947.  
386  
387 Hall, C., Randle, H., Pearson, G., Preshaw, L., Waran, N., 2018. Assessing equine  
388 emotional state. *Appl. Anim. Behav. Sci.* 205, 183-193.  
389  
390 Hausberger, M., Roche, H., Henry, S., Visser, E.K., 2008. A review of the human-  
391 horse relationship. *Appl. Anim. Behav. Sci.* 109, 1-24.  
392



- 393 Hintze, S., Smith, S., Patt, A., Bachmann, I., Wurbel, H., 2016. Are Eyes a Mirror of  
394 the Soul? What Eye Wrinkles Reveal about a Horse's Emotional State. PLoS ONE  
395 11.  
396
- 397 Lansade, L., Nowak, R., Lainé, A.-L., Leterrier, C., Bonneau, C., Parias, C., Bertin, A.,  
398 2018. Facial expression and oxytocin as possible markers of positive emotions in  
399 horses. Sci Rep 8, 14680.  
400
- 401 McBride, S.D., Hemmings, A., Robinson, K., 2004. A preliminary study on the effect  
402 of massage to reduce stress in the horse. J Equine Vet Sci 24, 76-81.
- 403 Mellor, D.J., Beausoleil, N.J., 2015. Extending the 'Five Domains' model for animal  
404 welfare assessment to incorporate positive welfare states. Anim. Welfare 24, 241-  
405 253.  
406
- 407 Mendl, M., Burman, O.H.P., Paul, E.S., 2010. An integrative and functional  
408 framework for the study of animal emotion and mood. Proc. R. Soc. B 277, 2895-  
409 2904.  
410
- 411 Nielsen, B.L., 2018. Making sense of it all: The importance of taking into account  
412 the sensory abilities of animals in their housing and management. Appl. Anim.  
413 Behav. Sci. 205, 175-180.  
414
- 415 Reefmann, N., Wechsler, B., Gyga, L., 2009. Behavioural and physiological  
416 assessment of positive and negative emotion in sheep. Anim. Behav. 78, 651-659.  
417
- 418 Sankey, C., Richard-Yris, M.-A., Leroy, H., Henry, S., Hausberger, M., 2010. Positive  
419 interactions lead to lasting positive memories in horses, *Equus caballus*. Anim.  
420 Behav. 79, 869-875.  
421
- 422 Schmied, C., Waiblinger, S., Scharl, T., Leisch, F., Boivin, X., 2008. Stroking of  
423 different body regions by a human: Effects on behaviour and heart rate of dairy  
424 cows. Appl. Anim. Behav. Sci. 109, 25-38.  
425
- 426 Silver, J.R., Parry, J.M., 1991. Hazards of horse-riding as a popular sport. Br. J.  
427 Sports Med. 25, 105-110.  
428
- 429 Valenchon, M., Levy, F., Moussu, C., Lansade, L., 2017. Stress affects instrumental  
430 learning based on positive or negative reinforcement in interaction with  
431 personality in domestic horses. PLoS ONE 12.  
432
- 433 Wolyncewicz, G.E.L., Palmer, C.S., Jowett, H.E., Hutson, J.M., King, S.K., Teague,  
434 W.J., 2018. Horse-related injuries in children - unmounted injuries are more  
435 severe: A retrospective review. Injury 49, 933-938.

436

### 437 **Acknowledgements**

438 We would like to thank Jean-Marie-Yvon for his assistance during the  
439 experiment, Sue Edrich from the translation agency Interconnect for

440 correcting the English manuscript as well as the riding establishments which  
441 allowed us to carry out the work on their premises.

442 IFCE (French Horse and Riding Institute) funded this experiment. This funding  
443 source had no role in study design, data collection or analysis, or preparation  
444 or submission of the manuscript

445

446 **Figure captions**

447 Figure 1. Percentage of horses expressing avoidance or approach/relaxed  
448 behaviours according to rider experience

449 NS: Non-significant, \*\*:  $p < 0.001$ , the different letters indicate significant  
450 differences between groups (Comparison of multiple proportions test, Monte  
451 Carlo method followed by a Marascuilo procedure for post hoc tests)

452

453 Figure 2. Percentage of riders expressing dangerous behaviour according to  
454 experience

455 NS: Non-significant, \*:  $p < 0.05$ , different letters indicate significant differences  
456 between groups (Comparison of multiple proportions test, Monte Carlo  
457 method followed by a Marascuilo procedure for post hoc tests)

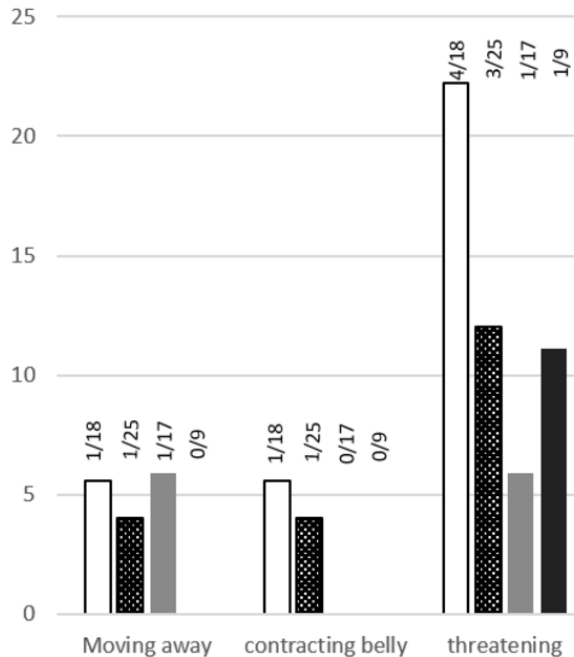
458

## Avoidance

NS

NS

NS

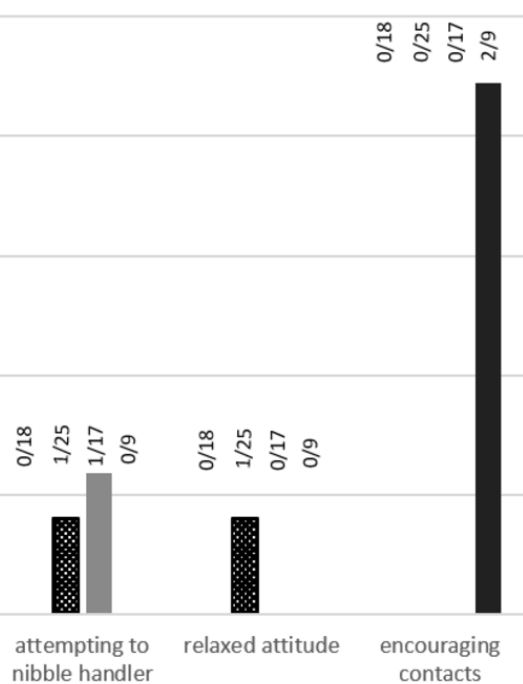


## Approach/relaxed

NS

NS

\*\*



Percentage

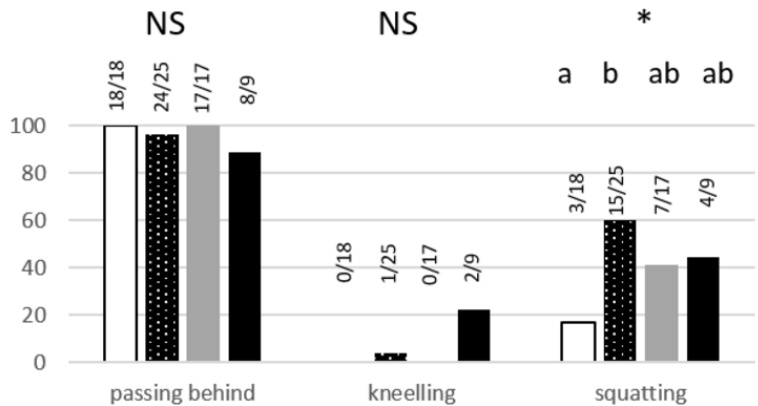
□ beginners (N=18)

▣ advanced (N=25)

■ professionals (N=17)

■ owners (N=9)

Percentage



□ beginners (N=18)

■ professionals (N=17)

■ intermediate to advanced (N=25)

■ owners (N=9)

| <b>Avoidance behaviours</b>            |   |
|--|---|
| Moving away                            | Horse moves in the opposite direction to the handler's action   |
| Contracting belly or back              | Horse contracts its belly or back suddenly after a brush stroke   |
| Threatening                            | Horse's ears are pinned back and a hind leg is lifted in the direction of the handler/Horse's ears are pinned back and lips are pulled back bearing the teeth in the handler's direction, the horse tries to bite the air or the leading rein |
| <b>Approach and relaxed behaviours</b> |   |
| Encouraging contacts                   | Horse seeks contact with the handler with its head, without signs of threatening or biting / Horse moves part of its body to lean or rub against the handler, sometimes with a backward and forward movement                                  |
| Relaxed attitude                       | Eyes half-closed, lower lip loose   |
| Attempting to nibble handler           | Horse's upper lip is extended and mobile, horse nibbles the handler or any other element in front of it (wall, leading rein, etc.)  |

Table 1. Behavioural parameters recorded during grooming