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

3

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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 ± 0.67 years and 24.31 ± 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: $11\text{min}40 \pm 0.47$).

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 ± 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

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436

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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)

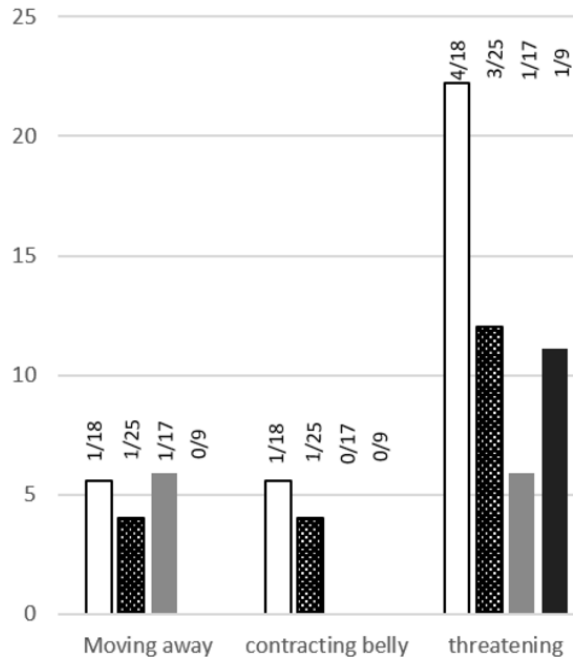
458

Avoidance

NS

NS

NS

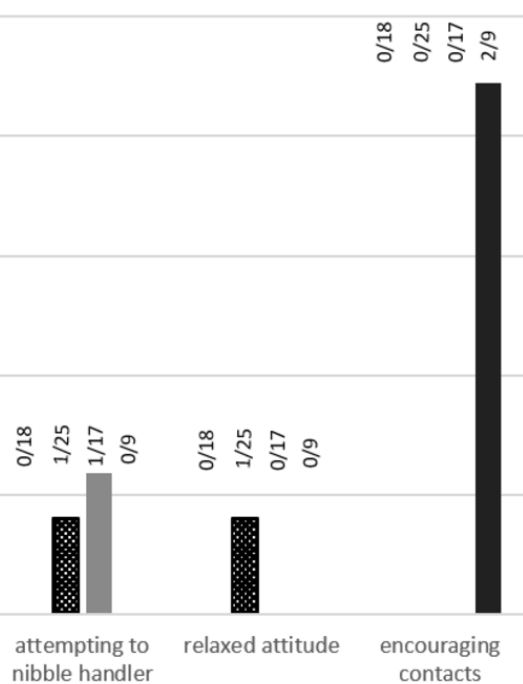


Approach/relaxed

NS

NS

**



Percentage

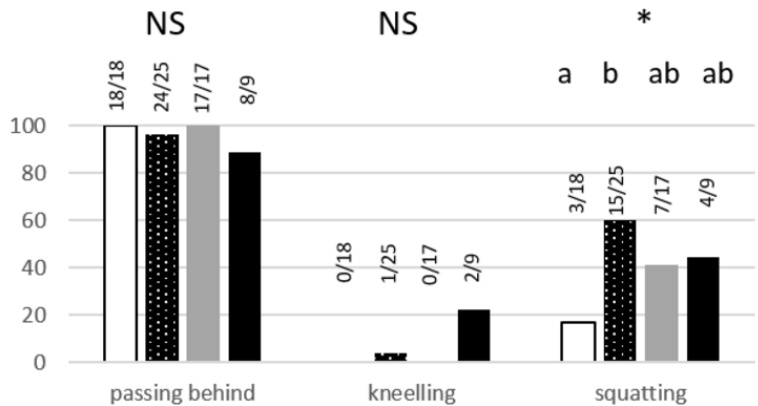
□ beginners (N=18)

▣ advanced (N=25)

■ professionals (N=17)

■ owners (N=9)

Percentage



□ beginners (N=18)

■ professionals (N=17)

■ intermediate to advanced (N=25)

■ owners (N=9)

Avoidance behaviours	
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
Approach and relaxed behaviours	
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