

maximum right and left RA contractions were normalised to the maximum dynamic contraction from condition 1 for 10 matched and consecutive strides using integrated EMG. Friedman analyses with post-hoc Wilcoxon signed rank tests (Bonferroni adjustment;  $P < 0.02$ ) identified if differences in RA workload occurred between the conditions. No significant differences were found in RA activity between no PTA and the use of the PTA in the low or middle position, or between the low and middle position ( $P > 0.05$ ). The use of the PTA did not increase RA workload in walk and trot on the treadmill. Evidence-informed protocols outlining how to use training aids are warranted and could enhance equine welfare and performance.

**Keywords:** training; aid; Pessoa™; equine; rehabilitation; performance

### 32

#### Factors influencing the symmetry and magnitude of rein tension in english and western riding

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The reins are one of the main means of communication between rider and horse, but little objective information on rein tension exists. The aim of this study was to investigate factors influencing the symmetry and magnitude of rein tension in Western (W) and English (E) riding. Rein tension was measured in a total of 93 combinations of 49 riders and 71 horses in different gaits and standardized tasks in E (50 rides) and W (43 rides). Mixed-model analysis was used. English riders applied overall higher rein tension (E:  $13.1 \pm 2.3$ N vs. W:  $5.7 \pm 2.4$ N,  $F_{6,150} = 10.58$ ,  $P < 0.0001$ ) and tensions differed within the specific disciplines, too (show jumping:  $19.7 \pm 4.3$ N, dressage:  $12.5 \pm 1.4$ N, leisure riders:  $11.2 \pm 1.3$ N in E; reining:  $6.5 \pm 1.3$ N, cutting:  $5.3 \pm 1.3$ N, all-round:  $4.9 \pm 1.2$ N in W,  $F_{6,137} = 10.86$ ,  $P < 0.0001$ ). Riders assessing their own contact as “very strong” had indeed significantly higher mean tension ( $21.8 \pm 5.5$ N) compared to strong ( $9.9 \pm 0.8$ N) or light ( $9.2 \pm 0.8$ N) contact ( $F_{3,161} = 8.59$ ,  $P < 0.0001$ ). Performances perceived as symmetric showed higher tension ( $10.5 \pm 0.7$ N vs.  $9.2 \pm 0.7$ N (asymmetric),  $F_{1,1962} = 8.55$ ,  $P = 0.004$ ). Those described as “very harmonious”, showed the highest rein tension ( $12.3 \pm 1.2$ N), whereas lightest contact was applied to horses perceived as tensed (harmonious:  $12 \pm 0.9$ N, unharmonious:  $11.5 \pm 0.9$ N, tensed:  $7.1 \pm 1.2$ N,  $F_{4,210} = 8.71$ ,  $P < 0.0001$ ). The magnitude of rein tension is related to or influenced by factors such as riding style, disciplines and riders’ experience. Importantly, the rider’s perception of rein tension is inaccurate, which is likely to affect training as riders may inadvertently maintain too strong contact and/or give rein aids of inappropriate intensity. Consequently horse welfare can be affected.

**Keywords:** rein tension; rider symmetry; horse laterality; English riding; Western riding

### 33

#### Behavioral responses of horses to humans with and without PTSD

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The use of horses in equine-assisted activities may be stressful to the animals. This study hypothesised that horses exposed to humans with PTSD would display more signs of stress than with ‘neurotypical’ humans. After 5 minutes of baseline observation, 17 therapy horses ( $16.4 \pm 3.6$  years) were individually subjected for 2 minutes in a round pen to each of four humans clinically diagnosed with Post Traumatic Stress Disorder (PTSD). A

professional acting coach then instructed four neurotypical humans matched physically to the PTSD humans in emulating the physical movements of their paired PTSD subject, after which the neurotypical humans were tested in the same manner. Heart rate (HR; bpm) and behavioral observations indicative of stress in the horse (gait, head height, ear position, distance from the human, latency of approach to the human, vocalisations and chewing) were collected every 5 seconds throughout each trial and analysed using a repeated measures GLM with Sidak’s multiple comparisons between treatments and time periods. Horse behaviors did not differ between PTSD and neurotypical humans ( $F_{1,21864} = 2.63$ ,  $P > 0.1$ ). However, a post-hoc analysis showed that horses approached quicker ( $F_{1,54} = 6.2$ ,  $P < 0.001$ ), stood closer ( $F_{1,3756} = 9.14$ ,  $P < 0.01$ ), and oriented their ears ( $F_{1,3704} = 13.07$ ,  $P < 0.0003$ ) more toward humans who were experienced with horses ( $N = 4$ ). Horse HR was lower when paired with inexperienced humans ( $N = 4$ ;  $F_{1,21531} = 16.9$ ,  $P < 0.0001$ ). Horses do not appear to respond differently to humans with PTSD than to those without, but they were more attentive to humans with more horse experience. Understanding horse responses can lead to improved welfare and horse and human safety.

**Keywords:** equine-assisted activities; PTSD; behavior; heart rate

### 34

#### One- or two- handed riding – does it make a difference?

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The impact of riders and handlers on horses has come under growing scrutiny with increasing availability of technology capable of accurately measuring physical horse-human interactions. Effective rein use is crucial for the delivery of clear signals and subsequently the discernable release of pressure when the required response is given by the horse. Rein tension studies commonly involve two-handed riding. This study aimed to compare the effectiveness of one- versus two-handed rein use. Twenty female riders ( $28.2 \pm 10.1$  years), self-rated as experienced, representing a wide range of equestrian disciplines sat in a general purpose saddle secured on stationary saddle stand with the stirrups set at their usual riding length. Centaur Rein Tension gauges were fixed to a solid box at horse head height and fitted with a standard pair of leather 5 x 20mm wide reins. Participants were asked to take up the rein tension that they would use when riding in trot, 3 times each two-handed and one-handed (using the riders natural hand of choice) using a cross-over design with a 30-minute wash-out period. No significant differences were evident between left and right hand rein tension when using two hands ( $t_{59} = 1.89$ ;  $P > 0.05$ ; left =  $4.73 \pm 2.65$ N; right =  $4.91 \pm 2.63$ N) or one hand ( $t_{59} = 0.20$ ;  $P > 0.05$ ; left =  $4.21 \pm 2.32$ N; right =  $4.17 \pm 2.91$ N). The relative use of the left and right reins is less consistent with one hand than with two. Reliable rein tension studies using different riding styles are necessary to improve understanding of the rider’s effect on the horse and ultimately to improve the welfare of horses used in equestrianism.

**Keywords:** rein tension; rider hands; contact; welfare; equestrian discipline

### 35

#### Development of a prototype for referees to monitor whip use in horse racing

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There is no standard surveillance system for flat horse-racing in Sweden, so the surveillance camera placement and quality varies between tracks. Thorough investigation of the current monitoring systems used revealed concerns about whether the stewards have enough time to estimate the number of whip strikes per horse. It led to the development of a technical solution that can be used in the supervision of whip use in horse-racing, useful where there are regulations limiting the number of strikes. Current specifications allow the system to send the attributes and number of strikes to the stewards. Stewards are thereby afforded more time to focus on actions that are important to the final result list. The prototype is a whip with force sensors placed on both sides of the cushion pad. The sensors, made of 0.203mm thick polyester, measure an area of 24mm by 275mm and covers the entire padded part. The sensor is connected to a microcontroller that sends information to the steward's office. The whip strike sensor prototype can distinguish between a wave of the arm that leads to no impact and a strike, as the force of each strike impact is recorded. The sensors can be embedded within the body of whips used in a range of equestrian disciplines. The possibility to register the properties of whip strikes will help to safeguard the welfare of horses used in these disciplines and provide information to the equestrian community that could change the way whips are used in training and racing.

**Keywords:** horse; racing; whip; force; sensor; welfare

36

#### Development of system for collection of positional based data for horses

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Data gathering is often a crucial part of Equitation Science. This project aimed to develop a tool to aid researchers gathering positional based data of horses. A data-collection system was developed, designed to enable cost-effective data acquisition, storage and presentation. The system includes a GPS-enabled collar for collection of positional data, as well as a platform for presenting the gathered data online. The GPS collar incorporates a microcontroller which allows tracking of horses within one metre. Furthermore, it is possible to extend the capabilities of the device to gather different types of equine data. The data are uploaded to a server and stored in a relational database for access via a graphical user interface using a dedicated website. The interface was developed using commonly practised interaction design methods such as user studies, heuristic evaluation and cognitive walkthroughs to ensure a user-friendly experience. Equitation science experts contributed to the design of the systems software in addition to the design and placement of the collar. The system can be used in Equitation Science projects that require identification of movement patterns of both individual horses as well as groups of horses and will be able to provide measures such as distance and speed of movement. It is able to be easily adapted according to the requirements of specific studies, and provides the possibility to collect objective data from horse's activities by removing the effect of the potentially biased human observer, and might thereby improve the quality of the conclusions in the scientific study.

**Keywords:** equine; data recording; positioning; GPS; software; welfare

37

#### Using accelerometers to automate the identification of the standing-rest position in a horse

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Horses spend 4 to 15 h/d in standing-rest. Deviations from normal resting behavior can indicate a multitude of welfare problems. Automating measurement of resting behavior would be helpful for early identification of welfare problems. A proof-of-concept case study was used to investigate if a tri-axial accelerometer could be used to monitor the standing-rest position in horses. Accelerometers (HOBO® Pendant G Data Logger) were positioned on both hind legs of a horse and set to record g-force values for the x-axis (pointing upwards), and z-axis (pointing inwards toward leg) at 1-s intervals. Leg position was filmed for 2-h then scored as standing square (all 4 legs bearing weight), standing-rest (1 hind leg rested and not bearing equal weight), or shuffling (leg in motion) for each 1-s of video and for comparison with accelerometer data. Data were analysed in R<sup>TM</sup> using a classification Random Forest model. Seventy-five percent of data were used as training for the model and 25% for testing. Overall model accuracy was 95% when both x- and z-axes for both legs were included, and 92% when only the x-axis was utilised. Sensitivity and specificity (calculated using x-axis only), and were good for left leg standing-rest (91.6%, 94.8%), right leg standing-rest (91.4%, 98.3%) and standing square (94.3%, 88.2%), but poor for shuffling (0%, 99.9%). This high level of accuracy for determining when the horse was in a stand-resting position provides the first evidence that an accelerometer using a single axis can reliably measure this aspect of resting behavior in horses.

**Keywords:** equine; welfare; rest; behavioral monitoring; accelerometer

38

#### In search of the origin and definition for the term 'kreuz' resp. 'kreuzanspannen' ('back' resp. 'bracing the back') in equestrian parlance: a review

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The terms 'Kreuz' resp. 'Kreuzanspannen' ('back' resp. 'bracing the back') are used frequently. At the same time, they lack a clear definition and are therefore incomprehensible for many horsemen. The aim of the present study was to trace their origin, spread and apparent errors in translation as well as to suggest a definition. For this purpose, a literature search in German, English and French equestrian literature for the terms 'Kreuz/Kreuzanspannen' and related anatomical and biomechanical aspects was conducted. Among the literature investigated, Francois Antoine de Garsault (1741) and Salomon de la Broue's (1593) emerged as the earliest documented use of the term 'back' or its equivalents in other languages. However, the search was further complicated by an abundance of translation errors. For example, in the German translation of Du Paty's (1826) treatise, coccyx and pubis have been interchanged. Notably, the German Equestrian Federation replaced the